

Annual Report 2010-2011



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OVERVIEW

The Department of Science and Technology, Government of India has played the nodal responsibility to promote the Indian Research and Development sector. The overall vision and mission of the department has been cast recently. The Vision of the department is *“To enable India becoming global knowledge power by promoting basic research, development of cutting edge technologies and innovation for globally competitive and inclusive growth to power technology led economic progress of the society.”*

The mission of the department is *“To strengthen the R&D base of the country through funding, development and utilization of technologies, building entrepreneurship and innovation, fostering international S & T cooperation, popularization and demonstration, generating S&T database, mounting mission mode initiatives, attracting talent to science and rejuvenating research in university and promotion of public-private partnerships”.*

Policy and Structural Support to Research and Development: Consistent with the stated vision and mission of the Department, programmes have been cast and recast suitably during the last two years. Evidence-based approaches for sizing the research support systems have been prioritized. New mechanisms and structures for supporting basic research have been developed. Support for Extra Mural Research and Development has been fortified during the last financial year. Science and Engineering Research Board has been notified and roles for supporting research through competitive grants are being segregated from the developmental and promotional roles of the Department in a structured manner. The Department has drafted a Science, Technology and Innovation policy for wider consultation and adoption. Data sharing and access policy has now been approved by the cabinet and is being formulated into a framework document.

Human Capacity Building for Research and Development: Large scale national programmes for attraction of talent to study of science and careers with research have been promoted. Reach of the **INSPIRE** programme to the school and educational systems has been widened. As many as 18 lakh posters describing the various elements of the scheme have been reached to the educational enterprises of the country. During the current year (2010-11) 1,76,243 students from 27 States/UTs have already been selected for awards under Scheme for Early Attraction of Talents for Science (SEATS).

Capacity and expertise building for research and development has been focused. **Fast Track Young Scientist Scheme** has been revised based on stake holder value appraisal. Based on responses received from 82 of 125 young scientists participating in the stake holder value assessment study, the grant size has been increased from Rs 17 lakhs to 25 lakhs. In order to expedite processing, IT enabled tools are being introduced for decision making. DST has been accorded a stake holder value of 8.3 out of 10 by the young scientists. The fund size for young scientist scheme is currently five times compared to that in 2005. There is a considerable increase in the number of research proposals being received and support under this scheme. The number of Ramanujan Fellows being attracted back to the country for research is currently at about 15-18 per year.

Strengthening Institutional Capacity for Research and Development: Rejuvenation of research in university sector has been accorded high priority. The Department has more than doubled investments into strengthening of institutional capacities during the last three years. Schemes like **Fund for Infrastructure Strengthening of Science and Technology (FIST)** has been expanded to include colleges and expand the R&D base of India. Parameters have been raised to extend critical level of support. During the last 10 years 1343 Departments spread over to 337 academic institutions have been supported under this scheme with a total support of about Rs 971 crores. For wider dissemination of the programmes, a new website has been launched. The Program scope would now be extended for supporting departments in the Colleges even at the Under-graduate level. After a review of the scheme over a period of ten years, the need to augment the scheme with special packages for regions not covered under the existing provisions have been developed. Special packages have been implemented for North Eastern Region, Jammu and Kashmir Region and Bihar state during the last three years. Major facilities Supported are Guwahati University (High Performance Computational facility with 64 nodes cluster and software), Tezpur University (Powder XRD Facility with High and Low Temperature systems), Tripura University (400 MHz NMR facility), Mizoram University (High Resolution TEM facility) and Coordinated Research Projects specific to NER region. A special scheme named CURIE Consolidation of University Research for Innovation and Excellence has been designed and implemented for women only universities. Six Women Universities have already been supported, namely, Banasthali University, Avinashlingam University, Padmavathi Mahila Viswavidyalaya, SNDT Women University, Karnataka State Women University, Mother Teresa Women University with a grant of Rs. 23.3 crore each for 3 years. This new initiative is expected to make an impact on the quality of research output from these universities.

The scheme “Promotion of University Research and Scientific Excellence” (PURSE) has been reviewed and data on publications emanating from the university sector have been collected. Thirty (30) new universities have been identified for support under this Program based on the publication output in Scopus International Database for a period 1998 to 2008. Inclusion of new universities under this program is major anticipated achievement of the programme.

To provide facilities of sophisticated analytical instruments to research workers specially from the institutions which do not have access to such instruments to enable them to pursue R&D activities the Department has set up **Sophisticated Analytical Instrument Facilities (SAIFs)** in different parts of the country About 14,000 research workers from all over the country utilized the facilities during the year. These included research workers from almost all the universities in the country. About 84% of the users were from academic sector. More than one lakh samples were analyzed at the facilities during the year and about 1,000 research papers were published by the users of the SAIFs

Support to Autonomous Research Institutions Nurtured by the Department: The Department has been providing Grant in Aid to total of 15 autonomous institutions developed in the form of independent societies. Majority of these institutions were founded by eminent scientist like CV Raman, JC Bose, DN Wadia, SP Agharkar and Birbal Sahni. These institutions have been receiving Grants-in Aid from DST. Funding systems for supporting research in autonomous institutions nurtured by DST have now been rationalized based on faculty strength and performance indicators. Recently a performance review of the institutions nurtured by DST directly was conducted. In terms of S&T output indicators per scientist, the overall outputs from the DST institutions meet the national bench marks of publications, doctoral researchers and patents per scientist.

National Innovation Foundation, Ahmedabad was being supported from the interests of a corpus provided by DST until last year. This is a grassroot innovation support system receiving small resource. In view of the expanding base of grass root innovation system and the opportunity that it offers for creation of open source and affordable innovations, the Government has now accorded an approval for the conversion of NIF into an autonomous body of DST.

Technology Development Programmes: DST has been engaged traditionally in promoting demonstration of technologies developed by public funded institutions. In recent times a strategic approach to focus on the implementation of sustainable and convergent technology solutions rather than to limit the objectives of technology interventions to demonstrations has been made. Under the new approach, some select sectors of technology have been identified for strategic interventions. They are a) Solar energy, b) Water related technologies, c) security technologies, d) Drug and Pharmaceutical and e) Chemical fertilizers.

Solar Energy Research Initiative included the commissioning of a solar thermal and hybrid technology plant to serve the entire needs of a village of population 4,000 establishing diesel energy parity in cost as well as a PAN IIT programme to deliver R&D outputs to a public sector unit (NTPC) for driving down the delivered costs of solar energy through technology innovations. This intervention has been designed to help policy building based on scientific assessment of viability gaps and size of generation bade subsidy. Under the initiative, total of 37 faculties from 6 Indian Institutes of Technology have been networked for a coordinated project.

Water Technology Initiatives and the Mission on “Winning, Augmentation and Renovation (WAR)” for water: These focus on both a) innovative deployment of available technologies and b) demonstration of applicability of revenue model based approaches. Under theses programmes, total of 89 clusters suffering from 26 different types of water challenges have been identified from various states in the country. Technology solutions for total of 8 clusters have been finalized and work commenced. This intervention aims to offer some sustainable solutions with revenue based models for Ministry of Water Resources to adopt successful solutions in their programmes.

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.

Drug and Pharmaceutical Research Programme: In this important ongoing initiative of the Department, more than 100 Public-Private Partnerships have been promoted for R&D on drug development. Some important technology leads have been reported during the year under the programme. Six new collaborative projects between public funded institutions and industry. 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.

Test Bed for Potash Fertilizer from Sea: India imports substantial quantities of potash based fertilizers annually. One of the public funded R&D laboratory had developed a technology for potash fertilizers from sea on a bench scale. A R&D consortium of the research laboratory, the fertilizer industry association and a leading company has now been promoted under a relationship model of technology development jointly by the Department of Science and Technology and The Ministry of Fertilizers to establish a test-bed for 3 ton per day plant using continuous technology. This intervention offers scope for reduction of subsidy on fertilizers.

Scientific Services: The Department of Science and Technology has been promoting some entities and sub-departments associated with R&D services in the areas of geospatial technologies, testing and standardization for quality systems for manufacturing, Good Laboratory Practices and Technology Forecasting and Assessment. The sub departments **Survey of India** and **National Atlas and Thematic Mapping Organization** are two important centres of the country. Geo spatial technologies and map products of SOI are known for their brand value. These organizations have rendered critical and important services to the country during the year 2010-11. This includes resolving some zones of conflicts. SOI has initiated a programme to update quickly the maps of India on 1:10,000 scale. Currently the map products available for public use are at 1:50,000 scale. Revision of the map policy is also under consideration. **Technology, Information, Forecasting and Assessment Council (TIFAC)** is engaged into look ahead in technologies, assess the technology trajectories and support technology innovation by network actions in select technology areas of national importance. **National Accreditation Board for Laboratories (NABL)** has gained self sustainability with respect to revenue expenditure and the number of certificates issued is growing annually at rate of ~14%. The major sectors in which NABL has granted accreditation are Textiles, Automobiles, Power, Telecom, Petroleum, Food, Health and Environment. As on date, more than 1300 laboratories have NABL accreditation, out of which 20% are Government laboratories.

DST has been entrusted with the responsibility for certifying Test Facilities with a **Good Laboratory Practices** compliance certificate for preclinical testing of Pharmaceuticals, Industrial chemicals, Agrochemicals, Cosmetics and Food and Feed additives. GLP certification is required by manufactures while registering these substances for use in humans and in animals. India has completed all requirements as stipulated by OECD for GLP compliance monitoring. The OECD recognition on Mutual Acceptance of Data (MAD) has been received data from Indian laboratories would now be acceptable in all 34 OECD member countries. Removing a new tariff trade barriers for the country.

Mission mode Programmes: DST has also been implementing and coordinating S&T missions on Nano science & technology, climate change and adaptation programme, National Mission on bamboo applications and “Mission for Geospatial Applications” The Department has been implementing Nano Mission for creating national capacity in frontier area of science and technology namely **Nano Science and Technology** since May 2007. So far 253 PhDs and 750 other professionals have been trained under nano mission in the country. Total of ~2700 publications and 82 patents have resulted from the mission. 11 units have been strengthened and some of them have gained global competitiveness in quality standards. Under Nano mission, 33 new projects have been initiated during the year. Indian beam line in Synchrotron at KEK, Japan has been built and made available to Indian scientists for 250 days a year on a dedicated basis. **National Bamboo Applications Mission** has delivered a number of technologies and products for bamboo applications. Technologies for construction materials have been standardized. Cost effectiveness of bamboo based construction materials against the conventional materials has been demonstrated. Housing shelters for flood affected people in Leh covering about 60,000 sq ft have been built in record time providing relief to the affected people. Two missions assigned to DST by PMO for implementation under **National Action plan for Climate Change** have commenced activities during 2010-11. The activities of the **Mission on Geospatial Applications** include Agricultural Assessment, Flood Modeling and Forecast.

S&T Interventions for Socio-Economic Development: Programmes relating Science and Technology for socio-economic development by the Department are of many types to include S&T Entrepreneurship Development, Science for Equity, Empowerment & Development, Natural Resources Data Management System, Science & Technology Communication and Gender initiatives.

The **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. 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 the adjoining region. During this year 5 TBI have been supported the total number of TBI's has grown to over 55 women entrepreneurship parks.

National Resource Data Management Systems (NRDMS) provide location specific data on natural resources using geo-spatial and other data. Several activities have been completed during the year 2010-11. A set of broad parameters has been approved by the Union Cabinet to help evolve a National Policy on Data Sharing and Accessibility. District geo portal prototypes have been developed and their utility demonstrated using standards-based open source software packages to provide end users with accessibility to information vital to local level planning. Sector-specific geo-information services have been validated and made accessible to the end user community in the sectors of Health and Hydrology. Studies have been completed in areas like Cartographic Generalisation, Disaster Management (floods and landslides), Biodiversity, Lake Ecosystem, and Pollution Modelling. Fresh studies have been initiated in areas like Spatio-temporal Data Analysis, Sensor Web Enablement, Marine GIS, Digital Heritage, and Hyper Spectral Remote Sensing. Technical capacity has been built through a series of training and user awareness workshops amongst the scientific and the end user communities towards operationalising National and State level SDIs.

The **National Council for Science & Technology Communication (NCSTC)** is mandated to communicate science & technology to masses. One of the flagships of science communication is the Science Express, a unique 16 coach custom-built AC train. The train also houses the indigenously developed 'Joy-of-Science' in which schools students are encouraged to perform over 50 hands-on experiments & activities in Physics, Chemistry, Biology, Mathematics & Electronics. This flagship programme of DST has also been able to effectively engage & motivate students to pursue higher studies as well as careers in science besides inculcating scientific temper among masses. This iconic mobile classroom has covered more than 160 destinations and enthralled a whopping 51 lakhs people including about 10 lakhs students and 50,000 teachers from 10000 schools. The 18th National Children's Science Congress-2010 was held at Chennai during 27-31 December 2010. The focal theme for 2010 & 2011 was Land Resources: Use for Prosperity & Save for Posterity.

Interventional Programmes for Social Contract: **Science for Equity Empowerment and Development** programmes have delivered long term core support to 17 field groups for development and dissemination of location specific technologies. Programmes for training and capacity building of youth in tribal & SC dominant areas have been continued. Several capacity building programmes involving self-help groups have been organized. A 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, Jorhat and other at Indian Institute of Technology, Madras at Chennai have been established in order to promote convergent technology solutions for applications in rural India. Technology interventions for elderly and S&T programmes for empowerment of weaker sections of the community through capacity and skill building through S&T tools are flagships of the Department. The budget for Tribal sub-plan & SCSP has been increased. Eleven network programmes on need based themes are being implemented in different parts of the country during the year. Eight thematic workshops and 55 training programmes have been

conducted at the field level. More than a thousand people were mentored into activities leading to remunerative incomes. Two Rural Women technology parks are being facilitated at Karnataka, A.P.

The Department undertook a study of per-capita income changes at district levels with 1993-94 as the reference year. Data reveal that in many states, the rates of change of per-capita income of several low-income base districts are higher than those of high-income base districts. The department is undertaking a study of districts with high and low growth rates of per capita income and examine the possible roles of technologies and planned socio-technological interventions in contributing to the inclusive growth agenda of the country.

Gender Initiatives: The department has pioneered several steps for improving gender parity in the science sector on the one hand and providing opportunities for re-entry of women into S&T related socio-economic activities is receiving wide support and enrolment of women.

Based on the report of the Task force constituted for “Women in Science”, several follow up actions have been taken. This includes the increase in the value of fellowship for under women re-entry scheme, crèche facilities for autonomous institutions under the science ministry and revisions of parameters for the ongoing programmes under women component schemes of DST. A standing committee has been constituted under the chairmanship of the Minister of Science and Technology for overseeing the implementation of various programmes leading to gender parity in science.

The Women fellowship schemes of the department provide enhanced opportunities to women scientists in diverse areas to include fellowships for R&D in basic and applied science (WOS-A), S&T oriented development and extension (WOS- B) and training in IPR (WOS-C). In the WOS-A scheme 191 projects were sanctioned this year. Thirty two projects were sanctioned in the WOS-B scheme which aims to motivate women scientists to contribute to the development of the country through research, development and adaptation of technology for improving the quality of life and provide additional opportunities for income generation in urban slums or rural. Under the WOS-C scheme the selected candidates are trained for one year in the area of IPR, mainly patents. Eighty four women scientists completed the one year training in IPR in May 2010 while 73 are undergoing the one year hands on training with reputed IPR Lawyers in different parts of the country.

S&T co-operation / Partnerships and Alliances: The Department has strived to promote and develop suitable and strategic partnerships and alliances in the S&T sector. International S&T cooperation has been stepped up many-fold. State-Centre Technology partnerships have been nucleated during the year 2010-11. Global Technology alliances and innovation partnerships have been fostered. Institutional mechanisms for building office of alliance between MHRD and MoST have been built. New models for PPPs for R&D and clean energy have been proposed. Efforts have been made to establish more active linkages among academy, research and industry.

International and Multi-lateral S&T Cooperation: The International S&T cooperation agenda of India has been stepped up many fold. The Indo US endowment Board and fund were established for promoting S&T cooperation between India and US. Science Bridge initiatives with UK and Indo-EU S&T cooperation projects received funding support to the tune of 10 million UK pounds and 5 million Euros, respectively from both sides. Total of 70 projects have been supported under Indo-Australia Strategic Research fund. India signed the agreement for participation in Facility for Antiproton and Ion Research (FAIR) and joined Thirty Meter Telescope as an observer during 2010-11. Other indicative trends in

fostering international cooperation and partnerships during 2010-11 have been bilateral R&D projects involving industrial partners (Canada, Israel, Russia, Germany), Co-investment of resources for symmetric joint research projects and strategic joint initiatives (Australia, EU, Israel, UK, Finland, Norway), Creation / Execution of Institutional Frameworks / Funds with other countries & regional bodies (IGSTC, ASEAN Technology Fund, Indo-US Endowment Fund, New Africa S&T Initiative), Joint research project based two-way mobility of researchers under active bilateral S&T programs of cooperation with more than 50 countries, Getting bright young minds initiated into and to excel in the realm of research through fellowships for Indian and Developing Country scientists, International interactions under joint project based visits have been instrumental in accelerating outcomes of national projects. Spectrum of impact can be gauged from the number of Joint Patents that have been filed with foreign scientist, project based mobility has provided indirect opportunities to Indian scientists for joining international projects, building extended and stable institutional tie-ups with foreign partners to incubate feasibility of scaling up of research, pilot scale production and high-tech competence in India and creation of new knowledge and research tools captured in co-authored papers with foreign scientists published in world class scientific journals. During 2010-11 agreements were signed with 29 countries during 2010-11 for S&T cooperation. 29 joint workshops 419 exchange visits, 353 joint projects with different countries and 20 joint /S&T committee council meetings were conducted during 2010-11. Joint centres in the areas of clean energy with US and computational sciences with Max Planck Society, Germany, Solar Energy Research with UK were established, Indo-German S&T Centre and Indo-Russian S&T centre in India were also established. Indo French Centre for promotion of Advanced Research developed new programmes and new partnerships with French side.

State- Centre Technology Partnership: The Government of India has prioritized the gainful applications of technologies available with institutions under the GOI by states. DST prepared a concept note for fostering the technology partnerships between states and centre. The concept note was widely circulated among the various science departments and states. A technology compendium has been prepared and converted into a technology portal. The first ever meeting of a state machinery and the central science departments was organised on 6th November 2010 at Kerala. A state specific technology deployment plan is being developed in consultation with the state. This exercise will be repeated with other states.

Global Innovation and Technology Alliance: The culture of translating a laboratory research finding into a commercializable Intellectual property and product requires experience sharing for both Indian R&D system and the industry. DST has been striving to build such cultural changes by twinning the R&D systems and the industrial enterprises through global alliances in technology and innovations. CII and DST have been working on a project mode for building synergies with Canada, Israel and other similar economies. Under GITA about 11 projects have been launched with partners from other economies.

Office of Alliance between MoST and MHRD: In order to promote academy and research alliances, a MoU has been signed between MHRD and MoST to establish and Office of Alliance and institutionalize the collaborative endeavours in rejuvenating research in university sector.

Public and Private Partnership in Innovation System: Public Private Partnerships for R&D and innovation sector form powerful instruments for building synergies between the knowledge and wealth creating activities. Some new models have been proposed for treating the entire knowledge domain of research and development in the country as a seamless and connected activity regardless of whether the

project is undertaken in the private or public sector R&D systems as long as the final output is focused on public or social good.

Under a partnership among Economic Times, Indian Institute of Management, Ahmedabad and DST, a call for power of ideas was made. As many as 16250 proposals were received. After screening, as many as 250 ideas have been short-listed for further mentoring and venture capital support. Intel and Lockheed Martin collaborations with DST in promotion of innovations have caught the imagination of the youth in the country. Partnership with industry has been established for promotion of Innovation clusters. DST has been engaged in a number of activities leading to promotion of an innovation eco system.

Academy for Science Policy and Implementation Research: An academy for science policy and implementation research has been mounted on a project mode in the Administrative college of India. This academy is to enhance the scientific departments in developing capacity in scientific inputs to policy building in the country

Overall National S&T Output Indicators: Indian R&D system is under a phase of transformation. Responding to the increased investments of the Government of India, the public funded research and development sector has stepped up their publication strength. The relative position of India with respect to the number of publications in SCI journals has improved from the 15th rank in 2003 to 10th 2009. Although the number of patents filed in India for R&D work done outside the country has been undergoing many fold increase, the patents filed for work done in India has also increased at an annual growth rate of about 20%. The PhD outputs in India in science sector have increased. There is a need to ensure quality in the S&T outputs while expanding the base. More active engagement of the private sector into R&D needs to be fostered and promoted through both policy and programme inputs. DST is currently seized with the development of strategies to enlarge the R&D base and attract the private sector investments into R&D.

STRENGTHENING BASIC RESEARCH AND DEVELOPMENT

One of the main goals of the department has been to enable the Indian S&T community to increase its scientific outputs in the form of scientific publications and patents. Various enabling measures, strengthening and improving funding systems for Extra Mural Research have been addressed. One of the key roles played by the Department has been to strengthen the R&D funding systems in the country. The rate of growth of scientific publications from the country as against the global average has been the targeted bench mark for monitoring the R&D performance of India. In its role as the major R&D funding agency, the Department has set for itself targets to a) increase the R&D base, b) increase the size of R&D grants, c) increase the process efficiency by reduction of process time for application to grant-decision and d) foster research in new and cutting areas of science and technology. The results of the enabling actions of the department in the role of major funding agency are evident in the form of growth trends in funding levels.

India has registered an annual growth of rate of 12% in scientific publications in Science Citation Indexed journals during the last three years. This is to be compared to about 4% of global average. There is also a relative improvement in the global ranking from 15th position in 2000 to 10th in 2009 with respect to the number of publications. There is also an improvement in the relative ranking of number of patents filed by Indian researchers in the USA and OECD countries. A significant increase in the number of PhD outputs in the country has been reported during the last five years.

The current share of DST in the Extra Mural Research funding in the country is about 50%. On account of several initiatives taken by the department, there has been an increase of more than 250% in the number of proposals received by the department indicating an expansion of R&D and stake holder bases. Service impact ratio of the department as the major R&D funding agency of the country is assessed by the percentage share of researchers receiving Extra Mural Research grants from DST. More than 50% of active researchers publishing papers in SCI journals are recipients of R&D grants from the Department currently.

A concerted effort has been made to increase the size of the project grants and speed up the decision making processes relating to release of R&D grants during the last three years. A Science and Engineering Research Board has been notified with a desire to de-bureaucratize R&D funding systems.

SCIENCE AND ENGINEERING RESEARCH COUNCIL (SERC)

Science and Engineering Research Council (SERC) is a flagship of DST. Since its establishment in 1974, SERC has been DST's apex advisory body for all matters related to promotion of research in emerging and frontier areas of Science and Engineering. SERC has been the single largest national agency engaged in promoting basic research in all areas of science and engineering and has achieved significant success in furthering the growth of research in new inter-disciplinary areas in science and engineering. SERC has been the mainstay to nurture scientific activities and promote scientific excellence in the academic

sector. It has been the mainstay of open-ended basic research in the academic sector; about 45% of the extramural research funding in Universities / Colleges was from SERC/DST and the rest from 18 other Departments/funding agencies.

The thrust of SERC includes the formulation of programme and schemes aimed at making India a world leader in the generation of new knowledge; planning, promoting and funding of high quality research in frontier and emerging areas; identification on a real time-basis major inter-disciplinary, frontier research areas (even futuristic) identifying individuals, groups and/or institutions; evolving and initiating nationally coordinated programmes in various identified areas so as to network institutions that will have multiplier effect in promoting research; developing systems to assess overall health of Indian science across disciplines and bring out relevant S&T indicators; encouraging a critical mass – adequate number of bright people – doctoral/post graduate/research students to meet the needs of high quality research; building up excellent infrastructure and environment dedicated to scientific pursuit; exploring synergy between academic institutions, S&T laboratories and industry etc.

SERC continued its programmes focussed on the promotion of research and development in new and interdisciplinary areas of Science & Engineering in the country. As in the previous years, Programmes under SERC were carefully selected through the Programme Advisory Committees (PAC) who 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. This has contributed in augmenting the R&D capabilities at academic institutions and national laboratories. Many of these Centres have advanced research facilities to attract young researchers to continue their research activities.

Manpower Development is an integral part of the SERC Scheme. A large number of Young Scientists were supported to take up challenging R&D activities as a career.

The Council, so far, has met thrice during the period and has approved support to several projects in various broad areas of Science & Engineering in addition to training programmes and workshops. Several SERC schools in areas like High Energy Physics, Theoretical techniques in atomic and molecular collision physics, Nano-Optics, Guided Wave Optics and Devices, Nonlinear dynamics, Technology of Processing Plasmas, Herpetology, Chronobiology - Clocks Rhythms and Behaviour, Neurosciences, Agricultural Drought : Climate Change and Rainfed Agriculture, Ocean Atmosphere interactions and Global change, Global warming on climate change, Dynamics and Forecasting of Indian Summer Monsoon, Statistical distribution theory and applications in data analysis, Electrochemical systems, Patterns and Interfacial Instabilities with applications were held.

Special efforts were made to identify active scientists, particularly Young ones, and Institutions in remote areas and to encourage them by providing research support and Visiting fellowships etc.

The Website for the SERC (www.serc-dst.org), which was launched nine 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 assess 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 391 Science and Engineering R&D projects till 15.12.2010 at a total cost of Rs 11106.3 lakhs. The discipline-wise and institution-wise break-up of funds is given in Fig. 1.1 & 1.2.

SERC SUPPORT - DISCIPLINE WISE 2010-2011 (till 15.12.2010)

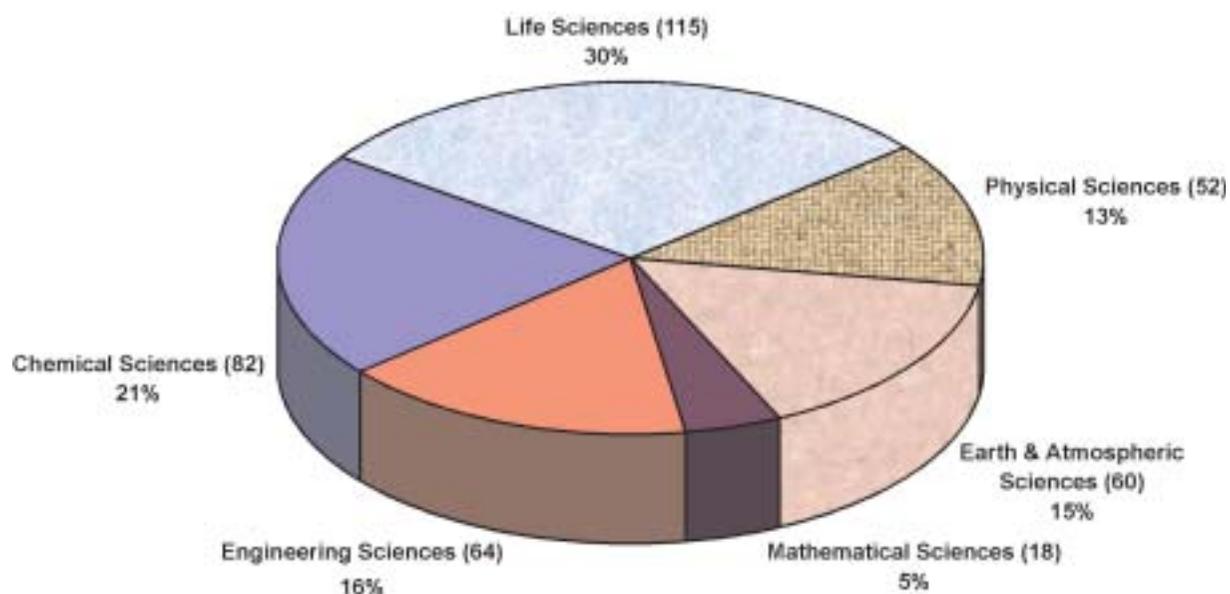


Fig. 1.1: SERC SUPPORT – DISCIPLINE WISE 2010-2011 (till 15.12.2010)
TOTALAMOUNT Rs. 11106.3 Lakhs

SERC SUPPORT - INSTITUTION WISE 2010-11 (till 15.12.2010)

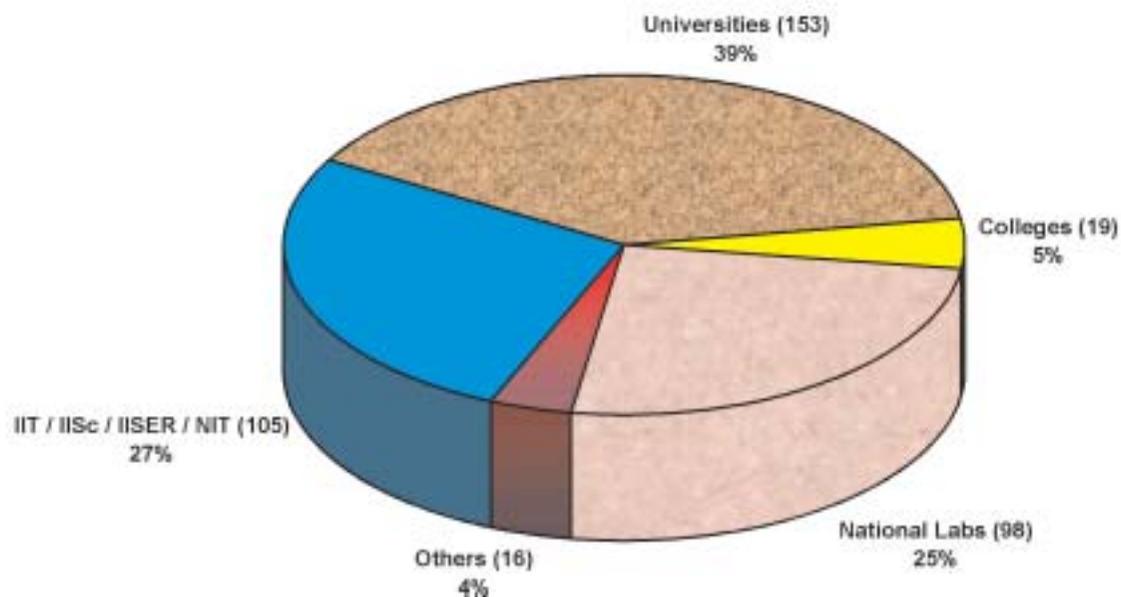


Fig. 1.2: SERC SUPPORT – INSTITUTION WISE 2010-2011 (till 15.12.2010)
TOTALAMOUNT Rs. 11106.3 Lakhs

R&D Projects sanctioned during 2010-2011 (till 15.12.2010)

Broad Area	No. of Projects	Sanctioned Cost(Rs. in Lakhs)
Chemical Sciences	82	3291.7
Life Sciences	115	3739.4
Physical Sciences	52	1248.1
Earth & Atmospheric Sciences	60	1077.5
Mathematical Sciences	18	114.8
Engineering Sciences	64	1634.8
Total	391	11106.3

A new national funding agency Science and Engineering Research Board (SERB) has been formed with the approval of the Parliament under a new legislation. The notification for the formation of the SERB was issued on 11th June, 2010. SERB gives an opportunity for the science and technology sector to de-bureaucratize R&D funding through new structures. The functional autonomy of SERB is expected to enable the department to meet the aspirational needs of the main stake holders of R&D community in the long term. SERB offers a unique opportunity hitherto unavailable to the Ministry to leverage functional autonomy accorded by the new rules and regulations of the new legislated body. The long term trajectory of the department is to deploy SERB as the main competitive funding agency and focus on developmental and promotional roles.

The broad discipline wise details of the achievements are as follows:

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 scheme. During the period under report organized two meetings of the 'Program Advisory Committee on Atmospheric Sciences'. A group monitoring workshop was organized in which 10 completed projects were evaluated and monitored the progress of 26 ongoing projects. The salient achievements under the above program are as follows:

Space Weather Physics and Dynamics

Observations of very low frequency (VLF) amplitude anomaly during the total solar eclipse of 22 July 2009 indicated depletion of electron density in the D-region of the ionosphere caused by the solar eclipse. A banded Spherics structure was observed at Agra during April 2010, which is caused by specular reflection from an irregularity of enhanced ionization at the base of the ionosphere. A wave-slab interaction model has been used to study the scattering of VLF ground transmitter signals from localized enhancements of ionization in the lower ionosphere caused by transient luminous events such as sprites. The results explain the VLF amplitude and phase anomalies in sub-ionospheric VLF transmitter signals received at Agra, which are caused by distant sprites.

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, study of nonlinear processes in Sun Earth connection and establishment of 'Stratosphere-Troposphere (ST) Radar facility at Nainital' are in progress. Initiated new projects on 'Investigation of atmospheric effects on future ground based augmentation for GPS system' and 'Electrodynamical control over the ionization processes near the northern crest of equatorial ionization anomaly and beyond'. Identified scientifically important locations (viz. Kochi, Kolkata and Visakhapatnam) towards the establishment of three more ST Radars and further discussions are in progress.

Atmospheric Dynamics and Modeling

The Sodar observations at Pune reveals the typical signatures of wind fields for the late afternoon thunderstorm (TS) such as deceleration of winds with or without change in direction leading to convergence, a few minutes prior to the onset of thundershower. Relatively higher turbulence kinetic energy in convective boundary layer is observed on all TS days. Mixed layer depth is higher than lifting condensation level on TS days in May and June indicating saturation of air parcels in updrafts.

A regional climate modeling system (RegCM3) has been integrated at 60 km horizontal resolution over India to evaluate the model performance in simulating some of the important components of Indian summer monsoon circulation and rainfall. Results indicate that RegCM3 captures the features well and close to observation. This model at 20 km resolution captures the well marked cyclonic circulation formed over the Bay of Bengal and south westerly flow over the Arabian Sea and the simulated precipitation is slightly below that of the observed during the heavy rainfall event of 26 July 2005. Further sensitive experiments using snow data indicated that precipitation was reduced mainly over the northeast and south peninsular India with the introduction of 10 cm of snow over the Tibetan region in April. Daily energetics (kinetic energy and momentum transport) of zonal waves (wave numbers 0 to 10) were computed from 1 April to 30 September during 1951 to 2010 at 10 standard tropospheric levels. 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. Studies on 'Numerical simulation of western disturbance and associated extreme weather using a mesoscale model', 'Monsoon Rainfall forecasting using Neural Networks' and 'Establishment of a coupled climate and carbon cycle modeling activity and investigation of the effects of CO₂ fertilization' are in progress. Further studies on 'Climate variability over India using Regional Climate Model' have been initiated.

Aerosols and Atmosphere Interactions

Completed the validation of indigenously developed handheld Sunphotometer and 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. Analysed the observations using Aircraft during 25 June to 03 July 2009 to investigate the spatial and vertical distribution of cloud condensation nuclei and hydrometeor size spectra over the Indo Gangetic Basin (IGB). The results suggest large absorption is associated with both fine and coarse particles, thus providing first direct evidence of coarse mode absorption. These

measurements of 3-D distribution of aerosol properties reduced the uncertainty in estimates of aerosol heating rate over the Indo Gangetic Basin to 10%, while the top of the atmosphere forcing over the region are comparable. Also, the atmospheric warming over the western and central IGB is twice compared to the eastern IGB, thus suggesting the persistence of high aerosol heating in the monsoon season when aerosols are expected to be washed out. For the first time, distribution and sources of ambient NH_3 over National Capital Region is estimated precisely as 18.4 ± 1.7 ppb with day and night variation. Sampling of airborne endotoxin and bacteria was carried out across ten sampling sites in Mumbai city. Twenty eight bacterial species were identified and Gram positive bacteria dominated across all sampling sites. *Staphylococcus*, *Klebsiella spp*, *Serratia spp*, *Enterobacter spp*, *Pasteurella spp*, *Proteus spp*, *Staphylococcus spp* and *Acinetobacter spp* are medically important species characterized from samples.

Regular measurement of organic and black carbon and chemical constituents of ambient aerosols at a suburban site of the Indo-Gangetic plain, 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 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 'Behaviour of Ozone and its precursors under different industrial Environment around Udaipur' are in progress. Initiated 'Design and development of Multi-wavelength Laser Radar (LIDAR) for measurement of Aerosols and Clouds in the Troposphere and lower Stratosphere' and 'Physical and optical properties of Aerosols over an urban location- Jaipur'.

Agrometeorology

Field experiments to understand the crop-weather interactions in selected medicinal and aromatic plants grown in Himachal Pradesh revealed that temperature has a major role in the biosynthesis and accumulation of compounds stevioside (St) and rebaudioside A (Rb) in the *Stevia rebaudiana* plants. In salvia, the vegetative growth of the crop was highest under open conditions than shade conditions. Thus, Salvia crop require sunny conditions for growth and development. 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; 'Integration of crop growth and yield response of cotton to multiple environmental stresses, soil and genotypes in space and time by dynamic simulation' are in progress.

Continental Tropical Convergence Zone

Special emphasis was given under Indian Climate Research Program (ICRP) to evolve and implement multiagency, multi-disciplinary coordinated field experimental campaigns to investigate the land-ocean atmosphere interactions and their role in monsoon variability. The Continental Tropical Convergence Zone (CTCZ) is a sub-program under ICRP. It is a multi-institutional program planned and executed by the Indians to understand monsoon rainfall variability in the monsoon zone over the Indian sub-continent. CTCZ objectives would 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 will 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°N, upto foothills of Himalayas. These new observational datasets were analysed by the participating scientists and a 'Workshop on CTCZ-Pilot Results' was organized during 29-30 April 2010 at Pune in which preliminary scientific results were presented by the multi-disciplinary scientists participated in the activity.

The CTCZ program, including the ongoing projects, was transferred to the Ministry of Earth Sciences, further implementation of the main observational and modeling studies with a holistic approach will be made available by the Ministry of Earth Sciences.

Human Resource Development activities:

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

1. SERC School on 'Ocean – Atmosphere Interactions and Global Change'
2. SERC School on 'Global Warming and Climate Change'
3. SERC School on 'Dynamics and Forecasting of Indian Summer Monsoon'
4. SERC School on 'Agricultural Droughts: Climate Change and Rainfed Agriculture'
5. Workshop in 'Scientific Ballooning'.

Himalayan Glaciology

Glaciers, important resource of fresh water, are known to have profound effect on environment and climate, land erosion, river discharge and consequential floods and droughts. The Himalaya have one of the largest resources of snow and ice and its glaciers which form a source of fresh water for the perennial rivers such as the Indus, the Ganga, and the Brahmaputra. Glacial melt may impact their long-term lean-season flows, with adverse impacts on the economy in terms of water availability and hydropower generation. The glaciers in the Himalaya lie at a formidable high altitude making them unique compared to the other glaciers in the world. The available data on Himalayan glaciers indicates that while recession of some glaciers has occurred in some regions in recent years, the trend is not consistent across the entire mountain chain. Therefore, scientific study of glaciers assumes foremost importance to understand the processes that effect on the ecological system and eventually on the socio-economic fabric, for planning sustainable development as well as to prepare for mitigation of the effects of future climatic changes.

To create the basic Research & Development base in the country for studying different aspects of Himalayan glaciers the Department of Science and Technology formulated a coordinated Programme on Himalayan Glaciology in 1986. These studies have contributed in understanding the various glacier

phenomenon at Chhota Shigri glacier, Durung Drung glacier, Kangriz glacier, Satopanth and Bagirath Kharak glacier, Thellu glacier, Gangotri glacier, Pindari glacier, Sonapani glacier and Changme Kangpu glacier, etc. Status report on the Chhota Shigri Glacier was prepared and the same was under peer-review for publication as a reference document. The inadequacy of long-term scientific data poses severe constraint in drawing definitive relation between the observed recessions of Himalayan glaciers in the last couple of decades and the phenomena of global warming. Thus there is a renewed thrust to this program and prepared the Science Plan for 'Integrated Program on Dynamics of the Glaciers in the Himalaya' including the scientific issues towards focused investigations at selected glaciers and also for long-term monitoring of all inclusive parameters at ten benchmark glaciers. Initiated a Centre for Glaciology at Wadia Institute of Himalayan Geology and also prepared the detailed project report towards establishing a 'National Center for Himalayan Glaciers' to give proper directions and more focused attention to glaciological research in the country.

Completed the studies on 'Geohydrological studies and quantification of sediment load of Thellu glacier, Uttarakhand Himalaya' and 'Deglaciation and associated consequences of future water scenario's: A case study of Gangotri Glacier'. Studies on 'Palaeoglacial reconstruction in Pindar Valley and monitoring of Pindar Glacier in Kumaun Himalaya', 'Glacier morphology and quaternary glacial history of Durung Drung glacier, Zaskar, Ladakh', 'Monitoring temporal and spatial variations in snow cover in Indian Himalaya through satellite remote sensing', 'Geomorphological cum sedimentological appraisal of Changme Khampu glacier, Sikkim Himalaya', 'Study of Atmospheric and Avalanche parameters affecting Gangotri Glacier', 'Spatio temporal monitoring of glaciers using satellite remote sensing and Luminescence measurement technique', 'Optical and microwave remote sensing of snow variations in Gangotri and Satopanth Glacier areas in Uttarakhand Himalayas', 'Monitoring dynamics of Surging glaciers in Indian Himalaya through optical remote sensing and geographical information system', 'Analysis of temporal variation of climate vis-a-vis glacial fluctuations in the northeast and northwest Himalaya based on multi proxy records' and 'Mass balance study, snout monitoring and quaternary history of Macholi glacier, Kashmir Himalaya' are in progress. The following new projects were initiated during the period under report.

- Impact of climate change on snowmelt runoff contribution to eastern Himalayan Nuranang River.
- Remote Sensing based debris cover analysis of Chhota Shigri Glacier
- Snout monitoring, mapping, mass and energy balance and assessment of biophysical environment of Naradu glacier, Bapasa basin, Himachal Pradesh.
- Long-term monitoring of Satopanth / Bhagirath-Kharak Glaciers, Chamoli District, Uttarakhand
- Spatio temporal monitoring of Pastio Glacier using advanced remote sensing and ancillary data
- Development of methodology for snow pack characterization and glacier movement studies using multi frequency SAR time series satellite data
- Study of Glaciers in the Himalaya using Synthetic Aperture Radar Interferometry.

The preparation of a detailed project report for the establishment of National Centre of Himalayan Glaciology has been commissioned. The DPR is ready for further study and decision making.

CHEMICAL SCIENCES

The support to frontier areas of research continued. Several projects in contemporary areas were supported. A project for establishing a ultra high vacuum (UHV) low energy (< 100 eV) ion scattering mass spectrometer which can measure up to 10K has been funded. This set up will be used to study

structure and reactivity of molecular solid surfaces with a view to understand the chemistry and physics of icy materials in the planetary system. This will be the first system in the country and may be second one in the world. Several young faculty members were given funds liberally to start their research career.

Progress of several projects was reviewed, and many interesting results were obtained. The details are given below. It is noticed that among the papers published from the projects, about one third of them were published in the journals published by American Chemical Society and Royal Society of Chemistry, UK. A few patents were also filed.

Organic Chemistry

While many areas were funded, most of them are related to synthesis of new molecules and exploring their applications either in biology or material properties. Some of them were also related to developing new and efficient methodologies. In the area of chemical biology, an effort to discover allosteric modulators of glycogen like peptide-1 receptor (GLP-1R) to combat type 2 diabetes; and regulation of cancer implicated genes and understand the molecular pathways through chemical modification of steroid hormone receptor were funded. Some of the new methodology projects are: stereoselective and atom efficient synthesis of multi-functional and bioactive molecules via Morita-Baylis-Hilman and Rauhut-Currier reactions; development of new synthetic protocols for creating natural products and related diversity in quest for anticancer agent using amino acids as chiral synthons; design and synthesis of flexible models based on pyrazol[3,4-d] pyrimidine for better understanding of arene interactions at molecular and supramolecular level; and synthesis of functionalized C-aryl glycosides. Some projects were supported in the area of drug delivery. They are on biocompatible synthetic capsules as reaction vessels and delivery vehicles; and oligopeptide based hydrogels and their applications in controlled drug release.

Some achievements arising from the projects are listed below:

- ❖ Co-crystals i.e. crystalline molecular complexes of two- or more neutral molecules are emerging as a class of pharmaceutical materials. Cocrystals of the anticancer drug Temozolomide (TMZ) were prepared to improve its stability. The Temozolomide–succinic acid cocrystal was found to be much more stable (no discoloration even after one year, two different batches of drug and drug cocrystal were studied) and has comparable dissolution profile compared to TMZ.
- ❖ A hitherto unknown novel and facile method for the chemo- and regioselective cleavage of benzylidene acetals to the corresponding α - and β -benzoyloxy carboxylic acids using $\text{RuCl}_3 \cdot 3\text{H}_2\text{O}$, NaIO_4 reagent system has been developed. The synthetic potential of this new methodology is further exploited in the enantioselective synthesis of pharmaceutically important α -benzoyloxy carboxylic acids from terminal olefins. The power of this methodology is further shown in the stereoselective synthesis of biologically relevant (2R,3S)-3-hydroxy pipercolic acid (*Angew. Chem. Int. Ed.* **2010**, 49, 804-807).

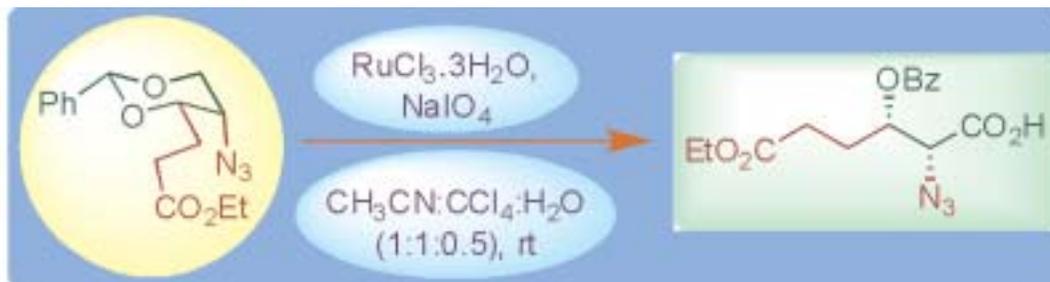


Fig. 1.3 : A Novel method

- ❖ Single and double Oxo-PyU labeled fluorescent oligonucleotide probes were developed, utilizing which it has been possible to detect A and consecutive AA bases and discriminate G and GG bases of target DNA located opposite to the labeled base of the probe DNA via generation of enhanced fluorescence signal. The probes can potentially be useful for discrimination of A/G or AA/GG allele as revealed from their fluorescence behaviour. (*Bioorg. Med. Chem. Lett.* **2010**, *20*, 3227-3230).
- ❖ A formal total synthesis of platencin a broad range antibiotic has been developed (Org & Biomol. Chem. 2010, 4472-4481).
- ❖ Cholesterol based liquid crystalline dimers have been synthesized comprising of a 5-phenyl substituted oxadiazole unit, connected to a cholesterol unit through a thio-alkyl spacer at one end and to a terminal O-alkyl substituted phenylbenzoate unit through an imine linkage, at the other. The main feature of the study is the observation of unusually large temperature range for the TGBC* phase, perhaps the largest range (~100°C) in a dimer. Interestingly, these dimers, having either TGBC*-N*-BP or TGBC*-N* phase sequence, exhibit the TGBC* phase enantiotropically. (*J. Mater. Chem.*, **2010**)
- ❖ Novel cholesterol based mesogenic compounds have also been developed using ‘click’ chemistry. The newly synthesized mesogens show N*, TGB and partially bilayered SmC* (SmCd*) phases (*New J. Chem.*, **2010**, *34*, 1255–1260).
- ❖ A JAVA based tool ChemEd has been developed, which allows drawing chemical structures on a graphical user interface (GUI) by selecting appropriate structural fragments defined in a fragment library. (*Journal of Chemical Information and Modeling* – 50, **2010**, pp 755-770).

Inorganic Chemistry

Some of the new projects funded were:

- Investigation of solubility and catalytic properties of substituted hydroxyl, fluoro and oxy apatite ceramics
- Synthesis and structural characterization of some novel organotellurium compounds: the potential precursors to materials
- An investigation of novel organic nitrate salts and porous metal oxides
- Role of copper in Alzheimer’s disease: An interaction of copper with Aβ peptide
- Platinum metal complexes of selected organic ligands: Synthesis, characterization, and exploration of catalytic properties
- Coordination polymers of transition and lanthanide metals for heterogenous catalysis, luminescence and magnetic studies
- N,N', N''- Triarylguanidine complexes of Platinum group metals
- Colorimetric sensing of ions with calixarene functionalized gold nanoparticles
- Cu(II) and Zn(II) complexes of imidazole and amino acid donors: Synthesis, characterization, stability and biological activities

- Inorganic hybrid helicate and encapsulation assembly mimicking cell and DNA structure
- Selective catalytic reduction of NO_x from lean automobile engine exhausts by hydrocarbons using metal oxide catalysts
- Syntheses of efficient and pure blue triplet emitting materials for fabrication of white organic light emitting diodes (WOLEDs)
- Self-assembly and spectroscopic investigations of bio-inspired catalytic surfaces
- Organo and metal-organo supramolecular assemblies based on 1,3,5-Triarylbenzenes
- Synthesis, evaluation and electrochemistry of novel pyrimidyl and quinolinyl chalcogenides (E=S, Se, Te) and their solubility enhancement in micellar/microemulsion media
- Nitric oxide reactivity of Copper (II) complexes
- Synthesis, reactivity, structure elucidation and catalytic aspects of vanadium complexes
- Transition metal complexes as triple channel sensors for anions and photophysical properties of metalloreceptors
- New Iron (III) porphyrin frameworks for the heterogenous catalytic oxidation reactions

Some interesting results obtained from ongoing/completed projects were as follows:

- ❖ A novel antenna complex of Terbium(III)-4-(dibenzylamino)benzoate has been designed and synthesized which exhibits intense green luminescence in the solid state with a quantum yield of 82%, thus making it as an excellent candidate for use in various photonic applications (*Inorg. Chem.* 2010, 49, 2407–2415).

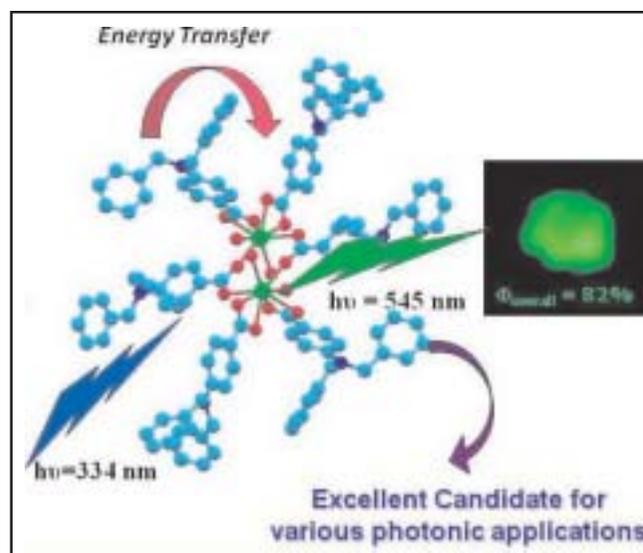


Fig. 1.4 : Highly Efficient Green Emitting Materials Based on Homodinuclear Lanthanide 4-(Dibenzylamino) benzoate Complexes

- ❖ In a project on devising imprinted polymer (biomimetic) based strategies for metal-based drug delivery vehicles, higher and sustained *in vitro* release of “COPPER SALICYLATE”(anti-inflammatory

drug) and “CHROMIUM PICOLINATE” (anti-diabetic drug) was demonstrated for first time based on novel metal-Chelate imprinting concept. Again, micro encapsulation of “FOSRENOL” (lanthanum carbonate) with CHITOSAN functions as “Para cellular Permeability Enhancer” by altering the physicochemical characteristics. Such successful incorporation was tested for de-phosphatization of 0.9% saline and Human Plasma Serum solutions. This resulted in lowering the PILL BURDEN arising out of the enhanced pharmacological effect compared to the un-encapsulated drug.

- ❖ Design and synthesis of a novel iron-catecholate model complex of a tridentate facial *N,N,O*-donor ligand that mimics the ‘2-His-1-carboxylate facial triad’ motif observed in the superfamily of nonheme iron enzymes has been made. *The extradiol cleavage reactivity without the formation of any auto-oxidation product is first of this kind with a model iron-catecholate complex of a 2-N-1-carboxylate ligand (Inorg. Chem. 2010, 49, 4518–4523)*. The iron-catecholate complex is a potential functional model of extradiol-cleaving catechol dioxygenases.
- ❖ A very effective fixation of environmental carbon dioxide was demonstrated in the form of carbonate in an air stable molecular capsule of an easily synthesized tripodal urea receptor followed by regeneration of free receptor from the capsule under mild conditions (*Chem. Commun. 2010, 46, 1082*). This system or similar systems could be potential for capturing aerial carbon dioxide in the form of carbonate capsule from atmosphere.
- ❖ In another work the assembly of a tripodal amide receptor on benzene platform to form dimeric capsule upon encapsulation of acetate/hydrated fluoride/hydrated chloride has been done (*Inorg. Chem., 2010, 49, 943*). This kind of capsular recognition of anions in their hydrated forms would be more useful in developing technologies for the removal of toxic anions such as fluoride from water.
- ❖ Several novel macrocyclic molecules containing pyrrole rings have been synthesized and their anion receptor studies have been carried out by NMR. These macrocycles represent an important new class of expanded calix[4]pyrrole systems. They bind with anions in different binding stoichiometries which are confirmed by Job’s plots. In general these receptors have high affinity of binding with fluoride anion as shown by the binding constants. Interestingly one of the receptors containing dipyrrolylmethane moiety exhibits selective binding with the sulphate anion from aqueous-organic solvent mixture in the presence of other competing anions such as phosphate and nitrate anions. This process of separation of sulphate anion from a mixture of anions in aqueous-organic solvent can be useful for remediation of nuclear fuel waste materials (*Org. Lett. 2010, 12, 3212–3215; Org. Lett. 2010, 12, 3910–3213*).

A review of projects sanctioned under “metal based drugs” program was done and some interesting results obtained in them are given below:

- ❖ Photodynamic therapy (PDT) is a fast developing modality for the treatment of various kinds of tumors and it involves the inactivation of living cells by the combined action of light and a photosensitizer. Of the various photosensitizers investigated so far, the hematoporphyrin derivative (HpD) is currently in clinical use for a number of cancers. However, it has been found that it causes cutaneous



Fig. 1.5

photosensitivity, immunosuppression and more importantly has only a weak absorption in the red region of the spectrum. In this context, a project was given to develop novel and efficient photosensitizers that absorb in the red region and are nontoxic and selective in efficiently destroying neoplastic tissues. Towards this objectives, a series of novel photosensitizers were synthesized based on modified squaraines, porphyrins, chlorins, N-confused porphyrins, porphycenes and their metal complexes and these compounds have been investigated for their photophysical and photobiological properties. Of these systems, the newly synthesized porphyrin derivative (SJR 103) found to localize in the cellular nuclei selectively and exhibits potent PDT activity through apoptosis. The fluorescence microscopic images showing the cellular localization of the porphyrin derivative in the nucleus are shown in the above figure .

- ❖ New iron (III) and oxovanadium (IV) complexes were designed that show photo-induced DNA cleavage activity in red light within PDT spectral window and these complexes show significant photocytotoxicity and poor dark toxicity in different types of cancer cells. This work is expected to help in design and development of metal based agents for potential applications in PDT.

Physical Chemistry

Some of the new projects funded were:

- Development of quasi solid-state photoelectrochemical solar cells with novel nanostructured composite photoanodes.
- Topologically new polymers through controlled molecular architecture: Synthesis of dendritic-linear hybrid multi-armed polymers using TEMPO end-capped and TEMPO anchored dendritic polyurethane core.
- Preparation and characterization of ceramic nanocontainers for biomedical applications
- Theoretical investigation of magnetism in molecules, molecular magnets, and magnetic materials
- Photo-processes of donor-acceptor substituted polyenes in ionic liquid media
- A study on the differential binding and recognition of mononuclear-metal ions at different sites of metallo-apoprotein by MD-simulation methods.
- Development of nano-structured catalysts for hydrogen production by steam reforming of methanol
- Catalytic CO₂ reforming of glycerol
- One- step co-electropolymerized nano conducting polymer-enzyme composite film biosensor for sensitive determination of polyphenol antioxidant
- Novel conjugated polymers for solar cell
- Studies on single source molecular precursors derived from 1,2,3-selenadiazole and transition metals for synthesis of magic sized nano-clusters (MSNCs) and quantum dots (QDs)
- Structure, stability and CO₂ uptake properties of layered hydroxides
- Development and assessment of porous poly l-lactic (PLLA)-silk fibroin-curcumin nano fibres for drug delivery

- Preparation and characterization of mixed metals oxide nanoparticles loaded with noble metals and its photocatalytic applications.
- Quantum dots based chemical and biochemical sensing
- Theoretical investigation of intersystem crossing dynamics in chemical reactions.
- Adsorption and freezing of heteropolymers on disordered surfaces: a model for biomimetic recognition
- Conformation of microhydrated peptides: Laser-desorption jet-cooled studies.
- On the dual electrode behavior of Li_yMXO_4 ($\text{X}=\text{Sn},\text{P}$) compounds: An explorative attempt on a new concept
- Effect of confinement on chemical reactions
- Size and shape controlled magneto-optical nanoparticles for cancer cell imaging and photo-thermal therapy

Some interesting results obtained from funded projects were as follows:

- ❖ The geometries of 1:1 CT complexes in solution using the polarization property of the two photon Rayleigh scattering signal have been determined. There is a significant twist in the geometry of the CT complexes studied here and the actual geometry is not slipped parallel geometry as was believed until now. In solution, thus far, there was no technique that reported deviation from the parallel stacked or T-shaped structure for 1:1 CT complexes. This is the first time it has been observed significant deviation from those two structures. This will open up other researchers to look for different equilibrium solution structures for these types of complexes.
- ❖ A novel technique of using inorganic crystal surfaces as templates for selective growth of polar structures among dimorphic forms of molecular crystal has been developed. The molecule, ZNPPA was studied, and the polymorphs were identified using SHG, x-ray diffraction and microscopy.
- ❖ A variety of amines are known to react with 7,7,8,8-tetracyanoquinodimethane (TCNQ) to yield push-pull diaminodicyanoquinodimethanes with a strongly zwitterionic structure and significant optical and nonlinear optical properties. The author has discovered a novel course of reaction that occurs with 2-methoxy-4-chloroaniline leading to three products in a single pot which could be separated through a simple protocol. This is an interesting case of a single pot reaction yielding different optical materials with attributes that can be switched through simple approaches such as protonation or tuned through modification of the push-pull characteristics.
- ❖ Understanding the role of water in protein folding is an important and challenging problem. To understand the origin of role of water during folding and unfolding transitions of proteins, a long atomistic molecular dynamics (MD) simulations of aqueous solutions of different proteins (HP-36, Hen egg-white lysozyme, barnase) were performed. The investigations carried out so far indicate that correlations exist between the partial unfolding of a protein and the microscopic properties of water around it. The extent of such correlations may depend on one or more of the following factors (i) nature of the secondary structures of the protein (ii) local motions of the residue side chains (iii) exposure of the residue side chains to water.

- ❖ The unusual two fold increase in the counter ion binding capacity of AOT when the concentration of the added NaCl becomes about 0.02 mol kg⁻¹ has been confirmed. It has been shown that at this particular concentration of NaCl the aggregation number of AOT and the polarity of the micellar interface change suddenly. Shift in the polarity of the interface occurring at about 0.02 mol kg⁻¹ NaCl is found to be dependent on the probe used and hence the sites of residence of probes in the AOT micelle are different. Through SANS experiments the author could show that at about 0.015 mol kg⁻¹ NaCl the shape of AOT micelle changes from prolate spheroid to rod-type revealing thereby the shape change of AOT micelle as responsible for the sudden two-fold shift in the value of \hat{a} .
- ❖ The application of less familiar ethylene glycol-AOT reverse micelle for the synthesis of silver nanoparticle using glucose as mild reducing agent and isooctane as the continuous media has been reported. The pure ethylene glycol-AOT reverse micelle and the perturbed reverse micelle (containing silver nanoparticle in its womb) through solvation dynamics measurement using steady-state and time-resolved fluorescence spectroscopy has been made. Finally, the results were compared to get the valuable information about the perturbed reverse micellar system containing silver nanoparticle. Through the work, it has been found that in the pure reverse micellar system, with increasing ethylene glycol loading, solvation time was decreasing and anisotropy value became slower. In the perturbed reverse micellar system (containing silver nanoparticle) having the same environmental state, that is, at the same ethylene glycol content, solvent and rotational relaxation became slower and faster, respectively.
- ❖ Nine transition metals complexes with ferrocenyl dithiocarbamates have been used as novel photosensitizer in the light harvesting solar cells. Out of the nine compounds, nickel complex, copper complex and platinum complex showed maximum light harvesting capacity. Hence, it can be concluded that the ferrocenyl dithiocarbamates complexes possessing square planar geometry have got the potential to become efficient photosensitizer for their use in the DSSC.
- ❖ Correlation study of ion transport with structure was carried out. Ionic conductivity was measured across the solid-solid state and melting transitions in the temperature range from -47 to 70 C. The system measured are; LiClO₄-SN; LiTFSI-SN; NaCF₃SO₃-SN. In all the above systems it was found that the ionic conductivity is influenced by the *trans-gauche* isomerism in dilute concentrations of the salt. It has been found that *trans-gauche* isomerization is important only for dilute salt concentrations and trace amounts of impurities such as water. At higher salt concentrations detrimental solvation effects become important and have to be taken into account for optimization of materials properties.

Green Chemistry

Some of the new projects supported were:

- Development of eco-friendly processes for producing Guaifenesin and p-Amino phenol using green catalysts.
- Development of environmentally benign syntheses of library of analog-based designed molecules as topoisomerase II inhibitors, and to perform their bioevaluation studies
- Preparation of cost effective “reusable catalyst” which will emerge as potential catalyst imparting high regio and chemo-selectivity in various chemical transformations.

Some interesting results are given below:

- ❖ The processability of Polylactic acid (PLA), a difficult to process biopolymer due to its brittle nature, was improved with the addition of Poly(butyleneadipate-co-terephthalate) (PBAT), an elastomeric thermoplastic. With the incorporation of 25% PBAT, the material could be easily processed without compromising its inherent properties such as modulus and tensile strength. The properties were further improved in the case of PLA/PBAT blend nanocomposites, which can be used for making injection molded or thermoformed products like plastic trays, shampoo bottles, cups etc.
- ❖ The effect of nanoparticles on the biodegradability behaviour of PBAT was also studied. Various organomodified layered silicate nanofillers, viz. C30B, C20A and B109, in varying ratios have been incorporated and the performance of nanocomposites was examined. It was observed that maleic anhydride grafted nanocomposites showed better performance confirming improved interaction between the clays and polymer after grafting. Further, the rate of biodegradation of PBAT increased with the addition of natural montmorillonite. Therefore, PBAT nano composites could be effectively used for packaging applications. These bio based nano composites find application in the area of packaging. Thus the development of bio based nano composites could also help in solving the issue of plastics disposal.

The following Patents were filed out of the results from various projects funded in the area of Chemical Sciences.

1. An improved method for the one step conversion of benzene to phenol with very high benzene conversion of 42% and high selectivity for phenol of 95%. This may lead to good commercial potential since currently phenol is commercially produced from benzene by three step process.
2. Catalytic preparation of enantiopure syn- or anti- alkoxy- and azido epoxides and their corresponding diols. A novel method has been found that employs HKR of recemic alkoxy and azido epoxides to generate two stereocentres of high purities in a single step.
3. A new regiospecific process for azidoination of olefins using NaIO₄-KI-NaN₃. The NaIO₄-KI-NaN₃ combination has been found to be an efficient, simple and inexpensive reagent system for azidiodination of alkenes. The regiospecific 1,2- azidiodination proceeds in an anti-Markovnikov fashion to produce α -iodoazides in excellent yields.
4. Aziridination of olefins. A new efficient protocol for the aziridination of olefins mediated by NaIO₄ as an oxidant and LiBr and Chloramine-T as a bromine and nitrogen source respectively has been described. Interestingly, the mechanism shows that, the formation of aziridine proceeds via bromoamination reaction in all the cases studied.
5. A novel Process for the Alkylation of Phenols. It relates to an improved process for the selective alkylation of phenols with catalyst regeneration. It provides a high yielding and selective process for the tert-butylation of phenol in liquid phase along with regeneration of the catalyst i.e. to obtain 100% conversion and around 95-97% selectivity towards p-tert-butylphenol under mild reaction conditions.
6. Novel porphyrin derivatives for photodynamic therapy (PDT): A Process for the preparation thereof and their use as PDT agents and fluorescence probes for biological applications.
7. A method for detecting analyte. The application relates to a method of detecting analytes using non-aromatic dendritic macromolecules. The inherent photoluminescence of dendritic polymers, namely,

poly(propyl ether imine) (PETIM) dendrimers, is affected significantly in the presence of nanomolar concentrations of analytes, thereby forming the first instance where-in a non-aromatic dendritic polymer is employed to detect analytes.

EARTH SCIENCES

The Earth Sciences Programme is guided by a Galaxy of experts viz. the Programme Advisory Committee on Earth Sciences (PAC-ES). The scope of the programme includes study of Earth and Earth System Processes – it's coupling with the atmosphere & oceans. In this programme, individual R&D proposals attempting to carryout research in forefront areas of earth sciences are being supported. Various co-ordinated programmes were evolved during the year of report wherever an integrated approach to understand a problem / phenomena is felt. During the year of report, projects related to Palaeoclimate Studies, Tectonic Geomorphology, Geo-hydrology were supported in addition to the ongoing activities of the PAC-ES. Around

- 50 research projects were supported under the scheme during the year. As part of manpower development several contact programmes /training programmes were conducted in areas of national / global interest. The Programme Advisory Committee on Earth Sciences, in addition to recommending projects to be funded also shouldered the responsibility to scout for talent to take up specific research problems, identified gaps in research and helped the scientist in developing new research ideas.

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

Completed Projects

Lower Paleozoic acritarch biostratigraphy of the Kinnaur basin

Under the project, Ordovician-Silurian acritarchs were reported by the P.I. from Vinoba Vabe University, Hazaribagh. It was also reported the first indubitable chitinozoans with a time range from the upper Darriwillian to Katian(Upper Ordovician) from the Shiala Formation of Tethyan Garhwal Himalaya. The yield of Chitinozoa is rich, well-preserved and poorly diverse. The morphological details are often retained. The Scanning Electron Microscopy (SEM) observations left no doubt as far as authenticity of these Chitinozoas are concerned. The findings revealed that the majority of Lower Palaeozoic Gondwanan land were situated at high latitude and north India is one of the few areas where we can study low latitude Lower Palaeozoic sequence on Gondwana. The Ordovician-Silurian boundary is known to be the global crisis of life due to a glaciation occurred for a brief period. The age assigned by the chitinozoans is very much consistent with the conodont age.

Study on fluoride geochemistry and its pathways to food chain in the fluoride endemic areas of Birbhum district, West Bengal with an approach to develop a defluoridation technique by geomaterials

Under the project, the effects of high-fluoride environmental background on crops and human health in the Fluoride contaminated irrigation water-type fluorosis-diseased areas of Birbhum district, West Bengal were investigated in detail. The samples were collected from local water, paddy soil, rice, whole vegetables and soils around their roots for chemical analysis, and the result were compared with those of the control groups in fluorosis-free areas, which are otherwise similar to the fluorosis-diseased areas both in natural background and in social background. The study indicates that rice and vegetables can accumulate water-

soluble fluoride either in soils or in irrigating water, and different crops have different abilities of fluoride absorption from the system. The fluoride content in different parts of vegetables collected from the fluorosis-diseased and fluorosis-free areas were statistically categorized. Moreover, different parts of a crop also showed significantly different fluoride fixation abilities. It was demonstrated that the fluoride contents of the strongly metabolic parts were relatively high. For example, the fluoride contents of roots, leaves and flowers of vegetables are much higher than those of stems.

Deformation and volume change during ductile shearing in the of the Kumaun Lesser Himalaya of Amritpur-Bhimtal area

The above project aimed at deciphering the structural geometry and the deformation pattern in the outer Lesser Himalaya. For this, three critical sectors in the rocks, ranging from the footwall of the Main Boundary Thrust in the south to the hanging wall of the Ramgarh Thrust in the north, were selected for detailed geological and structural mapping, and the structural analysis (Fig. 1.6 after Valdiya, 1980). These sectors are referred as Amritpur sector, Khairna sector and Ramgarh sector (Fig. 1).

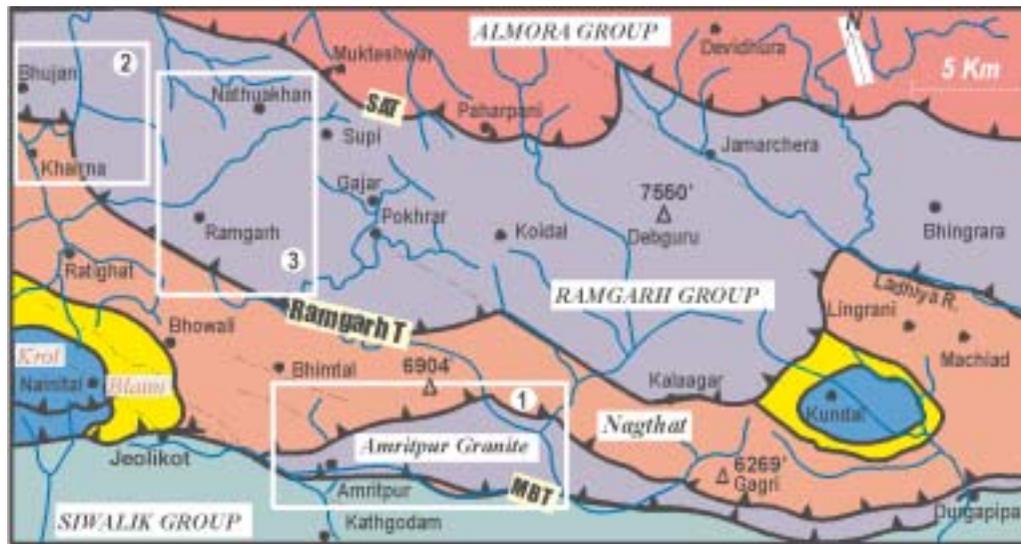


Fig. 1.6: Geological setting of the study area (after Valdiya, 1980). White rectangles define three critical sectors that are selected for detail structural studies. 1- Amritpur sector, 2- Khairna sector, and 3- Ramgarh sector.

It has been reported that the Main Boundary Thrust cuts through the large scale syncline, namely, the Ranibagh syncline in the Middle Siwalik sandstone beds. The Precambrian Amritpur granite has two mappable components: (i) the older mesocratic and porphyritic granite and, (ii) the younger leucocratic granite. The contact between these two types of granites is commonly faulted. It is the younger leucogranite that is juxtaposed mostly against the Siwalik Group of rocks along the Main Boundary Thrust. A new thrust, namely, the Chamaria thrust is mapped, within Ramgarh Thrust sheet, along the contact between the Ramgarh granite and the Nathukhan Formation. Structural analysis of the mesoscopic fabric data coupled with the outcrop scale overprinting relationships and the map pattern reveal a common deformation plan for the Nagthat Formation, the Ramgarh granite and the Nathukhan Formation. Results of palaeostress analysis from the striated faults and the mesoscopic kink folds imply the deformation of the rocks Lesser Himalayan duplex in all the three types of tectonic regime, thrust, strike slip and normal fault type during the Himalayan orogeny.

Fluvial Dynamics and Subsurface Stratigraphy of the Gandak Megafan.

The work completed under the above project provides the answer to many important questions such as control of climate and tectonics in the evolution of ganga plain, recharging of ground water, lateral erosion as an independent natural hazard even during low discharge period, spreading of water due to low water storage capacity of the basin, which causes flood during heavy rains and natural drainage for this ground water fed rivers which were earlier considered as tectonic in origin, and strong monsoon in the past besides the basic conclusion related with the palaeodynamics, facies of the channel, interchannel and subsurface deposits, geochemical, environmental magnetism and palynology of the Chhoti Gandak river basin.

Ongoing Projects

National Programme on Isotope Fingerprinting of Waters of India (IWIN)

Under the above IRHPA project, A multi-institutional collaborative national research programme on Isotope Fingerprinting of Waters of India (IWIN), funded jointly by the Department of Science and Technology (DST), New Delhi and Physical Research Laboratory (PRL), Ahmedabad is currently underway. IWIN aims at isotopically ($\delta^{18}\text{O}$ and δD) characterizing the Indian hydrological cycle, across all its components, namely marine source waters of Arabian Sea and Bay of Bengal, atmospheric water vapor, rainwater, groundwater and river water. The scientific objectives of IWIN are to better understand the atmospheric, surface and sub-surface processes involved in the formation of marine vapor and its lateral inland movement, rain formation, rain-out, evaporation from falling rain drops, evapo-transpiration, mixing with the terrestrial vapor, partitioning of rain into groundwater and stream flow, and quantitative estimation of contribution of various constituent components such as snow melt, groundwater and rainwater to river discharge.

A sampling network of about 150 stations across the country has been established from where samples of atmospheric vapor, rainwater, ground water and river water are being collected on fortnightly or monthly basis. A new Stable Isotope Ratio Mass Spectrometer (IRMS) laboratory equipped with state of the art Delta V Plus IRMS (with GasBench II), has been set up at PRL, Ahmedabad (Figure 1.7).



Fig. 1.7: IWIN-IRMS laboratory at Physical Research Laboratory (PRL), Ahmedabad

Calibration with International Standard Reference Material (VSMOW2, SLAP2, and GISP) obtained from International Atomic Energy Agency (IAEA), Vienna has been successfully completed. New insight about rain-vapour interaction and glacial melt contribution to Ganga river water discharge at Rishikesh has been obtained which has been accepted for publication in reputed peer-reviewed journal.

National Core Archive and Analysis Facility at Indian Institute of Technology, Kanpur

A National Core Archive and Analysis Facility at IIT Kanpur (Fig. 1.8) has been set up as a part of the Science of Shallow Sub-surface (SSS) programme. The main objectives of the Facility are to archive the drill cores, preserve and log them and to make them available for further studies to the researchers across the country. The primary focus is to develop a database for the shallow subsurface zone of the Ganga plains. Core analysis lab houses a drill core scanner and a core cutting machine. Sedimentology lab is equipped with Sediment dispersion and mixing unit, High temperature furnace, Rotary flask shaker, Low temperature oven and drier, thin section preparation unit, Clay mineralogy, sample preparation setup and Distillation unit. Wet lab is being used for wet analysis of cores. Instruments in this lab are Digital flame photometer (Elico, CL-360 for Na & K), Centrifuge pH/Conductivity/Ion analyzer (Eutech, Cyberscan PC5500), and Spectrophotometer (Systronics 106). Microscopy & environmental magnetism lab houses Petrological microscope, Stereo zoom microscope (Nikon, SMZ1000), Image Analysis System (Leica), and Bartington Magnetic Susceptibility Meter (Bartington).



Fig. 1.8: National Core Archive and Analysis Facility at Indian Institute of Technology, Kanpur

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

Nine new vertebrate yielding sites in the Upper Triassic Tiki Formation representing a mass burial event has been reported under the project. A large number of vertebrate fossils belonging to various groups of reptiles have been collected from the above site. Another important finding of this project is the discovery of dinosaur remains for the first time from the Bagra Formation of Central India. Considerable progress has also been made on palaeohistological studies of various Mesozoic vertebrate groups which is one of the main objectives of the project.

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 (KP) and Firozpur (FP) core have been measured. The $\delta^{18}\text{O}$ values of soil carbonate analyzed from the three cores range from -8.3 to -4.1 ‰. The $\delta^{18}\text{O}$ variations in $\delta^{18}\text{O}$ values from the cores suggest that during 100 to 18 ka interval, the monsoon intensified at around 100, 40 and 25 ka. Although, marine records show relatively high monsoon during MIS 3 (57 to 25 ka), drier phase observed at around 50 and 35 ka indicate high wind speed in ocean does not always maintain continental wetness. The estimation of rainfall variations using $\delta^{18}\text{O}$ isotope effect show 7 to 20 % change and the maximum lowering (~ 20 %) is observed around 18 ka corresponding to the Last Glacial Maxima (LGM). The results demonstrate that change in rainfall is one of the controlling factor for the floodplain aggradation and degradation.

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, Robotics and Automation. During the year, support to both basic and applied research was continued. The Committees regularly monitored the progress made in ongoing projects. Several interesting and significant results were reported from these individual engineering science programmes, are given below:

Chemical Engineering

Chemical Engineering Programme (CEP) continues to achieve a decent balance between productivity and excellence in exciting frontline areas, involving quality fundamental research. In addition to a good number of publications in quality Journals, many of the studies would eventually create a base or find direct application in terms of process development and commercial practices. SERC Schools and workshops were conducted during the period, primarily aimed to target people from Universities, NITs and other Institutions to take up challenging R&D activities.

A major project has been formulated during the period to investigate protein and nanoparticle interactions with supported Bilayer membranes.

Salient features of the output generated from a basket of about 150 ongoing projects and 18 new projects (sanctioned during current financial year) are reported underneath.

- ❖ The intelligent processing of advanced polymeric materials through controlled extruder monitoring was carried out to reduce production variability and to improve the industrial practice of compounding non-reactive polymer systems including nanostructured materials. The proposed work have been conducted for a number of rheologically different materials and their combinations like polypropylene/nanoclay composites; polylactic acid (PLA)/polyethylene (PE) blends, nanocomposites and blown films; polypropylene/clay/DBS composites and films; polypropylene/polystyrene/SEBS/clay systems; and polysiloxane / POSS nanocomposites.
- ❖ Investigated thermophysical properties of simple fluids, colloidal system and normal alkanes confined in nanoporous materials of various surface morphologies, with pore size less than 40 molecular diameters, display significant deviation from that of the bulk state. The properties such as relative shift

(with respect to bulk) in pore critical temperature display different linear regimes with pore width, which becomes more prominent for stronger surface field. The pore critical temperature monotonically approaches 3D (bulk) values with increase in pore width when the pore width is beyond 40 molecular diameters. The pore critical density and pore critical pressure follow a non-monotonic path while approaching bulk values. Interfacial properties also approach bulk values with increase in pore width. And also, the vapor-liquid surface tension under nanoscale confinement decreases substantially as compared to the bulk values. The surface tension at a reduced temperature (T/T_{cp} , where T_{cp} is the pore critical temperature) displays a non-monotonic behavior while approaching to bulk value, with the change in pore width. A similar behavior is observed with corresponding vapor-liquid interfacial width. It is a significant practical interest to look at the crossover in fluid phase properties from 3D to 2D-like behavior.

- ❖ Runs have been conducted in a stirred batch reactor to generate the data for kinetic model development in the esterification reaction and also conducted in distillation column for esterification reaction with varying inputs. Developed a dynamic model incorporating startup period and validated. The model is employed to develop the optimal operating conditions (reflux ratio, heat input to reboiler and methanol to acetic acid mole ratio in the initial charge) using genetic algorithm, and also to determine the optimal temperature set point trajectories that result in maximum yield of methyl acetate.
- ❖ Developed a rapid, green process for the formation of size-controlled metal nanoparticles. This paves the way for large-scale continuous flow manufacturing of monodisperse metal nanoparticles. A simple RF plasma based process for gentle removal of ligands without disturbing the ordering of nanoparticles imparts thermal stability. This finding is being used to develop a robust Surface enhanced Raman Spectroscopy (SERS) substrate that can be used to detect traces of organic compounds.
- ❖ A new sub-branch in frontal polymerization (FP) triggered by trace amounts of water was established. Triggering conditions such as type and concentration of red-ox couple and volume of water on front velocity, front temperature and shape of front were investigated. Helical and layered patterns formed in FB due to the imbalance in the heat generated in the reaction zone and the heat diffused in the next layer were analyzed. Developed a mathematical model to describe the phenomenon. The model predicts qualitatively the ramp wave and spiral wave motion as observed under scanning electron microscope (SEM).

Electrical, Electronics and Computer Engineering

Over the last six years, Electrical, Electronics and Computer Engineering Programme (EECEP) has evolved into a front runner in terms of efficiency, productivity and responsiveness. There had been a significant increase in volumes (both numbers as well as funding).

One major project has been formulated during the period around a state of art facility (RTDS) coupled with expertise building and are expected to deliver high level research.

Twenty four projects are sanctioned during current financially year. Some of salient features are reported underneath out of the 150 ongoing projects.

- Developed efficient methods for communication, computation, and coverage problems, which are fundamental and challenging in wireless sensor networks. Wireless sensor networks are highly

distributed networks of small, light weight wireless nodes, deployed in large numbers to monitor the environment or a system by the measurement of physical parameters such as temperature, pressure, and relative humidity. Sensor nodes can be used in military, health care, chemical processing, and disaster relief scenarios. Networking among a large number of sensors gives rise to a robust, reliable, and accurate information-gathering system covering a wide region.

- A novel patch based occlusion handling approach is proposed to detect foreground objects and recognizes the activities of the objects in the presence of occlusion (i.e. visually a person is hidden by another person or objects like walls, pillars, bags, etc.). The system is capable of tracking multiple human objects for real-time video surveillance and video anomaly detection applications. The system can be used to detect abnormal actions like gun shooting, collapse, fighting, punching, etc in the crowded environments such as railway stations and airport.
- Developed analysis algorithm for proper classification of PD patterns from noisy waveforms without denoising them. The cross-wavelet transform of recorded PD signals is an efficient technique for feature extraction from noisy PD pulses. The data table obtained after the extraction of the features may contain imprecise or superfluous information. Features extracted from cross-wavelet spectrum along with Rough-Set classifier are found to be effective for PD pattern classification. The integrated unit can acquire the PD pulses and can classify the PD patterns from the raw recorded signals. The developed method can be easily incorporated in an automated and intelligent PD detector that requires minimal human expertise during its operation and analysis. This enables the system to work in stand-alone and self-sufficient manner, which will be useful in both laboratory and on-site measurements.
- Developed a checkpointing infrastructure for multi-phase parallel applications, and a novel scheduling algorithm called Box Elimination (BE) to determine the sets of resources on which the application is migrated. And also, developed rescheduling algorithms to consider application dynamics for migrating an executing application between the phases. The scheduling and rescheduling strategies combined into a robust grid middleware framework called MerITA (Middleware for Performance Improvement of Tightly Coupled Parallel Applications).
- Developed a model for video data associated with dynamical objects and applied to deal with echocardiogram data. Developed a new SQL like video query language for specifying query regarding the object characteristics in echocardiogram video. The model has also been used for dealing with other class of videos, e.g. sports videos. Video indexing algorithms have been developed for echocardiogram view detection and view classification. Algorithms for echocardiogram analysis have also been designed. A new approach called “Radial M mode” analysis has been developed to identify cardiac sub states from color flow Doppler 2D video. This approach generates number of M-modes along a radial direction from the upper part of the echocardiogram frame. These M-modes are subsequently used for detecting sub states in systole and diastole. A prototype database on MSSQL Server 2000 has been implemented and a Graphical User Interface has been designed for executing queries in video query language and for displaying the results. The system has been tested with echocardiogram videos captured in different hospitals.
- Developed a scheme for parsing news video. An HMM based classification system has been built which can do simultaneous segmentation and characterization of the video sequence into a number of broad semantic categories. The system is unique in the way it leverages both aural and visual features extracted from the video in an integrated way. The system has been demonstrated for parsing news

video into semantic categories like: news reader sequence, field reports, headlines, interview in studio, interviews in the field. And also developed a scheme for identifying perceptually prominent objects in a given video sequence, Ontology Language for Multimedia, view synthesis scheme using uncalibrated views and Intelligent Video Summarization System.

Material, Mining & Mineral Engineering

During the year, support to both basic and applied research was continued. 17 new research efforts have been initiated / identified for support and another 34 are under evaluation.

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

- Development of Carbide Austempered Inoculated Low Carbon Equivalent Iron.
- Effect of Surface Nanocrystallization on Fatigue Life of Aeronautical Alloys: Timetal 834 and Superalloy IN718.
- Investigations on multifunctional properties of alkaline earth and rare earth doped BiFe-xO₃ solid solutions.
- Microstructure-Texture-Toughness relations in high strength automotive steel.
- Development of Nanocrystalline Ni-P Coatings by Mechanical Attrition Assisted Electrodeposition for Automotive and Engineering Applications.
- Novel Multifunctional Nanocomposites made of Epoxy Reinforced with Carbon Nanocoil coated Carbon Fiber for Structural Applications.
- Mineral Biotechnology for Mineral Beneficiation, Metal Extraction and Mining Environmental Control-Ramanna Fellowship.
- 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 M₃AX₂ 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:

- ❖ DLC/DLC:N films were grown on silicon, glass, steel and Ti substrates using a 3 kW microwave plasma CVD (MW-PACVD) system (Seki Technortron, Japan) at RRL, Bhubaneswar. Many experiments have been conducted to establish the suitable growth regime of DLC. The most important parameters that affect growth of DLC are: pressure, CH_4 flow rate and ratio, and substrate bias. A set of experiments for N doped DLC films have been tried using NH_3 was used. In the MW plasma reactor, even though the deposition was for 2 hours, the maximum thickness of DLC and DLC:N that could be grown was 60 and 40 nm, respectively. To test the multilayer design, a few multilayer of DLC:N have been grown. Adherent and hard diamond like carbon (DLC) films are useful coating materials for applications in wear and tribology, as protective and bio-compatible coating, scratch resistant and decorative coatings etc. DLC film is suitable for the above mentioned applications because of its high hardness, low coefficient of friction, smooth surface morphology, bio-compatibility and useful optical properties. Usually DLC coatings thicker than 200-500 nm peel off because of high residual stress in the film. In an effort to grow thick adherent DLC film and to achieve high hardness it was planned to deposit multilayer of DLC and DLC:N (N doped DLC) films.
- ❖ Development of Zn-TiO₂ Nano Particles Composite Coating for Industrial Applications are under progress at KU Shankaraghatta, Karnataka. The zinc-TiO₂ composite coating was obtained from the optimized zinc plating bath solution. A series of plating bath solutions containing 0, 1, 2, 3, 4 and 5g/l of Degussa TiO₂ particles of size 35 nm in nano scale were prepared. The coating was generated on mild steel using these solutions and the coating was designated as C₀, C₁, C₂, C₃, C₄ and C₅ respectively. The anodic polarization studies showed that, composite acquire higher corrosion potential when compared to pure zinc coating. And the corrosion resistance property of the plate increased with increase in TiO₂ particle concentration in plating bath. Further the Tafel polarization data indicated higher corrosion potential for all the composite coating surfaces when compared to bare zinc coating.
- ❖ Ultrasonic processing of magnesium alloy melts is under progress at IIT, Roorkee. Ultrasonic treatment of molten metal would be investigated both experimentally and theoretically. High intensity ultrasonic waves have ability to induce fluid flow and cavitations effects in the fluid. Magnesium and aluminum alloy melts would be ultrasonically treated before and during solidification and the micro structural evolution would be studied. Effect of the treatment on grain refinement, homogenization, size, and morphology of second phase would also be studied. A theoretical model would be developed to simulate fluid flow and heat transfer phenomena occurring because of ultrasonic vibration. Preliminary study has been done which will reduce casting defects and provide uniform and homogenous properties of melt through out the cross-section.
- ❖ A study regarding the effect of Rare-earth dopants on thermal stability and fracture toughness of nanocrystalline zirconia-based thermal barrier materials is under progress at IIT Madras, Chennai. The main objective of the project was to study phase stability, microstructural stability and fracture toughness of nanocrystalline TBC materials, namely rare-earth (Yb and Gd) stabilised zirconia materials. Compare the behaviour of nanocrystalline materials and those made by EBPVD. The results would help in devising strategies for developing high performance TBC's (temperatures >1150°C, up to 1350°C). Dense compacts of dYSZ, dGdSZ and quaternary 5Yb-1.5Gd-1.5Nd stabilized zirconia were developed using spark plasma sintering as well as free sintering. Electron beam physical vapour deposition (EBPVD) of YSZ on alumina and metallic substrates was carried out.

- ❖ Reinforcing white nano fillers for environmental friendly rubber products is under progress at IRMRA, Thane, Mumbai. The institute has successfully synthesized and characterized the Nano ATH (Aluminium trihydrate), Nano CaCO_3 and Nano Silica. He compared the properties of nano ATH, Nano CaCO_3 and Nano Silica rubber composites with carbon black and other available conventional/ Nano white filler rubber composites. It also modified the surface of Nano ATH, CaCO_3 and Nano Silica to improve polymer-filler interaction and thereby improve its reinforcing capability in rubber matrices. Replacement of carbon black fully with ATH or nano ATH is expected to improve physicommechanical properties as well as flame retardant properties making it suitable for automobile industry as well as in non tyre sector.
- ❖ Investigation of mechanical properties of basalt fiber reinforced polymer composite is under progress at Kalasalingam University, Krishnankoil, Tamilnadu. This project focus on the investigation of Mechanical properties of Basalt fiber reinforced polymer composites. Composites were fabricated by hand lay up and compression moulding (partially completed) methods. Thermosetting General Polyester resin was used as matrix material. Tensile, Shear, Bending and Impact tests were conducted for the fabricated composites as per ASTM standard to study the mechanical properties of the composites. All the tested, specimens were examined with the help of scanning electron micrograms, to understand the nature of fracture. It was found that the basalt fiber composites treated with Acid (H_2SO_4 treated) exhibit better performance compared to untreated and base treated composites in all the testing such as tensile, impact and shear. The basalt fiber composites may find their application in car body, filler for car mufflers, automotive equipment, high-pressure pipe and vessels, boat building, wind power generator and will serve as an alternative material to the glass fiber composites.
- ❖ Spark Plasma Sintering of Bioceramic Composites is under progress at IIT, Kanpur. Spark Plasma Sintering (SPS) facility was established in 2008 at Department of Materials and Metallurgical Engineering with financial contribution from Department of Science and Technology and CARE grants of IIT kanpur. This enables superfast consolidation to make dense ceramics, metals and powder metallurgical materials and was the second one in our country. The facility was currently installed in the Laboratory for Biomaterials. SPS is one of the variants of the field activated technique (FAST). Typically, holding time of 5-10 minutes at sintering temperature is sufficient to densify the materials in SPS process and total processing time is less than an hour. SPS is capable to consolidate difficult-to-densify materials. The results of the Spark Plasma Sintering experiments carried at the institute under the project reveals that fully dense (~98%pth) Hap-20% mullite composite can be obtained after spark plasma sintering at 1100°C for 5 minutes, whereas the same composite composition with equivalent density requires pressureless sintering at 1350°C for 2 hours.) The hardness measurements reveal that a high hardness of more than 7 GPa was achievable after spark plasma sintering at 1100°C for 5 minutes, whereas a maximum hardness of 3.5 GPa was measured in pressureless sintering route.
- ❖ Study on reactive processing of transition metal borides, carbides and nitrides is under progress at NAL, Bangalore. The transitional metal boride (TiB_2 - ZrB_2 and HfB_2 -based) composites have been considered for various applications including cutting tools, wear resistant parts, armors etc., nose caps for reentry vehicles, thermal protection systems, because of their high melting temperature ($>3000^\circ\text{C}$), high hardness (20-30GPa), high modulus (400-500GPa) and high temperature strength. Among them, especially ZrB_2 - and HfB_2 -based composites, referred as ultra high temperature ceramics (UHTCs) have been projected as potential candidates for applications where temperature exceeds $>1800^\circ\text{C}$. Since the melting points of UHTCs are very high, processing them to produce dense

bodies has traditionally required temperatures in excess 1800°C. Recently, it has been demonstrated that reactive densification under pressure can bring the temperature down by several hundred degrees. The present investigation was undertaken to understand the role of variables that promote such low temperature densification in composites containing ZrB₂, TiB₂, TiC, TiN, TiN and ZrC. The composites were produced by reactive hot pressure (RHP) of Ti/Zr, BN/B₄C/C powder mixtures. The role of small additions of transition metals (e.g. Ni, Cr) and rare earth (La) is under progress.

- ❖ Synthesis of dense, uniform and adherent Bulk Metallic Glass coating on different types of materials (mild steel, stainless steel and Zr-based alloys) are under process at IIT, Kanpur. Mechanical alloying/milling will be used as the production route for the BMG powder (Zr-based, Ni-based and Fe based) as well as in-situ method to develop coating. (this will be done for the first time using mechanical alloying/milling as a process to develop BMG coating). Industrial collaboration will be sought to pass the technology developed to the industry. In the present case, the mechanism for the formation of in-situ coating of Fe₈₀Si₂₀ alloy on mild steel substrate by high energy ball milling has been studied. Though, 150-200 micron thick nanocrystalline Fe-Si coating has successfully been developed on the mild steel coupons, corrosion behavior has suggested that the coating also contains some localized regions of pure Fe. The origin of these localized Fe deposits is mainly the course of coating formation. Further, he informed that a new mill (Stampcoat mill) for coating purpose has been designed, Patent of which will be filed soon.
- ❖ Piezoelectric thin films for actuator applications is under Development at MET, Thrissur. Piezoelectric thin films of lead zirconate titanate (PZT), have received significant attention in view of their application in micro electro mechanical systems (MEMS). The present work mainly concentrated on the development of good quality PZT thin films (Zr/Ti=53/47) for microactuator application using the chemical solution deposition (CSD) route. In order to overcome the inherent limitation of CSD method such as shrinkage of thin film which leads to cracks, the substrate Pt/Ti/SiO₂/Si was pre-coated with SrTiO₃ (ST) template layer. The careful control of solution chemistry along with ST template layer was utilized for the fabrication of dense, crack free PZT thin films using spin coating technique. Also the work aimed at establishing the suitability of such deposited PZT films for MEMS application by determining the transverse piezocoefficient, e₃₁ by measuring the piezoelectric vibrations of PZT/Si unimorphs, of specific dimensions.
- ❖ Development of High Strength Ultra Fine Grained Dual Phase Steels through Thermo-mechanical Processing is under progress at IIT Madras, Chennai. Ultrafine grained (UFG) metals and alloys exhibit superior mechanical properties (combination of ultrahigh strength with uniform elongation), which have led to renewed interest and new directions in the metallurgy of traditional metals. Cold rolling with subsequent intercritical annealing is one of the promising methods of producing dual phase microstructures. Dual phase (DP) steels are widely used in automotive applications. The present project aims at development of UFG ferrite-martensite microstructures in Nb-microalloyed steel through different processing routes involving combination of cold rolling and intercritical annealing. The microstructure, microtexture evolution of the processed materials will be investigated as a function of deformation, annealing temperature and time by using various characterization tools like scanning electron microscope with electron back scatter diffraction (EBSD), transmission electron microscope and differential scanning calorimeter.
- ❖ Development of Scandia stabilised zirconia electrolytes with rare earth co-doping for solid oxide fuel cells is under progress at IIT, Chennai. Solid oxide fuel cell (SOFC) is an electrochemical system

which generates electricity with high efficiency without harmful emissions. The high oxygen ion conductivity of stabilized zirconia (ZrO_{23}) over wide ranges of temperature and oxygen partial pressure makes it a suitable material for the electrolyte in an SOFC. Scandia stabilized zirconia (SSZ) shows the highest ionic conductivity among all zirconia based oxides. Therefore SSZ electrolyte can potentially reduce the operating temperature of an SOFC. It is, therefore, proposed to co-dope SSZ with small amounts of rare earth oxides (e.g. $YbO_{1.5}$, $GdO_{1.5}$ and CeO_2) with the aim of obtaining kinetically stable cubic phase to minimize the aging effect. The possible effects of co-doping on conductivity and aging behaviour were investigated.

- ❖ Development of Hollow fiber contained liquid membrane system with strip dispersion for recovery of metal values is under progress at Jadavpur Univ., Kolkata. In India many useful metals having considerable market values like Vanadium, Titanium, Nickel, Cobalt etc. are naturally occurring in ores in small proportions (< 1%) with other minerals. These ores when processed will yield very dilute solutions of more than one metal ion. Separation and concentration of these ions by the conventional processes of solvent extraction is not economically attractive due to high equipment and operating cost and poor recovery due to equilibrium limitations. In the proposed study, a single hollow fiber membrane module with strip dispersion was studied as a liquid membrane contactor for continuous simultaneous extraction and stripping of metal ions like V, Co and Ni from dilute aqueous solution. Considering the potential of Liquid Membrane technology in the above separation and suitability of Hollow Fiber contactors with strip dispersion as a Liquid Membrane contactor, the proposed study has relevance in the present scenario.

SERC SCHOOL Under Material, Mining & Mineral Engineering

The DST-SERC sponsored school on texture and microstructure was organised by the Department of Metallurgical and Materials Engineering at the Indian Institute of Technology, Madras from 25-10-2010 to 29-10-2010. This was attended by 25 participants consisting of faculty, scientists and research scholars from different institutions / laboratories across the country. The feedback on the program was also obtained from the participants and this will be used to structure the future programs.

Mechanical, Civil Engineering and Robotics

The PAC on Mechanical & Civil Engineering, Robotics & Manufacturing supported 37 proposals out of a total of 92 projects received by the PAC till 31.10.2010. It had 3 meetings during the year during which it reviewed 29 ongoing/ completed projects. Some of the highlights of the projects that were supported under the PAC are given below:

- **Experimental and analytical studies on fiber reinforced soils: (Civil-IISc)**

The team would like to study comprehensively about fibre reinforced soils as foundation materials for buildings and even road construction.

- **Behavior of FRP laminated smart sandwich structures having interlaminar imperfections under hygro-thermo-electro-mechanical loading (Civil-IIT Roorkee).**

The PI proposes hybrid efficient finite element model (FE model)/ technique for analyzing smart sandwich structure having inter-laminar imperfections.

➤ **Investigation into hard turning of hard chrome plated surfaces (Manufacturing-CMTI Bangalore)**

The proposal aims to investigate hard turning of chrome plated surfaces and to further analyze the output in order to look at hard turning as replacement for grinding which is complex and expensive.

➤ **Development of earthquake risk analysis system for RCC frame structure on Grid computing (Interdisciplinary) SGSITS – Indore and C-DAC, Pune**

The proposal had its objectives well defined with the team at SGSITS - Indore to focus on building models for the analysis of the data while C-DAC expertise of high power computation would facilitate in utilizing these models by developing algorithms for the same.

➤ In one of the projects at IIT-Mumbai the PI has already initiated the development of simulation model using FEM for reliable prediction of welds. He also expects that as outcome a new method of cleaning Al sheets would be developed, which could be patented.

➤ The outcome from another proposal was the platform independent STEP based automation feature recognition system. The model has since been validated experimentally.

➤ The progress made on one of the on-going project highlighted the new observations made related to buckling criteria in a single link flexible mechanism. These studies would be useful for design of MEMS based micro-actuators. The PI has 3 publications in highly rated journals.

➤ In one of the projects under Ramanna Fellowship the PI has done studies on the modification of rotary furnace design by adding a recuperator to utilize the heat energy from the flue gases. He has also carried out various geometrical design of the burner to observe the fuel consumption rate. The project has resulted in 4 publications in International Journals, 5 in National journals and a few conference papers. 2 PhD have emerged from the project apart from knowledge impartation to few Engineering/ Diploma students. The PAC has rated the outcome as “Excellent” and suggested that the PI be advised to write a monograph for the small scale foundries in India.

➤ In yet another completed project at NIT-Calicut the PI has indicated the non-intrusive technique of digital interferometry used to analyze performance of representative channel. He also highlighted the thermal image processing software developed by them.

The fourth SERC School in the area of Micro-fabrication and Micro-machining was organized at Jadavpur University, Kolkata 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.

The installation of the 5 axis machine under a project at IIT-Chennai 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 and 3 such Schools have been planned during May to August, 2011. The Department is also processing 2 major proposals for setting up Combustion Research Centres with human resources development as one of its major objectives.

In an earlier project the Electrical Research and Development Authority (ERDA), Vadodara has developed an electromechanical equipment “Pump as Turbine” to generate electricity from the water sources. KSCST has installed a micro-hydel power plant at Vanachalu village in Coorg district for field testing of the equipment developed by ERDA. The equipment has been installed and the KSCST is monitoring the installation in Village (Fig. 1.9).



Fig. 1.9 : ‘Pump as Turbine’ – A project under implementation

MATHEMATICAL SCIENCES

The Mathematical Sciences Programme promotes research in the areas of Mathematics, Statistics, Operations Research and Theoretical Computer Science. The other activities supported under the programme include specialized manpower training for research students/ young faculty members from the universities/ colleges/ research institutions, Interaction meets between mathematicians and prospective users and other awareness programmes. The highlights of the progress/achievements are as follows:

❖ Support to Research in mathematical Sciences

1. 30 new research projects were supported during the year in the areas including Algebra, Differential Geometry, Functional Analysis, Graph theory, Wavelet Analysis, Differential Equations, Mathematical Modeling, Bayesian Statistics, Fluid Mechanics, Stochastic Process Modeling, etc.
2. Support to 100 ongoing projects in various areas of mathematical sciences was continued.
3. As an outcome of research activities more than 100 research papers have been published in the Journals of National and International repute.
4. 2 group monitoring workshops were held to review the progress of the ongoing projects.

A major achievement during the year includes solutions of two 30 year old problems of Dr S.B. Rao, co-ordinator of the centre on Well-quasi-ordering of degree sequences and Hamiltonian dipaths in

self-complementary digraphs. The first conjecture was solved by Professor Paul Seymour, and Maria Chudnovsky of Princeton University, USA recently and the second conjecture was solved by Dr SB Rao himself recently. This will lead to the structure theory of directed self-complementary graphs.

Prof C. R Rao was honoured by the Hon'ble Prime Minister of India Dr Manmohan Singh with India Science Award for pioneering contributions to statistical theory and applications on 19th Oct, 2010 in Hyderabad. This is the highest and most prestigious national recognition given to a scientist in India by the Government of India for a major contribution of a path-breaking nature in any branch of science, engineering and medicine.



Fig. 1.10 : Prime Minister Dr. Manmohan Singh presenting the Gold Medal of India Science Award to Prof. C.R. Rao

National Mathematical Sciences Initiative

The support for National Mathematical Sciences Initiative was continued at Indian Institute of Science, Bangalore to organize Thematic programmes on different topics at the interface between mathematics and other disciplines including compact lectures/ workshops/seminar etc.

International Congress of Mathematician (ICM 2010)

The International congress of Mathematician (ICM 2010) is the most important international event of interest to the entire international mathematical community held once in every four years. Mathematicians from all part of world gather to take stock of the state of their subject and to determine possible future directions in the congress. It was for the first time in more than 100 years of the history of ICMs that the ICM 2010 was held in India during August 19-27, 2010 at Hyderabad. There were 20 plenary lectures in diverse Mathematical areas by eminent figures responsible for every evolution of the area and sectional talks by outstanding experts in specific areas describing important developments in the area. Apart from these there were paper presentations and poster sessions. About 3000 delegates from all over the world participated in the congress. As part of ICM 2010, 29 satellite conferences were held in different locations

of the country, just before and after the main events to take advantage of the presence of leading researchers from all over the world in various areas of mathematical sciences. The satellite conferences were supported under the Mathematical Sciences programme.

Support was also provided to about 500 Indian researchers for attending the ICM 2010 so as to help them, particularly young researchers, to keep themselves abreast with the latest developments in mathematical sciences and motivate them in their research pursuits.



Fig. 1.11 : International Congress of Mathematicians (ICM) 2010 was inaugurated by the Honorable President of India, Shrimati Pratibha Devisingh Patil held at Hyderabad on 19th Aug, 2010.

❖ Programmes for Manpower development

Following Training programmes/Workshops/ SERC School was 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. Another SERC school on “Development and transformation theory of ordinary and basic hypergeometric functions” has been planned to be organized for young researcher in the area.

Human Resource Development in mathematics: This is a new initiative and is being coordinated by Institute of Mathematical Sciences, Chennai to develop human resources in Mathematical Sciences through training of research workers by Adjunct and visiting professors from leading research institutes at select university centers, providing travel grants to Indian researchers to work at centers of excellence and holding Annual Instructional Schools on applications of mathematics.

National Meet of Research Scholars: A National Meet of Research Scholars in Mathematical Sciences (NMRSMS-10) was organized at I I T Madras, Chennai to train the research students

about research methodologies and to improve the presentation skill etc. 50 participants from all over the country attended the meet.

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

45 Training Programmes/Workshops/Colloquium etc were organized at various /universities/ colleges/ other institution spread all over the country on the following topics:

Modeling Optimization and Applications, Stochastic Modelling, Mathematical Models in Pattern recognition, Taguchi Philosophy, Vedic Mathematics, Graph Theory, Pedagogy in Mathematical training and research, Algebra, Functional analysis, Finite Geometry, Modular form, Dynamical Systems, Applications of control theory and optimization, Analytic and combinatorial number theory, Operator Algebra, Logic and Set Theory, Probability, Ring Finite Geometry etc .

The above activities were organized to train Indian research students/ young faculty members and to keep themselves abreast with the latest developments in mathematical sciences.

❖ 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 mathematics among the children and researchers. A mobile van has also been provided to attract and motivate the school children/ college students and demonstrate them the concept and applications of mathematics through various displays.

❖ Publication of a volume has been supported under Ramanujan Lecture Note Series in Mathematical Sciences in the area of Teichmuller Theory.

LIFE SCIENCES

Animal Sciences

During the year, several new basic research projects in sub areas like ecology, neurosciences, reproduction, immunology, parasitology, animal communication and faunal diversity were funded to scientists and technologists working in educational institutions and national laboratories,. Capacity building activities involving leading faculty members and active researchers from different parts of the country and abroad are being organised in sub areas of chronobiology, neurobiology and herpetology. New initiatives are being taken for promotion of research on avian fauna and wild life fauna of north east region.

Capacity Building Activities

SERC School in chronobiology at Delhi University Delhi. SERC School in neurobiology is scheduled from 21st February, 2011 to 6th March, 2011 at National Brain Research Centre, Manesar. SERC School in herpetology is scheduled from 24th January, 2011 to 7th February, 2011 at Salim Ali Centre for Ornithology and Natural History, Coimbatore. Twenty five to thirty participants are attending the SERC Schools which include lectures, laboratory studies and field training from leading faculty from different parts of the country and abroad.

New projects

Ecology

Projects sanctioned under the sub area include, Studies on the impact of Bt toxin on soil microbes, nematodes, annelids and arthropods; Structural and functional resilience of soil faunal community in a fire

disturbed forest gradient in Bankura, West Bengal; Ecological and life – history studies of the association between cryptogams and grouse locusts (Tetrigids); Ecology of leopard *Panthera pardus* in relation to prey abundance and land -use pattern in Kashmir valley;

Neurosciences

The projects under neurosciences include, Glucose sensing mechanisms in the brain of teleost fish: identification, characterization and physiological significance'; Regulation of intracellular calcium in the *Drosophila* nervous system and it's relevance to neuronal function; and Opioid modulation of motivated behaviours in male zebra finches;

Reproduction

Catfish ovarian vasotocin and vasotocin receptor genes: Molecular cloning, characterization and expression, and role in spawning activity; Hormonal and molecular mechanisms of pre-ovulatory water influx in the oocytes of a freshwater fish; Studies on sperm storage in female reproductive tract of *Scotophilus heathi* :hormonal and metabolic regulation.

Immunology

Studies on α -1, 3 glucan binding protein (α GBP) – Receptor mediated cellular immune responses in the marine mussel *Perna viridis*; Analysis of asrij in *Drosophila hematopoiesis* and immunity.

Parasitology

Biological control of trematodosis in livestock by egg parasitic fungi as a component of integrated parasite management;

Animal communication

Preparing a database on echolocation of calls of microchiropteran bat species of the Western Ghats region and adjoining areas of Maharashtra.

Faunal diversity

Testing the 'out –of-India' hypothesis through molecular phylogeny of lizards of peninsular India.

Achievements

Faunal Diversity:

- a) Taxonomic revision of Indian Arctiidae (Lepidopera)

Collection-cum-survey tours were conducted in far flung localities in the states like-Mizoram, Nagaland, Sikkim, Arunachal Pradesh, Tamil Nadu, Kerala, Jammu & Kashmir and Central India and as many as 1150 specimens of different species of Family Arctiidae were collected. Sorting was done on the basis of various external morphological characters such as labial palpi, antennae, legs, wing maculation, etc.

A total number of 48 species have been identified with the help of relevant literature. A total number of 280 permanent slides of forewings and hindwings were prepared. For authentic identification, as many as 140 dissections were performed to examine and study the external male and female genitalia

of different species. The illustrations of wing venation, external male and female genitalia of 48 identified species have been completed.

b) Diversity of spiders in Nanda Devi biosphere reserve

Taxonomic database of the Himalayan spider fauna was prepared for the first time. Family distributions at select sites were recorded, helping to formulate conservation designs to target these families/species, that are rare/endemic or range restricted. A total of 791 individuals belonging to 17 families under 29 genera were collected during sampling. Some families were widely distributed throughout the sampling area, while others were restricted to one or few altitudinal zones. Families Selenopidae, Clubionidae, Philodromidae, Agelenidae and Oxyopidae were recorded only from the lower altitudinal zone (2000m-2500m). Families Uloboridae and Miturgidae were recorded from the mid altitudinal zones (2501m-3000m), while family Linyphiidae although present in all the four zones was most dominant in the high altitude zones (3501m-4000m).

c) Bio-diversity of praying mantids (Insecta:Mantodea) of Karnataka, Tamil Nadu and Goa

The project deals with pure taxonomic work on the mantid fauna of Tamilnadu, Karnataka and Goa. Survey and collection of praying mantids (Insecta:Mantodea) have been completed from several districts of Karnataka and TamilNadu and also from northern parts of Goa. The study has indicated the species abundance in these areas. The data is expected to provide a sound foundation for further studies.

Neurosciences

a) Centre for sleep studies.

Preliminary studies on REM sleep were carried out at the centre. Estimation of Gamma Amino-Butyric Acid (GABA) showed that GABA level increased in the locus coeruleus (LC) after REM sleep deprivation. Continuous stimulation of perifornical area (PeF) was found to decrease both NREM and REM sleep and increase wakefulness. REM sleep deprivation was found to stimulate neuronal Na-K ATPase and inhibited glial Na-K ATPase activity and the effects were mediated by noradrenaline(NA). It was observed that glia contains choline acetyl transferase (ChAT) and glutamic acid decarboxylase (GAD). Western blot studies indicated that GAD expression get modulated in C6 by NA treatment. EEG analysis indicated that each intrinsic mode function (IMD) has a characteristic feature under different states/conditions. It was found that the unwrapped phase of the reconstructed signal during different states/conditions show different slopes, indicating involvement of complex dynamics in expression of EEG associated to these states.

b) Importance of CART-Peptide in learning and memory traces, reward and reinforcement and hypophysial regulation in rodents.

The study provided direct evidence in favour of a role of cocaine- and amphetamine-regulated transcript peptide (CART) in learning and memory. The studies suggest that exogenous CART may promote spatial learning and memory. And endogenous CART containing systems (like the ARC, PVN, DMH, CeA, BNSTI, AcbSh, DH, ZI, EW, DG and PVT) may play a role in acquisition and retrieval of information. The results may provide the basis for further investigations on the involvement of CART peptides and perhaps also receptors in learning and memory. Search for agonists for these receptors may be fruitful in treatment of amnesia like disorders.

Developmental biology

- a) Molecular mechanism of action of ultraviolet radiation and lithium during regeneration and pattern formation.

Xenopus laevis embryos were used to study functional conservation of hydra *noggin* gene in vertebrates. Animal cap assay was employed to study mechanism of action of hydra *noggin* in vertebrates. LiCl seems to interfere with pattern formation in hydra through its effects on genes encoding proteins in the Wnt pathway. First-time cloning and heterologous expression of hydra *noggin* gene points towards new interpretation of BMP-Noggin inhibition during evolution of pattern formation in animals.

- b) Role of Basic Fibroblast growth factor (FGF2) on epimorphic regeneration.

The study revealed that FGF2 play a definite role on the early events of epimorphic regeneration, viz, wound healing as well as formation, proliferation and differentiation of blastema in *Hemidactylis flaviviridis*, an amniote model for studies on tissue regeneration. The current study also showed that FGF2 induced prostaglandin E₂ play a cardinal role in wound healing, maintenance of apical epithelial cap, proliferation and differentiation of underlying mesenchymal cells that include myogenesis and angiogenesis. Comparative study of different vertebrates would reveal whether the mechanisms of epimorphic regeneration are evolutionary conserved or not.

Chronobiology

Role of proximate factor(s) in timing the seasonal breeding in passeriformes finches of North-East.

It was observed that passerine birds residing/visiting and experiencing climatic conditions of the North-East namely, the tree sparrow and yellow-breasted bunting possess seasonal cycle of gonadal growth and development, bill coloration, and feather replacement (molting) as evident in the birds studied in other parts of the country. Close correspondence was noticed between the gonadal development cycles and annual variation in day length. It was observed that, captivity modulates annual gonadal cycle in terms of period and amplitude. The amplitude of follicular growth was found to be attenuated.

The observations are useful in understanding the role of photoperiod as proximate environmental factor in the regulation of seasonality in the birds.

Endocrinology

Studies on the protective role of antioxidant vitamins against diabetogenic effect of di-2-ethylhexyl Phthalate (DEHP) in male rat.

The study indicated that DEHP is a potent inhibitor of glucose oxidation in skeletal muscle and glucose uptake in liver. Supplementation of vitamins (C&E) partially prevented the DEHP – induced changes. Collectively, DEHP exposure results in glucose intolerance as a result of defective insulin signal transduction and the associated decrease in skeletal muscular glucose oxidation and uptake of glucose in liver. Antioxidant vitamins have a protective role against the adverse effect of DEHP. Supplementation of vitamins (C & E) prevented the adverse effect of DEHP partially or completely.

Ecology

A study on host-parasitoid interactions with special reference to Uzi fly (diptera: Tachinidae) and *Antheraea assama* (Lepidoptera: Saturniidae).

The parasitoid *Exorista sorbillans* was found to respond to volatiles emitted by fifth instar larvae, their excreta and host plants fed by muga silk worms. The blend of chemicals emitted by host plant *Persea bombycina* in response to caterpillar feeding have been identified. The chemicals emitted by larvae and excreta have also been identified. The blend of chemicals identified to be released by insect fed host plant, larval excreta and larvae might be used to do behaviour study in order to explore the possibility of using them to develop uzi fly trap.

Biochemistry Biophysics, Microbiology and Molecular Biology

Department continued to promote modern biology by providing grants for research in the area of biochemistry, biophysics, molecular biology and microbiology. In this endeavour, about 50 research projects, with the commitment of Rs. 15 crore (approx) for three years, were sanctioned during the year. Out of these, 35 research projects were sanctioned in the academic institutions. Ongoing projects also continued to be supported with funds.

Some of the research projects initiated in the area covered the following topics:

Biochemistry and Cell Biology

- Mechanism of action of antilithiatic metabolites of *Benia liggulata*,
- Studies on genotoxicity and mutagenicity of commonly used organophosphate pesticides;
- Biochemical interaction of red florescent protein in *Bombax mori*;
- Synthesis of curcumin bioconjugates;
- Extra cellular matrix protein derived bioactive peptides involved in cell activity
- Regulatory factors in chromosome dynamics during meiotic cell division in yeast;
- Role of GTPase Hflx in ribosome assembly;
- Role of a core subunit of polymerase II Rpb4 in transcription elongation;
- Production of antimalarial drug artemisinin via metabolic engineering of plastids;

Structural Biology

- Structural studies of *Erysipelothrix* protein Rspb and its interaction with collagen;
- Formation and structural stability of DNA triplexes and their anticancer activity;
- Solution structure of malaria parasite proteins involved in chromatin assembly;
- Strategy for post translational peptide modification

Molecular Biology

- Interaction of flavonoids with telomeric g quadruplex sequence for anti cancer therapy, Characterization of chlorpromazine with mitotic kinesis Eg 5 and tubulin and its implication in cancer chemotherapy;
- Functional evaluation of novel 15 ink 4 mutation in esophageal squamous Cell Carcinoma,

- Interaction of leptin with endothelium and its implication with angiogenesis;
- Role of lamin A in muscle differentiation;
- Mapping chromosome segment duplications in *Neurospora crassa* genome sequence; Regulation of ribosomal DNA transcription in *Entamoeba invadens*;
- Study on Ataxin-2 binding protein 1 of drosophila and mouse in the context of spinocerebral ataxia type 2;
- Molecular basis of sex determination in lizard, search of female pathway genes;
- Identification of molecular targets for therapeutics in Alzheimer's disease.
- Mechanism of glucose mediated lac repression in *Ecoli*

Plant Molecular Biology

- Development of plastid transformation system for defensin gene in *Capsicum annum*;
- Development of transgenic *Brassica juncea*;
- Role of apoptosis inducing factor in dictyostelium cell death;

Microbiology

- Expression of edema factor gene for development of vaccine against anthrax;
- Molecular tagging of virulence and pathogenesis genes of powdery mildew fungus.
- Antimony resistance related genes of *leishmania donovani*;
- Regulation of ribosomal DNA transcription in *Entamoeba invadens*;
- Exploration of arctic microorganisms for production of industrial enzymes;
- Regulation of rotavirus gene regulation;
- Characterization of actin related proteins in *Leishmania*.

DST intervention has been successful in consolidation of Indian researchers' competence in the area by enabling training in emerging areas and publication of research papers. Research outcome from some ongoing and completed projects were as follows:

The finding from some of the successful research projects are as follows:

- A model for the modulation of *Vitreoscilla* haemoglobin (VHb) mediated oxidative stress response in heterologous hosts and regulation of VHb biosynthesis in its natural host *Vitreoscilla* was proposed to explain the function of VHb under oxidative stress.
- It was reported for the first time that GAPDH has a novel cell surface localization in mammalian cells and that this molecule functions as a novel receptor for the important iron transport protein 'Transferrin' into mammalian macrophages.
- The silk protein sericin isolated from the cocoon of the tropical tasar silk moth *Antheraea mylitta*

was shown to have three major bands. The lowest 70 kDa, suggested as a glycoprotein, was purified and has been identified as a potent antioxidant and photo protective agent against ultraviolet B (UVB) irradiation in mouse skin model.

- Role of Rab 11 in normal eye development was strongly indicated. Genetic interaction of Rab 11 with the JNK pathway was shown. Over expression of mutant Rab 11 was shown to alter wing disc morphology that resulted in cell shape changes.
- Olfactory system was proposed to develop in a multi-step process. A single transcription factor, Lhx2 was required for multiple aspects of olfactory system development: A diencephalic origin of pAOB cells in the *Xenopus* was proposed suggesting an evolutionary conservation of pAOB migration across species.
- BMP downstream genes in bone development were expressed in bone and expression was shown to be lost in knockout mice. All the putative target genes expressed in bone marrow cells differentiated to osteogenic lineage.
- A study relating to drug resistance in HIV protease mutant proposed a structural model for the catalytic cycle of HIV 1 protease. A new protease inhibitor was synthesized that seemed to bind to the active site ASP25 covalently. The activity of the purified protease was also tested to be inhibited in presence of this inhibitor. The findings could be useful in structure based inhibitor design process.
- *Pseudomonas putida* CSV 86 was shown as a natural isolate which utilizes aromatics and organic acids in preference to glucose. This was proposed as a novel property in terms of carbon source preference for any bacterial strain.
- The procedures were standardized to generate two dimensional langmuir- Blodgett (LB) films. It was shown that both DNA and protein retain their activity. Specific interaction between DNA and protein were also done. It has been shown for the first time that it was possible to estimate the thermodynamic constants for DNA- RNA polymerase interaction in a crowded environment very close to the natural system.
- SbdREB2A factor was shown to confer stress tolerance in the E. coli cells. This indicated that DRE binding elements exist in the promoter region of some prokaryotic genes and that regulatory components have some similarity in both prokaryotes and eukaryotes in imparting stress tolerance.
- A gene construct which could induce post transcriptional gene silencing of toxic endosperm protein of castor -Ricin and RCA- was developed involving three different strategies.
- A proposal to study how three dissimilar subunits of kinesin-2 recognize each other contributed in highlighting the basic principle of coiled-coil association between the two motor subunits. In addition, it yielded a new model for the kinesin-II complex, which will be useful in explaining mechanism of kinesin-II motor activity in vivo.

Health Sciences

The Department continued support to projects/ programmes and activities in the cutting edge and frontline areas of Bio-medical/Health Sciences.

Several projects/ programmes were generated, to generate baseline data, develop newer diagnostic

methods, devices, processes, and drug delivery systems, study mechanism of action, to develop work force and motivate them to engage R&D activities in emerging and frontline areas of biomedical sciences. Apart from developing Human Resource from the projects, the department has been making special effort in designing training programmes/workshops for the scientific and medical professionals with special attention to latest developments in frontline and emerging area of Biomedical Sciences to create more workforces in the specialized cutting edged technologies.

Keeping in view trends of disease pattern in the country some of the new project initiated in the area of neurosciences (Alzheimer and Parkinson diseases), Reproduction and Developmental biology(Endometriosis), Cancer Biology(Lung cancers, Breast Cancers), Infectious Diseases (*Leishmania donovani*, *Mycobacterium leprae*, *Mycobacterium Tuberculosis*), Drug development, Ophthalmology (Retinoblastoma), Immunology, Nutritional Sciences etc.

Some of the important research projects funded during this year

Neurosciences

- Pharmacogenetics on Alzheimer's Drug Therapeutics.
- Mass spectrometry based plasma proteomics in patients with attempted suicide.
- Neuromapping of functional deficits associated with Parkinsonian disorders.

Reproduction & Developmental biology

- Surface accessibility of extracellular loop of follicle stimulating hormone receptor and their role in ligand receptor interaction.
- Identification of potential biomarkers for the diagnosis of endometriosis: a proteomics approach.
- Study of Epigenetic Changes in the rat male germ line following neonatal exposure to environmental Endocrine disrupter Bisphenol A.

Cancer Biology

- Novel derivative of Lovastatin as anticancer agent
- Identification of pathways that determine tumor survival and radioresistance in cells derived from the oral cavity.
- Identification of Bronchogenic cancer markers through proteomic analysis of bronchial alveolar lavages and sera.
- Functional genomics of AATF gene in oncogenesis

Cardiology

Molecular Changes and differential signaling mechanism involved in cardiac dysfunction in rat"

Infectious Diseases

- Study of anticestodal activity of glands and hairs of fruit of mallotus phillippinensis in experimental animal models.

- Role of Glyceraldehyde 3 phosphate dehydrogenase a novel transferring receptor , in the survival of intracellular mycobacterium tuberculosis”
- “Stress induced regulation of extracytoplasmic sigma factors in mycobacteria”
- A study orf circulating immune complexed anti cytokine auto anticeties in leprosy patients.”
- “Trehalose e-e dimyclate (cord factor) of M tuberculosis and its role in the immunopathogenesis of tuberculosis

Drug development

Development of some novel antitumor agents from *Spirulina platensis*. A semi synthetic approach.

- Synthesis and Neuro-pharmacological evaluation of novel and selective ligands for the development of Improved and fast acting anti-depressants for the treatment resistant depression.
- Identifications and characterization of novel angiotensin converting enzyme (ACE) inhibitors for hypertensive cardiovascular disease.

Ophthalmology

- To understand the role of Micro RNA in drug resistant Retinoblastoma cells”
- A Study on the effects of UV Rays on riboflavin treated corneal limbal stem cells during the process of collagen cross Linking.”

Immunology

Development of small molecule inhibitors of cytokines for treatment of inflammatory disorders”

Nutritional Sciences

- Studies on 3 fatty acid rich Garden cress (*Lepidium sativum*) seed oil as dietary supplement and its modulatory effect on inflammatory mediators.”
- Expression systems for Food Grade Lactic Acid Bacteria.”
- Chondroitin sulfate/Dermatan sulfate in Kidney: Changes during diabetes and modulation by *Coccinia Indica*.

Some of the important findings/observations from the ongoing and completed projects:-

- ❖ Study on Lupus nephritis: Studies on immunogenic profiles of patients from southern India, revealed that :- 1) ACE I/D polymorphism study revealed that the genotype DD is strongly associated with development of lupus nephritis among south Indian Tamil population. 2) The +2373 A to G analysis of DNase I gene showed higher frequency of the heterozygous genotype (AG) in SLE). This association was stronger in patients with Lupus nephritis.
- ❖ Study on “Osteogenic actions of a naturally derived from NP-1 pure compound on bone” results showed that osteogenic actions of pure compound K095 (medicarpin) derived from *Butea monosperma*, medicarpin enhances osteoblast differentiation via ER-p38/BMP2 pathway and

increases bone formation and mineralization apposition rate *in vivo* as assessed by tetracycline and calcein double labeling (Fig 1.12).



Fig. 1.12

- ❖ The project on “Electrophysiological study of Peripheral nerves in leprosy diabetic and alcoholic polyneuropathies” revealed that by this electrophysiological method investigator is able to predict the high risk cases for nerve damage and provide the treatment so prevent the progression of nerve damage and further to prevent the occurrence of the deformity.
- ❖ The Study is underway that the screening the potential plants/plant parts of *Tephrosia purpurea*, *Fumaria indica*, *Hemidesmus indicus*, *Rubia cordifolia*, *Amaranthus spinosus* for Cancer chemopreventive potential for treatment of Hepato cellular carcinomas.
- ❖ The project on “ Evaluation of the chemopreventive potential of neem (*Azadirachta indica*) leaf fractions in the hamster buccal pouch carcinogenesis model” results revealed that the Neem leaf (sub) fractions exhibited antiradical scavenging activity and inhibited the development of hamster buccal pouch (HBP) carcinomas.

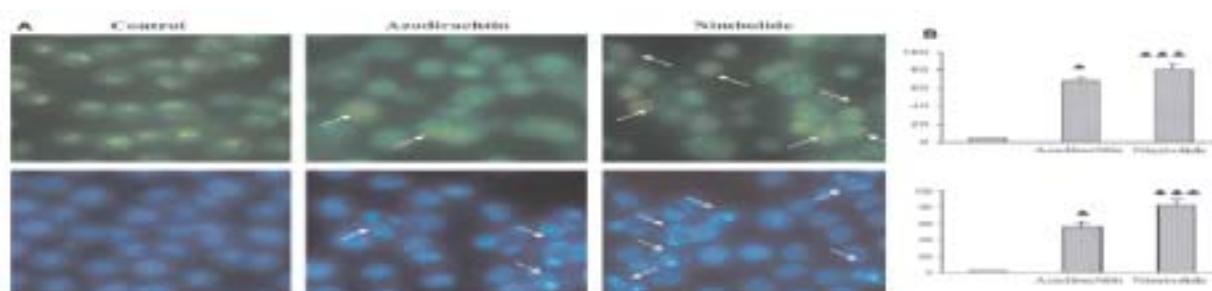


Fig. 1.13: Nuclear morphology and apoptotic nuclei

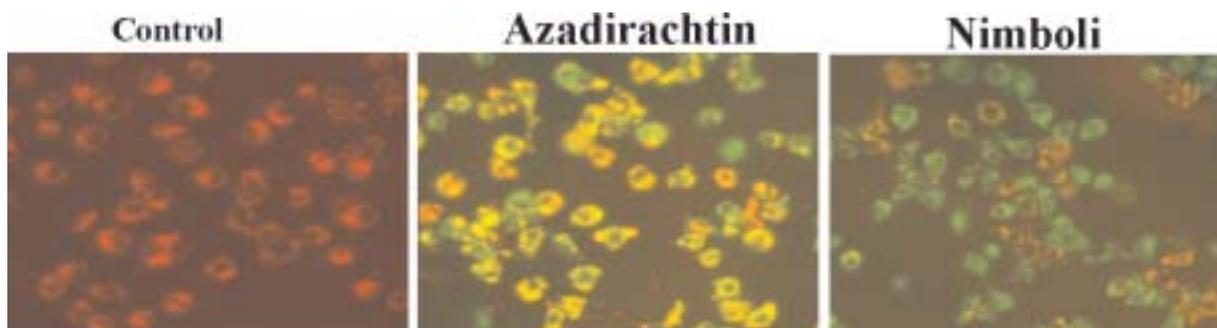


Fig. 1.14 : Fluorescent microscopy images of mitochondrial membrane potential

- ❖ The study on ‘Frequency distribution of three HIV-1 resistance conferring polymorphisms SDF1-3’A, CCR264I and CCR5Δ32 in Asian Indians’ results revealed that low frequency of the protective allele CCR5Δ32 observed in this study suggests high vulnerability of North Indians to HIV-1 infection. The information generated in this study may serve as a baseline genetic data to assess the genetic predisposition of Asian Indians to HIV-1 and for future designing of therapeutic strategies.
- ❖ Preliminary studies on “Differential expression of Matrix metalloproteins and Collagen IV in oral submucous fibrosis” were found that, expression of MMP-2 and MMP-9 has been found in oral submucous fibrosis in comparison to controls. It may be exploited in clinical medicine in the early detection of disease and prediction of biological development of oral lesions.
- ❖ The Study on “An approach towards the development of anticancer agents specifically for hormone dependent breast cancers” resulted in synthesizing the two important analogues which have exhibited potent anticancer activity against hormone dependent breast cancer cells. The most potent compound exhibited anticancer activity better than tamoxifen, standard drug in the market and it also showed selective anticancer activity against hormone dependent breast cancer cells.
- ❖ Studies are initiated to “Study on mutation of genes of monogenic forms of diabetes in the young onset Type 2 Diabetes Mellitus in Eastern India” by which to identify the susceptible individuals by family screening for presence of mutation by this method.
- ❖ Studies were carried out to determine the mechanism of the aphrodisiac action of the alcohol extract of *V. tessellata* flower and to isolate the active principle involved was competed and found that, It activates penile tissue endothelial NOS [e-NOS] and neuronal NOS [n-NOS] and brings about aphrodisiac action by increasing the levels of cGMP by the action of NO. This drug is extremely promising to develop a commercially viable phytomedicine.
- ❖ “Investigations on the Synthesis of Nanocrystalline Calcium Phosphates to Prepare Bone and Dental Replacement Materials and Drug Delivery Systems”, project findings revealed that HAp is similar in composition to bone mineral and it has biocompatible, bioactive, osteoconductive and antibacterial properties. It is one of the widely used biomaterial for bone repair, substitution, augmentation and as a scaffold for tissue engineering in bone and teeth regeneration.
- ❖ The project on “Analysis of nod2 gene defects in indian patients with crohn’s disease” may reveal the genetic differences in Indian patients with inflammatory bowel disease provide significant clues to the biology of the disease and may eventually be useful in strategies to prevent disease in predisposed individuals.
- ❖ The study on “Role of Promastigote Surface Antigen-2(PSA-2) in drug resistance in *Leishmania donovani*.” revealed that the role of PSA-2 in drug resistance in Kala-azar, using genetically manipulated *Leishmania donovani* parasite. Overexpression of PSA-2 gene in the drug sensitive parasite (laboratory strain and field isolate) resulted in conversion of sensitive *Leishmania* parasites into resistant phenotype. Data suggested that, PSA-2 plays a central role not only in antimony resistance but also in susceptibility to new antileishmanial drugs Amphotericin B & Miltefosine.

Calcium phosphate and their polymer composites, developed and it could be used for preparing bone replacement, and tissue engineering applications.(Fig.1.15)

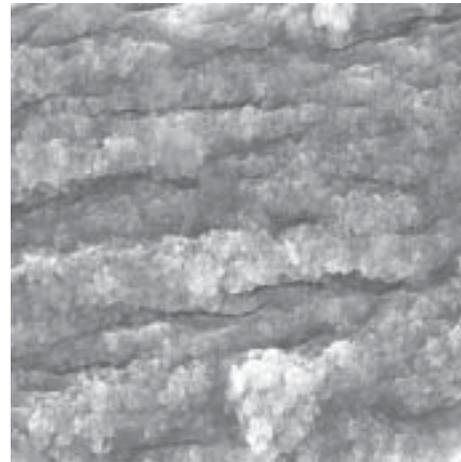


Fig.1.15: SEM image of Laminated structure of Hydroxyapatite nanocomposite ;

Development of strontium substituted Calcium phosphate biomaterials Strontium substituted Hydroxyapatite developed is suitable for drug delivery since it can simultaneously improve osteointegration and prevent infectious areas by releasing therapeutic agent. The fibrous hydroxyapatite could also be used as a reinforcement material to improve the reliability of HAp based biomaterial composites. (Fig. 1.16)

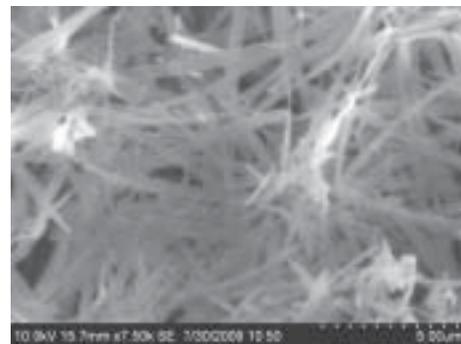


Fig. 1.16: SEM micrograph of fibrous strontium substituted calcium phosphate bone and dental replacement material.

Nanocrystalline hydroxyapatite (nHAp) rods of size resembling bone mineral about 40-75 nm long and 25 nm wide was synthesized without using any surfactants or modifiers under microwave irradiation, (Fig.1.17) which could be used for drug delivery applications. The nHAp prepared by microwave irradiation in this study could be made use of as an ideal local drug delivery system for the treatment of bone infection.

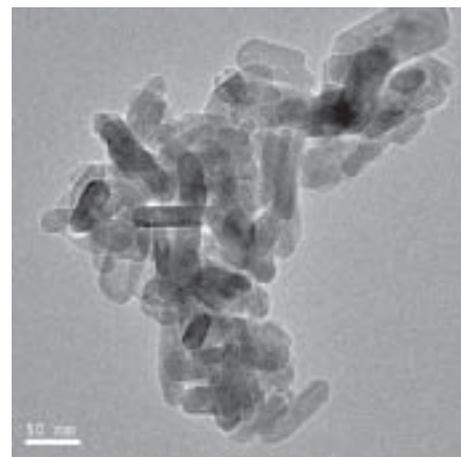


Fig. 1.17: TEM images of Hydroxyapatite nano rods synthesized by Microwave techniques

Some the workshop/Training programmes funded by the department under PAC-Health Programme.

- Techniques in Animal Cell Culture-Workshop.
- Live cell functional imaging and neurotransmitters receptors functional regulation using confocal microscopy & gene expression studies using real time PCR-Workshop.
- Interdisciplinary Workshop on “Value Addition to Cytopathological Practices through Multimodal Imaging and Computer Vision Approach”.
- “Hands on training course on use of cell culture technology for studying apoptosis and angiogenesis”.

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 and bio-diversity.

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, taxonomic revision on Indian Marantaceae and Musaceae, Algal Biodiversity of the Idukki and wayanad districts of Kerala . Molecular characterization of Amaranth and Buckwheat, Marker assisted selection of resistance gene, Biotic and abiotic stress studies on various crops, Biocontrol, Plant microbe interaction and Mycorrhizal relationship, Entophytic fungi and development of a DNA bank of tree species etc.

Two weeks training programme on “Capacity building on Plant Taxonomy” was held at FRI, Dehradun for students and researchers of various colleges and universities.

Findings from the ongoing projects funded under the programme revealed :-

Early blight, caused by *Alternaria solani* (Ellis and Martin) Jones and Grout, is a major production constraint in tomato, causing losses up to 78% in India. The pathogen is seed borne and supply of disease free seed is a pre-requisite for effective disease management. A simple and rapid diagnostic assay for detection of seed borne infections is a very much essential as the *A. solani* never sporulate in culture and detection based on traditional methods is time consuming and tedious. Thus, development of a PCR based diagnostic assay for detection of *Alternaria solani* infections in tomato seeds was contemplated at IIHR, Bangalore as it is highly useful in seed and plant quarantine industry.

Design of species-specific primers

Nucleotide sequence of ITS 1 region of r DNA of *A.solani* isolates was aligned with the same region from other *Alternaria* species such as *A. alternata*, *A.brassicae*, *A.brassicicola*, *A. sesami*, *A.porri*, *A.helintahi*, *A.ricini* and *A.carthami* along with sequences with NCBI data base. Based on r DNA, β -tubulin, glucose -6-phosphate dehydrogenase, Alt I a, acetyl co A sequence analysis of *A.solani* , a total of 34 primer sets were designed using Manual inspection and Primer Blast, Primer 3, Primer 3 Plus and Primer Quest soft wares.

Specific PCR amplification

A sequence within the ITS 1 and gpd regions unique to *A.solani* were identified. To check the specificity of the primers, DNA from tomato, *A. alternata*, *A.brassicae*, *A.brassicicola*, *A. sesami*,

A.porri, *A.helintahi*, *A.ricini* and *A.carthami*, *Sclerotium rolfsii*, *Fusarium equiseti*, *F.oxysporum*, *Phytophthora infestans*, *Colletotrichum gloeosporioides*, *C.capsici*, *C.falcatum*, *Cercospora canscens*, *C.capsici*, *C.beticola*, *Phoma exigua*, *Curvularia spp* and *Drechleria spp* were also tested. A PCR primer (ALP-GGCACCTCCCGGGGTGGC) designed for *A.linicola/A.solani* complex on linseed (McKay *et al* (1999) was also tested for *A.solani* on tomato in this study. *A.linicola* and *A.solani* has been found to be identical and named as *A.linicola/A.solani* complex. Primer pairs specific to *A.solani* ALP (5'-GGCACCTCCCGGGGTGGC-3') and ITS4 and ASGF(5'-GCCATCMGCAYCGCGANAT-3') and ASGR (5'-TGGGYTGTGGMGGGTNCT-3') were selected. Primers ALP and ITS-4 amplified a fragment of c.535bp (Fig.1.18) while Primer set ASGF and ASGR produced a band of c.200bp (Fig. 1.19) with DNA of *A.solani*. These primers did not cross react with tomato DNA nor DNA from the other fungi tested.

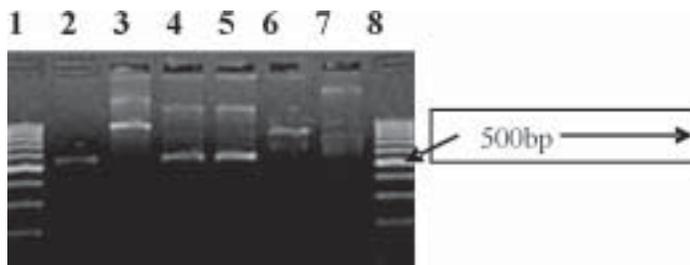


Fig.1.18: Selective amplification of *Alternaria solani* with primers ALP-F and ITS4. Lane 1 and 8 : 100 bp ladder, Lane 2 : *A. solani* (OTA 22), Lane 3: *A. brassicae* (OCA 13), Lane 4: *A. brassicicola* (OCA14), Lane 5: *A. alternata* (OCA9), Lane 6: *Colletotrichum gloeosporioides* (OBP 1), Lane 7: *C. capsici* (OCC15)



Fig.1.19: Selective amplification of *Alternaria solani* with primers ASGF and ASGR. Lane 1 and 9 : 100 bp ladder, Lane 2 : *A. solani* (OTA 22), Lane 3: *A. brassicae* (OCA 13), Lane 4: *A. brassicicola* (OCA14), Lane 5: *A. alternata* (OCA9), Lane 6: *A. carthami*, Lane 8: *A. ricini*

Detection of *A.solani* in planta

About 535 bp product was amplified when primers ALP and ITS 4 used for PCR amplification of DNA extracted from infected tomato plant material using irrespective method of DNA extraction was used (Fig.1.20).

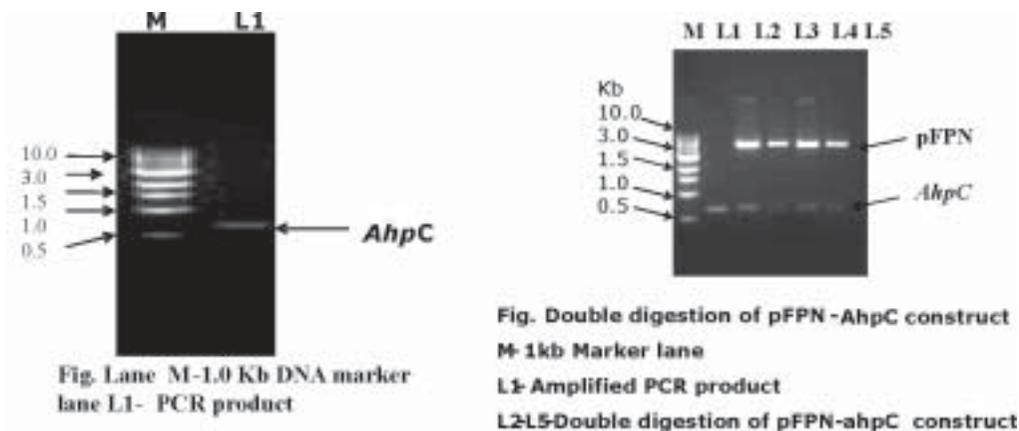


Fig.1.20: PCR amplification of *Alternaria solani* early blight infected samples of tomato with ALP-F & ITS 4.

Lane 1 & Lane 7: 100bp ladder, Lane 2 : DNA from healthy tomato leaf, Lane 3 : *A. solani* infected fruit, Lane 4: *A. solani* infected leaf, Lane 5 : *A. solani* infected stem, Lane

The AhpC gene, a key component of a large family of antioxidative proteins, capable of protecting bacteria from abiotic stresses like peroxides and reactive oxygen, nitrogen and sulfur species was cloned from *Anabaena* and over expressed in *E.coli*. The AhpC over expressing *E.coli* developed tolerance against multiple abiotic stresses. This gene has been cloned for the first time in *Anabaena* using the cyanobacterial vector (pFPN) containing *psbA1* promoter at BHU, Varanasi. The transformed cyanobacterium has been found tolerant against heat, UV-B, salt, pesticide, Cd, Cu etc. thereby providing a novel strain capable of nitrogen fixation in agricultural fields challenged with multiple abiotic stresses. The major achievements of the project are:

Cloning and expression of *ahpC* gene of *Anabaena* sp PCC 7120 in *E. coli* (BL-21) for functional analysis against heat, salt, UV-B, metals, and pesticide. 2. Cloning of *ahpC* gene in the cyanobacterial vector (pFPN) containing *psbA1* promoter (light inducible), and 3. Development of genetically modified *Anabaena* sp PCC 7120 and thus opening a new possibility of nitrogen fixation under above abiotic stresses.

The above Significant achievement in the project entitled “Molecular analysis of AhpC (alkyl hydro peroxide reductase) in offering abiotic stress tolerance in *Anabaena* species PCC 7120” has been published in Biochemical and Biophysical Research Communications.

First time in India the antagonistic yeasts were identified in a project at TNAU, Coimbatore, to promote as a biocontrol agents against the major soil-borne pathogens of sugarbeet viz., *Sclerotium rolfsii*, *Rhizoctonia solani* and *Pythium aphanidermatum* (Fig 1.21). Molecular identification of yeast was carried out and it was identified as *Pichia kudriavzevii* (A) and *Trichosporon asahii* (B) (Fig. 1.22) The effectiveness of yeast isolates were proved for their inhibitory activity on mycelial growth of sugar beet pathogens viz., *Rhizoctonia solani* (Fig. 1.23), *Pythium aphanidermatum* (Fig 1.24) and *Sclerotium rolfsii* (Fig 1.25) by adopting the dual plate technique.



Fig. 1.21

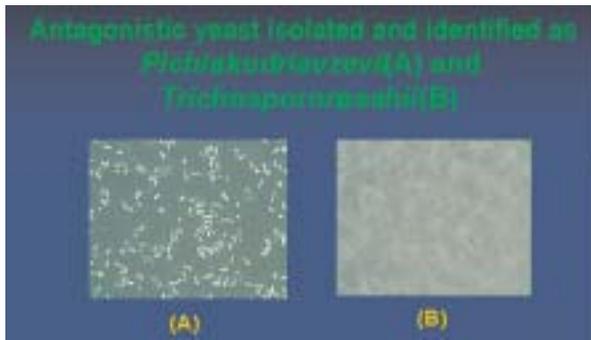


Fig. 1.22

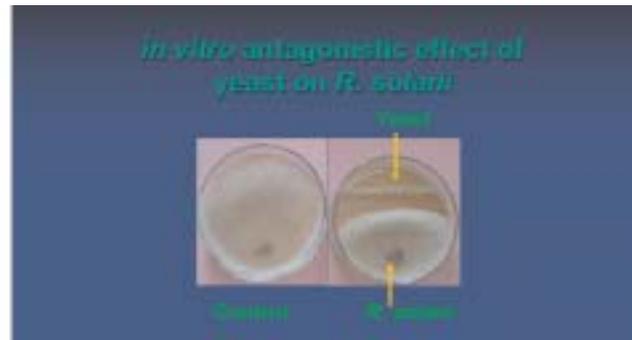


Fig. 1.23



Fig. 1.24



Fig. 1.25

It has been demonstrated under the study on Gametophytic and marker assisted selection for pyramiding *Fusarium* wilt resistance genes in chickpea at UAS, Bangalore that the genes conferring *Fusarium* wilt resistance in chickpea determine the resistance at both sporophyte and gametophyte phases. The *in vitro* pollen response to patho-toxin indicates the degree of resistance of the sporophyte producing pollen grains. The pollen bioassay is a simple indirect technique to determine and select the genotype of the plant. Further, gamete selection for wilt resistance in F_1 generation by a simple method (spraying the pathotoxin to F_1 plants at critical stage; Fig 1.26) increases the frequency of resistant plants in the F_2 generation. The molecular analysis of different crosses demonstrated the increased frequency of resistant plants in the populations derived through gamete selection. The gamete selection technique can be easily adapted in crop improvement programmes to enhance the frequency of resistant plants in the early generations for selection. It saves a lot of space and time.



Fig. 1.26 : Hybrid plant treated with pathotoxin for gamete selection

Research outcome from some completed projects are as follows:

Explorations were made in the evergreen forests of India, especially in Northeastern states and Andaman Nicobar Islands for the collection of live specimens under the project “Further studies on Indian Zingiberaceae” at University of Calicut, Calicut. The largest ginger germplasm in India and second largest in the world with 18 genera and 156 species and 1698 accessions was established in the Calicut University Botanic Garden. Digitalization of Zingiberaceae specimens deposited at CAL, ASAAM, BSHC, PBL *etc.* were completed and a database of Indian gingers was also developed. During this project two new generic records to India (*Plagiostachys* Ridl. and *Stahlianthus* Kuntze), one new species (*Plagiostachys nicobarica* M. Sabu *et al.*), five new cultivars of Large cardamom and two new species records for India were published in peer reviewed international journals like *Blumea*, *Rheedea*, *Folia Malaysiana* and *Acta Botanica Hungarica*.



Fig. 1.27 : *Plagiostachys nicobarica*



Fig. 1.28 : *Stahlianthus involucratus*

The *P. nicobarica* is a critically endangered species from Nicobar Islands and need special attention for its conservation. Most of the plants were wiped off during Tsunami. A few plants have been conserved in Calicut Univeristy Botanic Garden, Calicut.

Arabidopsis seedlings grow with two distinct developmental patterns in the presence and absence of light. A sophisticated molecular network is operative to sense the dark-light transitions, and regulate the seedling morphology and gene expression accordingly. Our laboratory has identified and functionally characterized several transcription factors (ZBFs, SHW1 and EHY1) that play important regulatory roles in light signaling pathways. Various studies suggest that Ca^{++}/CaM is involved in light mediated seedling

development and gene expression. However, the molecular and physiological function of CaM remains largely unknown. We have shown that CAM7/ZBF3 is a transcriptional regulator that directly interacts with the promoters of light inducible genes and promotes photomorphogenesis (Kushwaha et al., (2008) *Plant Cell* 20 1747-1759). We have further demonstrated that one of the ZBFs, ZBF2/GBF1 genetically interacts with COP1 and SPA1 of light signaling pathways. Furthermore, the stability of GBF1 requires the presence of COP1 ubiquitin ligase in light. However, the stability of GBF1 in the dark is not regulated by COP1 or its associated factor SPA1 (Mallappa et al., (2008) *Journal Biological Chemistry* 283, 35772-35782). MYC2/ZBF1 is a bHLH transcription factor that cross-talks with light, ABA (abscisic acid) and JA (jasmonic acid) signaling pathways. Under Investigation of genetic and molecular interrelations of ZBFs in light signaling pathways in *Arabidopsis thaliana* under Rammana Fellowship it has been shown that MYC2 directly binds to the G-box present in *SPA1* promoter, and it controls the expression of *SPA1* in a COP1 dependent manner (Figure 1.29). Taken together, study demonstrates the molecular and physiological interrelations of MYC2 and SPA1 in light, ABA and JA signaling pathways (Gangappa et al., (2010) *Plant Physiology* 154, 1210-1219). The outcome of the above project has been published in *Plant Physiology*, *Journal Biological Chemistry* & *Plant Cell*

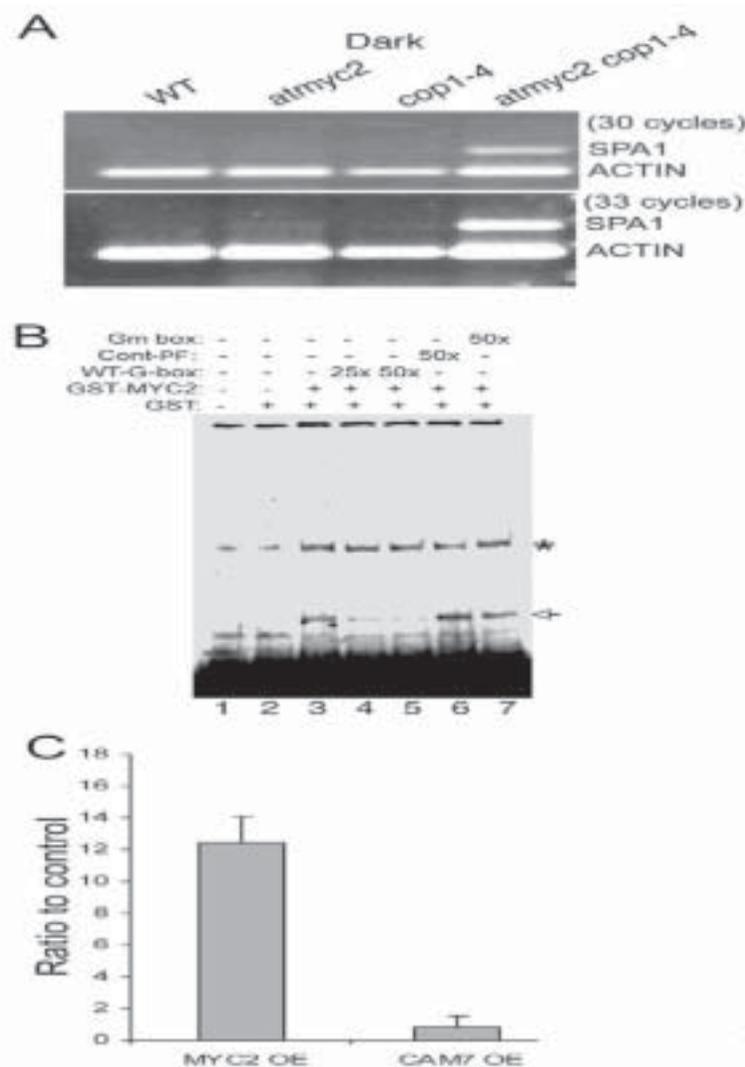


Fig. 1.29

Under the project on *Ganoderma lucidum* (fig.-1.30), a mushroom of medicinal and economic importance from Kerala was investigated for potential biologically active principles. Chloroform extract of *G. lucidum* showed acute and chronic anti-inflammatory activities. It showed significant DPPH radical, superoxide radical and nitric oxide scavenging activities along with inhibition of lipid peroxidation. Chloroform extract also showed *in vitro* cytotoxic activity with IC_{50} values $178.33 \pm 20.2 \mu\text{g/ml}$ and $46.66 \pm 4.7 \mu\text{g/ml}$ against DLA and EAC cell lines, respectively. Polysaccharide fraction isolated from the aqueous extract of *G. lucidum* showed antitumour activities against Ehrlich's ascites carcinoma cell lines when tested simultaneously with tumour inoculation and when administered before tumour inoculation. Polysaccharide fraction also showed significant anti-inflammatory activity. Extensive phytochemical studies on the pet. ether, chloroform and methanol extracts of *G. lucidum* fruiting bodies resulted in the isolation of sixteen secondary metabolites viz., steroids, terpenoids, alkaloids and fatty acids. Two major compounds identified were ergosta-7,22-diene-3 β -yl pentadecanoate (Fig. 1.31) and 3 β -hydroxy-7,11,15,23-pentaoxo-5 α -lanosta-8-en-26-oic acid. The steroid ester in the pet. ether and chloroform extracts was estimated by HPTLC. This major steroid ester showed good anti-inflammatory activity. Host-specificity in the chemical profile of *G. lucidum* has been studied by comparative HPTLC profiling. No significant variations were found between different host-based *G. lucidum* accessions. *G. lucidum* from south India is a repository of potential biologically active molecules.



Fig.130: *Ganoderma lucidum*

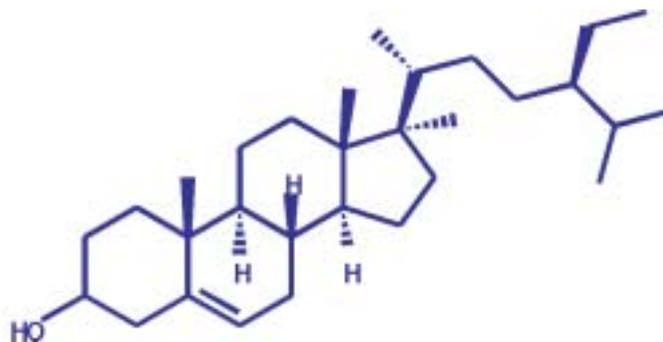


Fig. 1.31: Ergosta-7,22-diene-3 β -yl pentadecanoate

PHYSICAL SCIENCES

The research projects and programmes supported under Physical Sciences covered a wide range of emerging topics. The technical evaluation was done by Programme Advisory Committees (PACs) on (a) Condensed Matter Physics and Materials Science, (b) Plasma Physics, High Energy Physics, Nuclear Physics, Astronomy & Astrophysics, Nonlinear Dynamics and (c) Lasers, Optics and Atomic and Molecular Physics. The PACs also monitored the progress made in ongoing projects on a regular basis.

Condensed Matter Physics and Materials Science

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

In a project, study of excess conductivity in YBCO superconductor near T_c by introducing intra grain homogeneities using swift heavy ion radiation will be done. In another project, giant magneto-impedance of Fe and Co based amorphous alloys will be investigated. Electrical resistivity on transition metal oxides and silicate minerals at high pressure–high temperature conditions will be undertaken in this project towards understanding phase transitions and associated variations in the properties of the materials. Single crystals of a new multiferroic electronic ferroelectrics will be developed in another project. Study of dielectric relaxation, magneto- dielectric phenomenon and PE loops under magnetic field will also be performed. In a different project, nano size magnetic particles will be synthesized and their dispersion in various media for possible communication and engineering applications will be investigated. Fe, Se and $\text{FeSe}_{1-x}\text{Te}_x$ compounds will be synthesized and characterized in another project. Study of electronic structure, magnetic and transport properties of these iron chalcogenide superconductors will be done. In a project, nano-structured double perovskites will be synthesized and characterized for spintronics applications. Low lead and lead free ferroelectric-piezoelectric composites will be studied in another project. Synthesis, characterization, evaluation of dielectric/ferroelectric properties, structure- property correlations etc. of this important class of materials will be undertaken. In a different project, magnetic nano particles using magnetotactic bacteria will be synthesized in a project for biomedical applications. A scalable and eco-friendly method for synthesis of ferrite nanoparticle will be employed.

In a project, Organic-inorganic hybrid nanostructured liquid crystals materials will be synthesized and characterized in another project. Study of the dynamics of anchoring effects on the hybrid aligned liquid crystal materials will be performed. In another project, the banana and W-shaped liquid crystalline materials exhibiting chiral behaviour will be designed, synthesized and characterized. The influence of central core and interfacial layer interaction on the chiral properties will be investigated. The material characterization will be carried out by spectroscopic methods. Various material properties will be studied through Thermal microscopy, DSC, X ray etc. Banana shaped liquid crystals will be synthesized using standard methods in a different project. These will be characterized by spectroscopic techniques. Study of their optical and electric properties will be accomplished. Different types of DLC materials will be synthesized in another project. Their optical properties like birefringence, tilt angle, switching, dielectric anisotropy etc. will be measured. The measurement of the spontaneous polarization of FE and AE LC phases in the DLCs formed by their chiral molecules will also be performed.

In a project, PANI composites will be synthesized towards the development of multicomponent sensor materials. Materials characterization and fabrication of sensor devices with multicomponent materials in pallet/film/FET gate module will be done in that project. Red phosphors suitable for white LED applications will be developed in another project. Nanomicrostructures will be synthesized on semiconducting substrates in another project. Electro deposition of metallic and semiconducting materials will be used to study their

electrical properties. Colourful, device grade dye sensitized solar cell based on nanoporous ZnO films with targeted efficiency of 4-5% will be developed in another project.

Nano-microstructures will be synthesized using polymeric layer on semiconducting substrate and create templates making track etched membranes (TEM) and finally electrical properties will be studied using electro deposition of metallic and semiconducting materials in another project. Interaction of surface and interface properties on photophysical behavior of nanocrystals will be investigated. Quenching of photoluminescence when porous silicon gets functionalized and exposed to organic vapours will be studied in a different project. Electret state in biodegradable polymers with the aim of utilizing the electret property of drug carrier biodegradable polymers will be studied in another project. Hybrid core-shell nanoparticles will be grown and characterized in one of the projects, this work will decouple optical and transport gaps of the nanoparticles with the possibility to tune the two gaps independently.

Deposition of Ta_2O_5 - TiO_2 thin films of uniform thickness for microelectronic applications will be undertaken in another project. Nanocrystalline TiO_2 thin films will be fabricated by chemical routes and characterized for their structural and optical properties in a different project. Quantum dots of CdS and CdSe will be made by chemical methods and incorporated in the TiO_2 thin film matrix to prepare quantum dot sensitized solar cells.

In a project pure and rare earth doped KTP single crystals will be grown and characterized for electro-optic applications. In another project, nanobioactive glasses (NBG) will be synthesized by sol-gel and sonochemical methods. Electrochemical anodizing method will be employed to coat NBG on the implants such as Ti, Ti alloys and stainless steel

In one of the projects, phase separation kinetics in binary fluid mixtures, in bulk and near surfaces will be studied through two different simulation techniques of molecular dynamics and coarse-grained Ginzburg-Landau models. Surface-directed spinodal decomposition studies will also be undertaken in the project. FFLO state in a variety of systems, including specifically cold atom systems will be studied in another project. Phase transitions between the BCS-FFLO-normal states will be tracked by employing Josephson effect. Relationship between fermionic superfluidity and atomic superfluidity will also be studied. Correlation between magnetic and electronic structure of DMS systems will be studied in a different project. Element specific magnetometry and electronic structure study of such class of materials will be accomplished. Standard one - dimensional bosonization approach will be extended to higher dimensions in one of the projects and this will be used to calculate quantities of interest in the higher dimensional interacting Fermi liquid. Complex spin systems with quenched disorder will be studied in another project using graph cut techniques.

In a project, the electrical conductivity of transition metal oxides and minerals will be measured as function of pressure and temperature upto 9 GPa and 2000 K respectively will be developed. In a different project, electron transport studies on electromagnetic potential barriers, impurities and electron-electron interaction etc. in grapheme will be undertaken. Swift heavy ion induced modification on thin film and nanostructure of TCO will be analyzed/ studied in a separate project. In a project, thermal protection materials will be synthesized by magnetron sputtering and shock initiated combustion synthesis and their interaction with high enthalpy gases produced by shock waves will be studied. Elaborate study of high enthalpy gas dynamics, non equilibrium reactions, catalytic and non-catalytic surface reactions will be performed. Ion transport mechanism in different ion conducting systems (electrolyte and positive electrode

material) will be studied and optimized for advanced energy storage applications in a different project. Eco-friendly zeolites will be synthesized in pellet and film form environmentally health hazardous fly ash by hydrothermal method in a project. Gas sensing properties of zeolites will be studied. One scientist has been awarded the Ramanna Fellowship.

Several interesting results were reported from ongoing projects.

In a project, importance of pulling direction and molecular crowding on the force induced transitions in Biopolymers was demonstrated. Explanation for decrease in extension with temperature in constant Force ensemble and the theoretical understanding of structural transitions in single stranded DNA were some of the significant contributions. A long standing puzzle in NA biophysics related to force-temperature diagram had also been studied. A protocol to observe the reentrance in force induced transition at ambient condition had been proposed for the first time.

In a different project, the breathing dynamics of DNA observed experimentally was explained using stochastic dynamics. The equilibrium opening constant of single base pair found using imino proton exchange and NMR spectroscopy was explained by developing theory taking into account the energy barrier. The melting transition of DNA which was found to be the first order had been explained by developing a theory to calculate the statistical weight of a bubble. Theory was developed to describe the formation of loops and stems in RNA and single stranded DNA. A free energy functional for ordered phases had been developed. That included symmetry conserving and symmetry broken pair correlation functions. The free energy functional was used to study the stability of glassy phase and elastic constants of solids.

In another project, a class of p-band materials, showing orbital ordering, was identified. Charge ordering was found to derive ferromagnetism in $K_2Cr_8O_{16}(K_{0.25}CrO_2)$, $SrVO_3$ thin films. Orbital ordering was found to derive a metal insulator transition in $SrRuO_3$ thin films.

Electron transport through a variety of mesoscopic systems, such as along a line junction which lied between two quantum hall systems, across a point contact in a quantum hall state with filling fraction 5/2 and across a quantum dot where electrons could interact with each other, were studied in another project. Effect of quenching systems across a variety of quantum critical points or lines were also studied. Interesting results were obtained in the project.

In a different project, phase transition properties of ferroelectric and antiferroelectric liquid crystals & reentrant phenomena in archiral liquid crystals were studied. The order parameters coupling terms driven the system to nematic reentrance regime above a critical pressure. New thermodynamic model to study the properties of ferroelectric and anti ferroelectric mesogens was developed. MC and MD simulations were being performed towards studying structure and properties of mesogenic systems.

Origin of electron hole asymmetry in the cuprate phase diagram had been explained through one of the projects. A single parameter description of the phase diagram via the Fermi surface convexity parameter was obtained. New method for optimization of variational wavefunction was developed.

Fundamental band to band and excitonic absorption and refraction with and without field was studied for group IV alloys based materials in another project. Performance of photodetectors using Si/SiGe multiple QWs and GeC layers was analysed.

In another project, a new low temperature Mossbauer set up was installed. It has the range from room temperature down to 4.4K. ^{57}Fe Mossbauer was studied over a wide temperature range in nanoporous

Fe_2O_3 , nanorods of $\alpha\text{-Fe}_2\text{O}_3$ and nanoparticles of $\text{La}_{1/3}\text{Sr}_{2/3}\text{FeO}_3$. The results at low temperature distinctly probe the microscopic properties such as local internal magnetic field, superparamagnetism, relaxation dynamics, blocking temperature, isomer shift, quadrupole shifts and proportion of different magnetic phases.

A cryogen free 8 Tesla high magnetic field superconducting magnet with power supply, compressor (Fig. 1.32) and integrated variable temperature insert (1.6 – 325K) was successfully installed and calibrated in another project. Synthesis of nanometric CMR, charge and orbital ordered manganites (PrSrMnO, NdSrMnO, LaGdSrMnO, SmCaMnO, LaSmCaMnO, NdPrSrMnO), Spintronic oxides (Fe, Ni, Co, Mn transition metal doped ZnO), Magnetic heterojunction (LSMO/ZnO/sapphire, LSMO/SiO₂/Si, LCMO/SiO₂/Si, Pt/ZnO:Fe/sapphire) etc. was carried out and characterized through XRD, TEM, FESEM, EDAX and AFM.

In a project, the MPMS-XLS SQUID magnetometer was successfully installed under this facility. Users from different academic institutes and universities had been utilizing the facility to study a variety of areas/problems i.e. multi ferroics, FSMAs, Giant Magnetoresistance in Cu-Co multilayers and granular nanostructures, ferromagnetic semiconductors, hydrodynamic properties of magnetic nanoparticles, dilute magnetic semiconductor oxides, superconductor MgB_2 etc.

A valved oil free two stage linear motor compressor for driving the J-T circuit was developed and tested for operating conditions in the project. Complete thermal analysis and development of computer codes for designing of heat exchanger taking care of thermal properties changes at low temperature were carried out. Pressure wave generator for driving two stage pulse tube cooler had been tested in the project.

In another project, interfacial nano-granular magnetic phase had been realized by swift heavy ion irradiation for magnetic material semiconductor interfaces in the project. These nano-granular interfacial magnetic phases embedded in semiconductor enhanced the current flow by two orders of magnitude and gave rise to magnetic field sensitivity on electronic transport across the interface. The magnetic field sensitivity further gave rise to GMR effect showing the influence of spin controlled electronic transport.

A novel way to measure spin life time in semiconductors was demonstrated in another project. Spin polarized electrons were injected in bulk GaAs and Ge using circularly polarized light. The polarization is modulated at high frequency; the changing magnetic field generated by the spin polarized carriers was detected by a sensitive RF coil. On application of a magnetic field, the signal decays according to the Hanle effect from which the life time was determined.

BST and BZT ceramics were synthesized and the dielectric properties on the samples were investigated in another project. Attempt was made to lower the sintering temperature of BST by the addition of low loss glasses.

A dilution refrigerator was installed in a project. Base temperature of 9 milliKelvin was achieved in the project. Low temperature cryo-amplifier was designed and calibrated. Noise in graphene based field effect transistors had been measured. A new phase had been observed in low-density GaAs/AlGaAs systems.

In a project, single crystals of high performance piezoelectric PZNT were grown by flux method. Crystallographic, dielectric, piezoelectric and mechanical properties of these samples were studied in detail. L-lysine monohydrochloride (LLMHCL) and glycine lithium sulphate were grown by slow evaporation solution growth technique in a project. The grown crystals were characterized by XRD, UV-VIS-NIR and TGA/DTA techniques.

Different gel/polymer electrolytes were synthesized for their application as solid like electrolytes in supercapacitors in one of the project. The capacitors were characterized using a.c. impedance spectroscopy, cyclic voltametry, galvanostatic charge-discharge tests for different current densities and prolonged cyclic tests.

Organic films deposited with low evaporation rate and high growth temperature lead to high structured order and an improvement in organic FET in one of the projects. P-type doping could be achieved in organic semiconductors using charge-transfer technique.

In one of the projects, an electronically push-pull type DPNME was designed, synthesized and modeled for its ground state electronic structure and excited state transitions with DFT and TD-DFT computations and its intramolecular charge transfer pathway was established. Protonation induced molecular orbital switching and insulator –metal transition in interfacial monolayer protected Janus clusters-capacitance tuning was achieved. Real –time monitoring of DPPC-Tryptophan interaction at air-water interface was also estimated.

Synthesis and characterization of fullerenated polybenzol [c] thiophene and fullerenated poly (N-vinylcarbazole) and polybenzo [c] thiophene was performed in another project. Photovoltaic characterization on these materials has been performed.

In a project, Raman spectroscopic studies of 13 LnO₃ compounds were carried out at normal atmospheric pressure. High pressure studies upto 15GPa to 20 GPa were carried out on Y₂O₃, Gd₂O₃, Sm₂O₃, Pr₂O₃, Eu₂O₃ etc. High pressure XRD studies were completed on Gd₂O₃.

Laboratory for electric measurements and small scale chemical synthesis was established in another project. A number of oxalate – ligand based mixed-metal molecular materials were prepared and characterized electrically.



Fig. 1.32: Valved Oil free two stage Linear Motor compressor

The existing FCVA system was modified in one of the project. Cathodic Jet Carbon Arc (CJCA) and Anodic Jet Carbon Arc (AJCA) techniques were custom designed and fabricated & integrated into the existing Filtered Cathodic Vacuum Arc (FCVA) system. Undoped and nitrogen doped amorphous carbon thin films were deposited using CJCA techniques. Undoped ac films were also deposited using AJCA techniques. The effect of substrate bias, arc current and magnetic field were studied on the electrical, optical mechanical, structural properties and field emission properties.

In one of the projects, phase pure, CuInO_2 films and Sn & Ca doped CuInO_2 films were deposited by RF sputtering under different conditions. Structural, optical, electrical and interface properties of these films had been studied.

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

In one of the project, a large area atmospheric glow discharge apparatus (10kv, 10KHz) will be set up for treatment and possible restoration of antique paper manuscripts. In another project it is proposed to set up the experimental system as well as incorporate various diagnostics for laser liquid and solid-liquid interface for characterization of kinetics of plasma using time- and space-resolved spectroscopy and beam deflection technique. The laser plasma interaction as applied to particle acceleration and radiation generation will be investigated in a different project. The computations will focus on optimization of the wakefield amplitude and gain in electron energies and also on the development of radiations sources generated during laser plasma interaction. In another project, analytically the generation of surface harmonic of very high order by the plasma electrons undergoing strong anharmonic motion under the influence of intense laser field at intensities $\sim 10^{22} \text{ w/cm}^2$ will be investigated. Various parameters which can influence the high order harmonic generation will also be studied. In another project, effect of magnetic field on laser ablated plasma plume as well as on the process of pulsed laser deposition during ablation of SrRuO_3 will be studied. Optical imaging and Langmuir probe would be used to characterize and understand the process under magnetic field.

In one project the supersymmetric extension of the Left-Right symmetric models to describe some of the aspects of Physics beyond the standard model for elementary particles will be explored. Studies on some quantum aspects of gravity, in particular some geometrical aspects of D-brane dynamics in the framework of sting theory and non-commutative geometry will be done in one project. Techniques of calculation on the properties of chiral fermions on the lattice, and to increase the performance rate of computers on which the relevant programmes will run will be developed in another project. In one project, gauge theories in space time with generalized non-commutability will be studied. This will be extended towards generalisation of the constant non-commutativity parameter to a situation where it is a dynamical field. The connection between quantum entanglement and quantum phase transitions in disordered systems will be studied in another project. The Problems of hydrogen molecular ion placed in external fields involving a nontrivial 3-body interaction will be dealt in a different project. Investigation on new physics beyond standard model using data from the belle experiment and detector R&D for the super KEKB experiment will be done in another project. CP properties of MSSM higgs sector in the context of LHC". He proposed to address the questions of CP violating Higgs sector in the Minimal Supersymmetric Standard Model (MSSM) will be studied in a different project. Another project will aim of investigating some open issues in the theory of origin of the inflationary cosmology within the general framework of "brane inflation" scenario inspired by String Theory. Some issues pertaining to the so-called "Quasi-Normal Modes" (QNMs) of Black Holes, again within the broad framework of string theory, in particular, using the so-called gauge/gravity duality will also be studied.

In a project, final outcome of the various chemical species of interest formed in star-forming regions in the interstellar space will be predicted by coupling the hydrodynamics of the collapsing rotating cloud to the chemical evolution network. In another project by creating a systematic and unified database of interstellar absorption in the Galaxy from various available astronomical data, a 3-D map of the interstellar medium will be created. A primarily an exercise in multivariate statistical analysis will be done in another project to understand the differences and/or relationships between dwarf spheroidal galaxies, dwarf irregular galaxies and ultra-compact dwarf galaxies.

In one project, Different methods of Pade approximation related to semi-classical orthogonal polynomials in nonlinear dynamical systems will be studied. Emergent dynamics on growing networks with comparable time scales will be investigated in another project. In a different project, various mechanisms to modulate the phase (frequency) of the x-band Gunn oscillator with radio frequency chaotic signal, and then synchronize with another Gunn oscillator will be explored. Chaos based security systems in transform domains will be studied in another project. He proposes to investigate optical solitons in quadratic non linear media, photorefractive materials and left handed materials will be investigated in a different project. Temporal, spatial and incoherent soliton propagation through non linear optical media will be studied in this project. Solitons in autonomous and non-autonomous inhomogeneous nonlinear optical media will be investigated in another project.

In one project, high energy heavy ion induced nuclear fragmentation reactions for different target-projectile combinations related to hadron and space applications will be studied. Investigations on Hadron interactions near threshold with nucleons and nuclei will be studied in another project. The RMF approach is extremely successful in providing a reliable description of the nuclear masses and radii with good precision. However, its predictions for nuclei near shell closures and drip lines could be improved. One of the projects will investigate the various aspects of RMF to improve the prediction capability of RMF for nuclei far away from the line of stability. In another project, a systematic study of multi-quasiparticle states and nuclear isomers in the near-yrast and non-yrast level of nuclei will be performed

In additions to above Ramanna Fellowship has been awarded to one scientist.

In addition to this, one SERC School on “Astronomy & Astrophysics” was held at National Centre for Radio Astrophysics, Pune during June 14 – July 10, 2010. SERC Preparatory School in Theoretical High Energy Physics (THEP) was held at Birla Institute of Technology & Science, Goa during October 20 - Nov. 16, 2010. SERC Main School in Theoretical High Energy Physics (THEP) was held at Jamia Millia Islamia, New Delhi during January 31 - Feb 20, 2011. SERC School on “Nonlinear Dynamics” was held at Bharathidasan University, Trichy during January 04-26, 2011. SERC School on “Nuclear Astrophysics and Neutrino Astrophysics” was held at University of Calicut, Calicut during January 18 – February 08, 2010.

Several interesting results were reported from ongoing projects.

In a project, research involved in the general field of High Energy Physics phenomenology and cosmology, mostly in the background of data expected from the commissioning of the Large Hadron Collider (LHC). Some of the possible signatures for new physics that may be uncovered there had been investigated.

In another project many new problems in nonlinear oscillators, nontrivial soliton interactions in nonlinear Schrodinger equations in $(1 + 1)$ and $(1 + 2)$ dimensions, matter wave solitons in BECs with homogeneously

varying control parameters, chaos synchronization in coupled delay systems, nonlinear dynamics of underlying magnetizations evolution in nano ferromagnets under the influence of spin current, experimentally realized strange nonchaotic attractor using electronic circuits etc. had been investigated in detail. From the above investigations several new and novel results in the area of nonlinear dynamics were produced.

In a different project, an extensive survey of Megalithic stone alignment at Vibhutihalli in Shahpur taluk, Karnataka was done along with initial survey of few other sites such as Hanamsagar, Rajan Kollur in Shorapur Taluk and Bhimrayanguddi, Shahpur taluk in Gulbarga district and Mudumal, Murardoddi sites in Mahbubnagar district, A.P. Literary as well as observational data related to Vidya Shankara temple, Sringeri along with Suryanar koyil, Thanjavur, Thiruvvisayanallur temple and Karketeswara temple, Kumbhakonam, T.N. and Chaya Someswara temple, Pangal, Nalgonda, A.P. and *suryapitha* from State Archaeological Museum, Hyderabad- were obtained and photographs taken by the team have been analyzed. Substantial progress had been made in tracing the evolution of astronomical spectroscopic studies in India during 18th to 20th century.

Lasers, Optics, Atomic and Molecular Physics

Among the projects that were sanctioned, in one of the projects, supercontinuum generation in nonlinear photonic crystal fibre will be studied for different core materials with diverse fibre parameters. Analytical models will be developed and subsequently numerical verifications using standard software will be attempted. Vector beams using optical fibres will be generated and studied through another project. In another project, diffractive optical elements (DOEs) will be developed with sub wavelength features on miniature substrates like the tips of optical fibres for eliminating separate optics for focusing the beams.

In a different project, nonlinear properties of atomic and molecular BESs keeping in view the large high order non-linearities will be investigated. A time resolved fluorescence study of microscopic samples with the aim of investigating the effect of dipole-dipole interaction and radiative rate will be undertaken in another project. The acoustic memory effect at the ferroelectric domain wall in lithium niobate crystals will be studied in another project.

A special effort was made to organize interaction meetings on the fields

“Growth of Technologically important Crystals” during 4-5 February, 2010. One discussion Meeting on “Intense laser fields and their interactions with Matter” was held on April 15 and 16, 2010 at TIFR, Mumbai.

In addition to this, SERC School on “*Theoretical techniques in atomic & molecular collision physics*” was held BITS, Pilani during April 05-23, 2010, .one SERC School on “*Nano Optics*” was held at NIT Hamirpur during September 13-October 01, 2010. One SERC Preparatory School on “*Modern Optics*” was held at IIT Guwahati during November 10-23, 2010.

Several interesting results were reported from ongoing projects.

In a project, pseudo pure states, entanglement of end qubits and W –states in a 3-qubit system using only nearest neighbour Ising coupling were achieved. Adiabatic 1-SAT algorithm using strongly modulated pulses and quantum version of several games were implemented. Deterministic Bell discrimination using a 3-qubit NMR quantum processor was performed in the project. Long lived singlet states in NMR were experimentally monitored. It was found that CSA/DD cross correlations did not effect the life time of the long lived singlet state in a two spin system.

A resonant non linear magneto-optic rotation (NOMR) set up with amplitude modulated light was established using an acousto-optic modulator in another project. A comprehensive experimental and computational study of Hanle EIA, EIT and NMOR were carried out. A four layer mu-metal magnetic shield was fabricated in the project.

In a different project, two novel schemes of THz generation using optical rectification of intense short pulse laser and optical rectification of pulsed surface plasma wave were explored. Feasibility of driving a THz wave by an electron beam in rippled density plasma was shown in the project.

Analysis technique was developed for photonic crystal fibre in one of the projects. Renovation of conventional MCVD fibre fabrication unit for drawing photonic crystal fibre was done in the project. Some of the designed structure was fabricated and analyzed for liquid filled sensor.

In a different project, two specific designs of segmented cladding fibre in fused silica glass material were completed. Both the designs employed Ge-doped silica glass for core and high –index cladding segments, F-doped silica for low –index cladding segments and pure silica glass for the outer index jacket.

In another project, symmetrically etched straight and bend waveguides was fabricated using a single mask process followed by dicing and end-facet polishing. Asymmetrically etched bend waveguides were also fabricated and characterized in the project. Compact integrated optical directional couplers with symmetrically and asymmetrically etched S-bend waveguides on SOI platform was designed, fabricated and characterized in the project (Fig. 1.33).

In a project, Laser beam filamentation at ultra high powers and studied the effect of this filamented laser beam on Stimulated Raman Scattering (SRS) and Stimulated Brillouin Scattering (SBS), harmonic generation and particle acceleration. It was found that the SRS could be suppressed upto 20% in laser filaments due to enhanced Landau damping.

In another project, nano size metal colloids were prepared by using laser ablation technique in different polymer systems like PVA, PMMA, Poly vinyl pyrrolidone/PVA blend and copolymer doped nanocomposites (PMMA/Ag and PMMA/Au). The formation was confirmed by UV-VIS study. Third order NLO study was performed with Z scan set up. The obtained value of non linear susceptibility and non linear refractive index were of order of 10^{-11} and 10^{-9} respectively.

Bimetallic thiocyanate non linear optical crystals of CMTC and MMTc were grown in a different project. The crystals were investigated by carrying out structural, optical, non linear optical, mechanical thermal and surface properties studies.

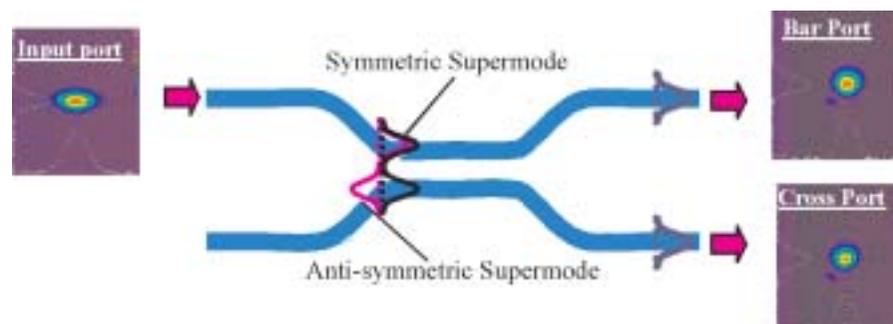


Fig. 1.33: Schematic of a directional coupler along with the experimentally measured mode profiles at the input and output ports (TE-pol, $\lambda = 1.55 \mu\text{m}$)

STRENGTHENING INSTITUTIONAL CAPACITIES IN RESEARCH AND DEVELOPMENT

In India's quest for global competitiveness in science, technology and trade, universities and related institutions have to play a major role as providers of high caliber human resource and as repositories of national intellectual wealth in the R&D sector. In order to meet these diverse challenges, strengthening the existing S&T infrastructure support system in the universities and other related institutions, DST has designed several new programmes and implementing various schemes. Under the scheme Fund for improvement of Science and Technology (FIST) state of art facilities and equipments in universities and higher educational institutions have been installed. FIST offers competitive grants for academic departments for strengthening the R&D infrastructure. Sophisticated Analytical instruments vital for pursuing research in cutting edge areas of modern science and technology have been provided through the Sophisticated Analytical Instrument Facilities (SAIF) programme so that non-availability of these instruments does not come in way of the scientists in pursuing R&D activities. Intensification of Research in High Priority (IRHPA), the main thrust of the scheme is to ensure intensification of scientific research in selected areas of great relevance and potential for scientific and technological development of the country.

As a proactive and inclusive measure, the Department has designed and developed special packages for North East Region, J&K and Bihar for strengthening science and technology education in the years 2008-09, 2009-10 and 2010-11, respectively. An initiative entitled "Promotion of University Research and Scientific Excellence" (PURSE) provides incentive grant system for universities based on the evidence of scientific publications. Consolidation of University Research for Innovation and Excellence (CURIE) is a special initiative to improve the R & D infrastructure of 'Women Universities'.

Mega Science initiatives have been launched in collaboration with Department of Atomic Energy facilities for creation of new facilities and gain access to state of the Art R&D facilities in and out of the country for the Indian scientific community, especially from the academic sector. New initiatives to connect Indian R&DS systems through science bridges with institutions in UK and joint R&D programmes with EU and USA have been developed

The Department has more than doubled fund allocation for strengthening of Research and Development capacities in the academic sector in the country during the last three years. A review of the performance of the 14 universities selected for research incentive grants under PURSE was made in the year 2010-11. Improved performances of all 14 universities during last three years are reported. 29 new universities have qualified for support. Share of university contribution to scientific publications has increased from 15% to 31% levels in last six years.

FUND FOR IMPROVEMENT OF S&T INFRASTRUCTURE IN UNIVERSITIES AND HIGHER EDUCATIONAL INSTITUTIONS (FIST)

Considering the status of the S&T sector in the universities and related academic institutions who were in dire need for strengthening the existing S&T infrastructure support with adequate funding and associated flexibility, nearly a decade ago the scheme "**Fund for improvement of S&T infrastructures**

in universities and higher educational institutions (FIST)’ was launched to provide support for basic infrastructure & enabling facilities and conducive environment for promoting R&D in new and emerging areas including ready access to information system, networking, databases & scientific journals and also to computational facilities. It has enabled the Universities & academic institutions for attracting fresh talent, pursue competitive research and also enhanced visibility of these departments.

Currently, the Program is in operation in two levels of support i.e Level – I & Level – II in six broad subject areas i.e. Life Sciences, Physical Sciences, Chemical Sciences, Engineering Sciences, Earth & Atmospheric Sciences & Mathematical Sciences along with support to post-graduate colleges as ‘College as a whole’. A two-tier committee structure i.e. i) FIST Advisory Board (FISTAB) and ii) Seven expert Committees are in place for implementation of the Program.

Till 2009, more than 1300 departments spread over around 350 academic institutions including about 150 Colleges have been covered at a total investment of more than Rs 950 crores. Apart from support made available to about 100 on-going projects of FIST 2005, FIST 2006, FIST 2008 & FIST 2008, 40 new proposals identified during FIST 2009 have also been supported in the current year.

In the year 2010 based on the advertisement towards seeking fresh proposals out of more than 400 fresh proposals received, finally 120 proposals in six subject areas from the Departments of various Universities & Institutes and 30 proposals from the post-graduate Colleges have been finalized at a cost of about Rs 158 crores for support under this program. It is expected to complete the support of these projects in the current year.

Since monitoring and reviewing of the progress is a part of the activity in the overall implementation of this program, evaluation of 94 projects in both Levels and all subject areas has also been completed during the year. Further to reviewing individual projects supported under the program, an independent study was also carried out to evaluate the performance & importance of the program as a whole. The study basically compared and analyzed pre & post FIST support scenario in each department with statistical methods. The salient findings of the study are as:

- Substantial increase in the number of Research Publications in SCI Journals as well as non-SCI Journals, Conference Proceedings & Books,
- Increase in enrollment of students in M Tech course in Engineering & Technology in post-FIST era,
- While an appreciable increase in enrollment of Ph.D. students in Science subjects, statistically significant increase in M.,.Sc. and PhD degrees granted in Life Sciences area in post-FIST period.
- Significant increase in funding received from other sources as sponsored projects during post-FIST in all other subject,
- Significant increase in recruitment at the Lecturer level in University Departments,
- In Engineering departments, generation of funds through consultancy increased by 3-fold in post-FIST period apart from increase in publications and also increase in Industry User of Laboratory facilities in Engineering Departments.

Moreover the Program has enabled many departments to install some of the state-of-art facilities such as Ion Chromatograph, Automated DNA Sequencers, Ultracentrifuges, FACS, Scanning Probe Microscope, Oligonucleotide Synthesizer, HPLC-cum-FPLC, Molecular Imaging System, Liquid Nitrogen Plant, Liquid Helium Plant, High Resolution Powder X-ray Diffractometer, Single Crystal X-ray Diffractometer, 300 MHz, 400 MHz & 500 MHz FT-NMRs, Mass Spectrometer, PPMS, Thermal

Analyzer Systems, Plasma Deposition Etching System, Universal Testing Machines (UTMs), Renshaw Raman System, Electron Microprobe Analyzer, High Resolution Microscopes, Confocal Microscope, Field Emission Scanning Electron Microscope, High Resolution Transmission Electron Microscope, Protein Sequencing Platform, Atomic Force Microscope, Scanning Tunneling Microscope, Vacuum Melting Furnace, High Resolution Mass Spectrometer, High Power Computational Facility, etc. Apart from this, more than all most all departments supported under the program have created a Computer Laboratory in the department which are being extensively used by students, research scholars and faculty members for computational and other activities like Internet browsing etc.. A large number of Wet Laboratories at universities and colleges mostly in the Chemistry and Life Sciences area have also been renovated to provide a modern look. The departments of small universities and colleges have also been benefited by acquiring Text Books for the Department level Library.

Meanwhile the program on rejuvenating of research in S&T i.e. FIST has expanded its wing in different areas i.e. Special Packages for states/region having marginal participation, incentive based special support for enhancing research activities in select universities (PURSE) and also support to Women Universities (CURIE). Accordingly different programs are designed and developed at DST for this purpose.

CONSOLIDATION OF UNIVERSITY RESEARCH FOR INNOVATION AND EXCELLENCE IN WOMEN UNIVERSITIES (CURIE)

In 2009, the Department initiated a special programme “CURIE” (Consolidation of University Research for Innovation and Excellence in Women Universities) to enhance R&D infrastructure in women universities. Since 2009, 6 Women Universities have been supported under CURIE programme. This year, under CURIE department has supported Two (2) Women Universities i.e. - i) Karnataka State Women’s University, Bijapur and ii) Mother Teresa Women’s University, Kodaikanal for 3 years. This new initiative is expected to make an impact on the quality of research output from these universities.

PROMOTION OF UNIVERSITY RESEARCH AND SCIENTIFIC EXCELLENCE (PURSE)

PURSE is a pro-active initiative of DST to boost research activities in the University sector. The main objective of PURSE Scheme is to initiate Value added Research & Development Support in performing Universities. DST provided support to these universities essentially for research man-power cost, augmentation of equipment & computational facilities, research consumables, organization of scientific conferences/workshops, travel and maintenance of the facilities.

As the first instalment of research grants was made available to universities under this program in 2009, the universities have started procuring and installing the equipments/facilities. The major expected outcome of the scheme is improved research performance in terms of publication output in supported Universities and therefore up gradation in h-index of performing universities.

The support provided to each university has been classified under ‘Flexible’ and ‘Fixed’ Components. The expenditure heads in ‘Flexible Components’ are totally flexible with in 85-80% of total budget. The expenditure heads under Flexible Component includes support for acquiring Equipment, Consumables, Infrastructure Facilities and Networking & Computational Facilities. The support areas in ‘Fixed Components’ covers expenditure heads like Manpower Cost (10-15%), Contingences (1%), Travel (1%), Seminar/Workshop to organize or to attend abroad(1%) and Maintenance (2 %) and comprises 20-15 % of total support.

Based on Study Report “Status of India in Science and Technology” as reflected in its publication Output in Scopus International Database, 1996-2006” by NISTADS, New Delhi, top 35 S&T Institutions in India were listed based on ‘h-index’ value. Out of which there were 14 performing Universities whose h-index ranging from 56 to 26 these have been considered for support ranging from Rs 30 crores to Rs 6 crores for 3 years. The total cost of this program is Rs 201 crores for 3 years and Rs 67 crores for the 1st installment in the first year has released to these 14 Universities during the last financial year. Similar independent studies were carried out this year as well and 30 Universities whose h-index are up to 26 have been pro-actively identified for support in the current year with a total investment of Rs 264 crores for next 3 years, starting from current year. The list of 30 Universities identified for support in the current year is at Table given below:

Table 2.1: Identified Universities with respect to h-index values for support under PURSE Scheme in 2010-11.

S. No	University	h-index (1998-2008)	S. No	University	h-index (1998-2008)
1.	University of Calcutta, Kolkata	42	16.	Osmania University, Hyderabad	32
2.	Annamalai University, Annamalainagar	41	17.	Dr Harisingh Gour University, Sagar	32
3.	Bharathidasan University, Trichi	37	18.	Mangalore University, Mangalore	31
4.	Bharathiar University, Coimbatore	37	19.	University Kalyani, Kalyani	31
5.	University of Burdwan, Burdwan	36	20.	University of Mysore, Mysore	30
6.	Guru Nanak Dev University, Amrisar	36	21.	University of Lucknow, Lucknow	30
7.	Sri Venkateswara University, Tirupati	35	22.	Pondicherry University, Pudducherry	30
8.	Mahatma Gandhi University, Kottayam	35	23.	CCS Haryana Agricultural University, Hisar	30
9.	University of Jammu, Jammu	34	24.	Bangalore University, Bangalore	30
10.	Cochin University of Science & Technology, Cochin	34	25.	Punjab Agricultural University, Ludhiana	29
11.	M S University of Baroda, Vadodara	33	26.	Tamil Nadu Agricultural University, Coimbatore	27
12.	Shivaji University, Kolhapur	33	27.	University of Agricultural Sciences, Bangalore.	28
13.	Utkal University, Bhubaneswar	33	28.	Alagappa University, Karaikudi	27
14.	Madurai Kamaraj University, Madurai	32	29.	Sardar Patel University, Anand	26
15.	University of Kerala, Trivandrum	32	30.	North Eastern Hill University, Shillong	26

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 Sophisticated Analytical Instrument Facilities (SAIF) programme to enable them to pursue R&D activities requiring such facilities and keep pace with development 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, Secondary Ion Mass Spectrometer, ICP, NMR, EPR Spectrometers, Mass Spectrometers, X-ray Diffractometers and 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, X-ray Diffractometry, Molecular characterization/structure determination and Magnetic material characterization to meet the current and emerging needs of research community. Some of the major instrument facilities installed at the SAIFs during the year are Vibrating Sample Magnetometer (Photograph 1) at the SAIF, Chennai, High Resolution Scanning Electron Microscope with EDAX & WDS and GC high resolution Mass Spectrometer (Photograph 2) at the SAIF, Mumbai, Q-TOF high resolution Mass Spectrometer (Photograph 3) at the SAIF, Lucknow, 200 KeV Transmission Electron Microscope (Photograph 4) at the SAIF, Shillong and Single Crystal X-ray Diffractometer (Photograph 5) at the SAIF, Kochi. The following instrument facilities are further being added to the existing SAIFs to strengthen them. FT-Raman Spectrometer at the SAIF, Chennai, ESR Spectrometer at the SAIF, Mumbai, X-ray Fluorescent Spectrometer at the SAIF, Chandigarh and Single Crystal X-ray Diffractometer at the SAIF, Guwahati. The SAIFs over the years have acquired the capabilities of repair and maintenance of instruments and a substantial number of the instruments with them are being maintained in-house.

ANALYSIS PROVIDED/OTHER ACTIVITIES UNDERTAKEN

Analysis Provided

- A wide range of sophisticated analytical instrument facilities/techniques are being provided by the SAIFs to the research workers from all parts of the country. The instrument facilities at the SAIFs are meeting the analytical needs of scientist for materials characterization 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.
- 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, research in various areas of Chemical sciences, Study of biomolecules and their structure elucidation, Research in Condensed matter physics/material science, Nano-science & technology, studies related to crops/seeds, insecticides, various diseases etc. About 1,000 research papers were published by the users of the SAIFs with the support from the facilities provided.
- About 14,000 research workers from all over the country utilized the facilities during the year. These included research workers from almost all the universities in the country. About 84% of the users were from academic sector.
- More than one lakh samples were analyzed at the facilities during the year.

Workshops/Training programmes/Short term courses organised

Workshops/training programmes/short term courses 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 workshops/training programme/short term courses organized are as follows:

- A workshop on high resolution Scanning Electron Microscopy by SAIF, Chennai.
- A workshop on basic principles, preparatory methods and applications in Scanning Electron Microscopy by SAIF, Shillong.
- A training programme on Electron Microscopy for scientific investigators by SAIF, New Delhi.
- A workshop on Electron Microscopy by SICART, Vallabh Vidyanagar.
- A workshop on Surface Analysis by SAIF, Mumbai.
- A workshop on FT-IR Imaging by SAIF, Mumbai.
- A workshop on Elemental detection and analysis by SAIF, Kochi.
- Workshop on NMR Spectroscopy by SAIF, Kochi and SAIF, Chennai.
- A workshop on 'NMR Spectroscopy: Theory, Application and Experimentation' by SAIF, Shillong.
- A workshop cum hands-on-experience on FT-NMR and GC-Mass Spectrometers by SICART, Vallabh Vidyanagar.
- A workshop on Mass Spectrometry by SICART Vallabh Vidyanagar
- A workshop on Chromographic techniques by SICART Vallabh Vidyanagar.
- A short term training programme on 'Basics and Applications of Sophisticated Analytical Instruments' by SAIF, Lucknow.
- A short term course on 'Single Crystal X-ray Diffractometry' by SAIF, Chennai.

Analytical techniques developed/significant analysis done/research work facilitated.

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

- A new procedure for mounting crystals using Lindemanns tube for single crystal X-ray diffractometer was developed at SAIF, Chennai.
- NMR studies of rare and less sensitive nuclei such as ^{125}Te , ^{95}Mo and ^{119}Sn were carried out successfully at SAIF, Chennai.
- NMR is a powerful method for studying partially and fully ordered systems. One of the key issues in these studies is accurate measurement of dipolar couplings. A novel approach has been developed for measurement of dipolar couplings at SAIF, Bangalore. This approach does away with the use of cross polarization as traditionally practiced with the use of the Hartmann-Hahn condition which requires precise and time consuming adjustments of rf fields. The developed method involves free evolution

under the dipolar Hamiltonian without any precise condition required to be satisfied and thus the experiment is easy to set up, while providing accurate dipolar coupling information.

- Novel techniques have been developed to resolve rich proton NMR spectra and to extract enantio-discrimination information at SAIF, Bangalore. The spin state selective detection of single and multiple quantum have been employed for simplification of complex NMR spectra, yielding information on chiral discrimination and their qualification.
- Solution of structure of the pantothenate synthetase, the enzyme that catalyses the final step in the bio-synthesis of pantothenate (vitamin B5) was facilitated by SAIF, Bangalore.
- In a research work facilitated by SAIF, New Delhi, entry and localization of reconstituted Sendai virus particles in various compartments of hepatocytes in culture was shown for the first time with the help of Immuno-Electron Microscopy. It was found that when viral F protein is denatured, it takes the viruses to endosomes of hepatocytes through receptor-mediated endocytosis. TEM was useful in dissecting the overall entry of Sendai virus into hepatocytes.

In a research work facilitated by SAIF, Shillong, it was established that coupling behaviour of Muga silk moth *Antheraea assamensis* is controlled by UV light to a great extent. The result has significant bearing to the major problem of low auto coupling in Muga silkworm industry in North-East.



Fig. 2.1: Vibrating Sample Magnetometer at the SAIF, Chennai.



Fig. 2.2: GC High Resolution Mass Spectrometer, at the SAIF, Mumbai.



Fig. 2.3: Q-TOF High Resolution Mass Spectrometer at the SAIF, Lucknow



Fig. 2.4: 200 KeV Transmission Electron Microscope at the SAIF, Shillong



Fig. 2.5: Single Crystal X-ray Diffractometer at the S

INTENSIFICATION OF RESEARCH IN HIGH PRIORITY AREAS (IRHPA)

The main thrust of the scheme IRPHA is to ensure intensification of scientific research in selected areas of great relevance and potential for scientific and technological development of the country. The following initiatives have been supported during the year:

PROJECT: SETTING UP A SQUID BASED MEG SYSTEM FOR NON-INVASIVE STUDIES OF THE HUMAN BRAIN, AT IGCAR-KALPAKKAM



Fig. 2.6: MEG system inside the Magnetically Shielded Room.

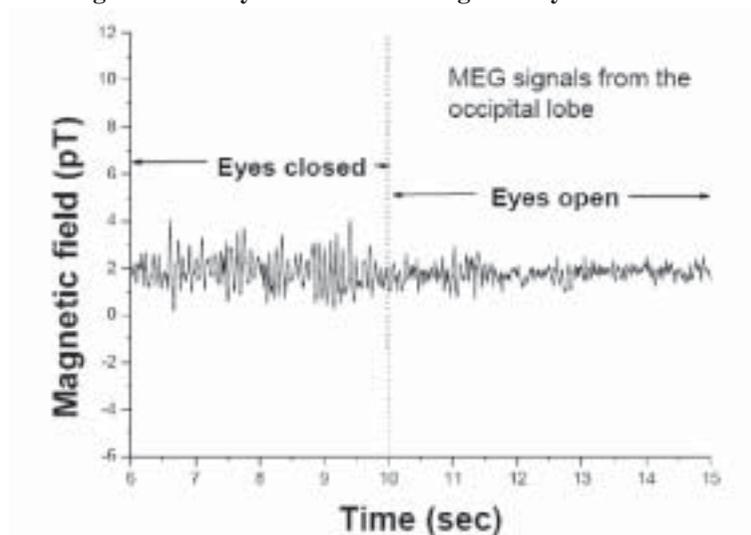


Fig. 2.7: MEG of α -Rhythm on a subject (eyes closed) and its suppression (eyes open)

This project established the first facilities in India for the SQUID based non-contact and non-invasive measurement of extremely weak magnetic fields associated with the physiological activities of the human brain (~ 100 femto Tesla to ~ 2 pico Tesla) and of human heart (~ 50 pico Tesla), known respectively as Magnetoencephalography (MEG) and Magnetocardiography (MCG). Spontaneous brain rhythms as well as the much smaller evoked responses have been recorded. The development can lead to clinical trials to probe brain disorders as well as to the study of electrophysiology in the areas of both cardiology and

neurology. It holds promise for quick and mass screening programmes and for enhanced diagnostics leading to better healthcare. As a result of this project, indigenous expertise has been developed to assemble multi-channel MCG and MEG systems.

PROJECT: STUDIES OF EXOTIC NUCLEI UNDER EXTREME CONDITIONS USING AN INDIAN NATIONAL GAMMA ARRAY (INGA).

The INGA project is a collaborative project of Inter-University Accelerator Centre (IUAC) - New Delhi, Tata Institute of Fundamental Research (TIFR) - Mumbai, Saha Institute of Nuclear Physics (SINP) - Kolkata, Bhabha Atomic Research Centre (BARC) - Mumbai, Variable Energy Cyclotron Centre (VECC) - Kolkata, UGC-DAE Consortium for Scientific Research - Kolkata centre and some Universities.

Nuclear structure studies encompass large number of phenomena like band crossing in nuclei, super deformation, shape coexistence, shape polarization, identical bands etc. There is a strong need to investigate phenomena, that occur at very low ($\ll 0.1\%$) population intensities, to be able to unfold new nuclear mechanisms and precisely understand the already known behaviour. To achieve this general goal, a 24 Clover Detector array with a total photopeak detection efficiency of $\sim 5\%$ named as INGA was assembled. A number of unique auxiliary facilities like Hybrid Recoil Mass Analyzer (HYRA), Charged particle detector array, Low energy photon spectrometer, Recoil distance device for lifetime measurement are planned to be added for doing additional A, Z selection or measurement. The photos of INGA facility installed in TIFR/BARC (2010), and used in IUAC (2008-09) are given below.



Fig. 2.8: INGA at TIFR 2010

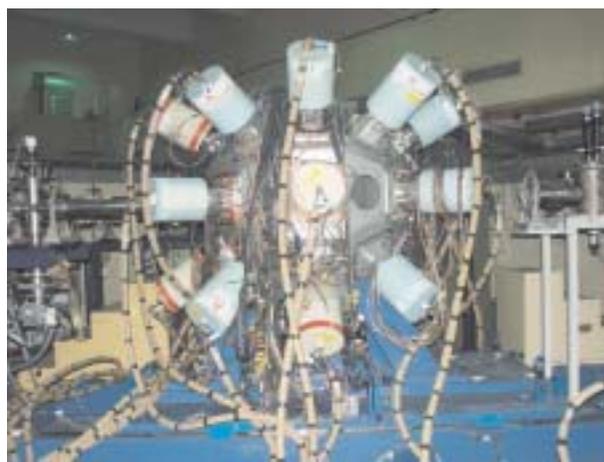


Fig. 2.9: INGA at IUAC 2008-09

Funds from DST were used to procure 9 Clover Detectors and to fabricate support systems like detector support structures, scattering chamber, bias supplies, analogue and digital processing units, liquid nitrogen filling system and data acquisition electronics with in-house design at IUAC. The data collection and analysis software were developed with advanced features which increased the impact of the array.

One INGA campaign was done in VECC with 10 Clover Detectors during August – October 2005 using ^{20}Ne beams and using the analogue electronics developed by IUAC. The completed INGA facility, with 20 Clover detectors was installed in the new beam hall at IUAC in 2007 and 30 experiments were done successfully in two phases. At present, next INGA campaign is in progress at TIFR/BARC Pelletron Laboratory, Mumbai using bias supplies developed by IUAC.

The project has significantly added to the knowledge-base and the technical manpower in the country in the field of nuclear gamma ray spectroscopy with heavy ion accelerator facilities for nuclear physics. A large number of publications have come out in high impact journals (Phy. Rev. C: 30, Nuc. Phy. A: 7, NIM A: 6). Results from the research using INGA have been presented in several workshops in the country and abroad. Dedicated workshops have been held under the project where results from INGA have been discussed and have been appreciated by the participants from India and major laboratories working in this field from abroad. A total of 20 research scholars have carried out their Ph.D. research work using the detectors obtained under the INGA project from DST and 13 more students from various universities are currently pursuing their Ph.D. using experimental data from INGA. University groups from all over India are actively participated in the project.

PROJECT: CENTRE FOR ASTROPARTICLE PHYSICS & SPACE SCIENCE: A NATIONAL FACILITY AT THE BOSE INSTITUTE, DARJEELING.



Fig. 2.10

Objectives of the Project

1. Cosmic ray studies at high altitude – search for cosmic strangelets.
2. Changing Airspace Environment in Eastern Himalayas.
3. Children’s Science Resource Centre – dissemination of science, Outreach programmes.
4. Manpower development – training programmes, Workshops, etc.

Highlights

1. Cosmic ray studies

- New passive detectors for cosmic ray studies, polyethylene terephthalate (PET) which are the usual overhead projector transparencies, have been standardized.
- In one single image frame (out of more than 8000), six almost identical nuclear tracks have been found which may be the first signal of some exotic phenomena (Fig. 2.11).

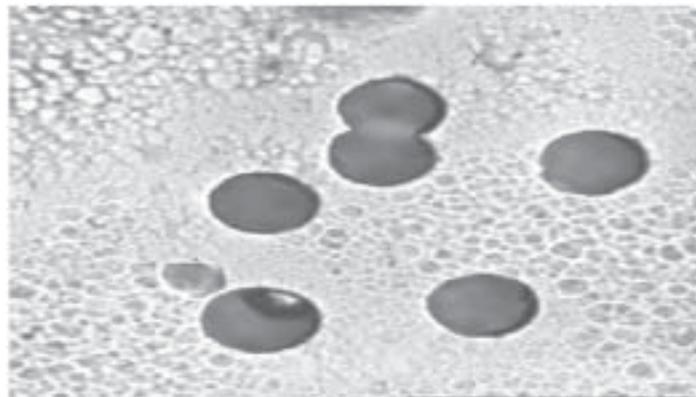


Fig. 2.11: Six almost identical tracks in a single image frame

(The contours of the circular openings are sharp with an average diameter of 10.5 μ m)

In the course of calibration, six pronged multifragmentation (Fig. 2.12) event has been observed which could be the first observation of Coulomb fission at low energy.

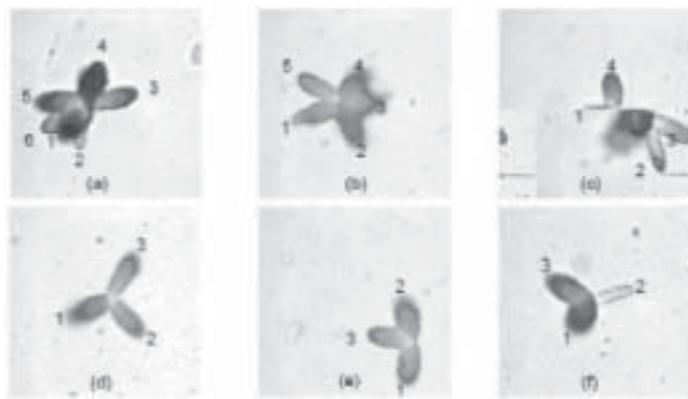


Fig. 2.12: Multi-pronged tracks in uncoated PET (a-f)

2. Changing air space environment in eastern Himalayas:

➤ Study on Aerosol Chemistry

Seasonal and diurnal variation of aerosols of different sizes has been studied at Darjeeling (Fig. 2.13).

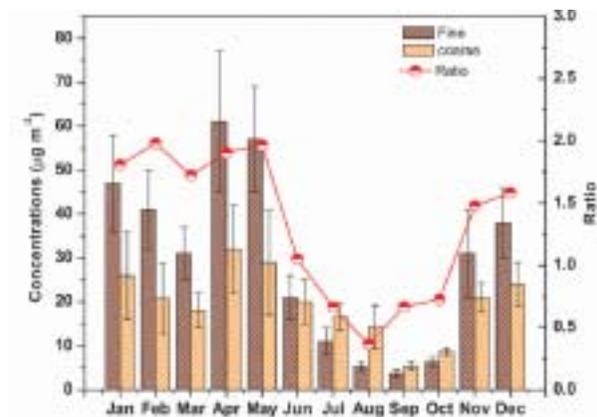


Fig. 2.13: Seasonal Variation of Aerosols of Different Sizes

Aerosol shows higher concentrations during winter months and minimum concentrations during monsoon. The analysis indicates the presence of long range transport of dust aerosol from arid regions of western India and even from Arabian deserts during pre-monsoon.

Principal component analysis (PCA), a multivariate analysis technique and a trajectory model HYSPLIT_4 were used to identify possible source types and regions of aerosols in Darjeeling. Figure 2.14 shows that, 80 % of ionic species originated from the local and other continental sources and 20 % was from marine source.

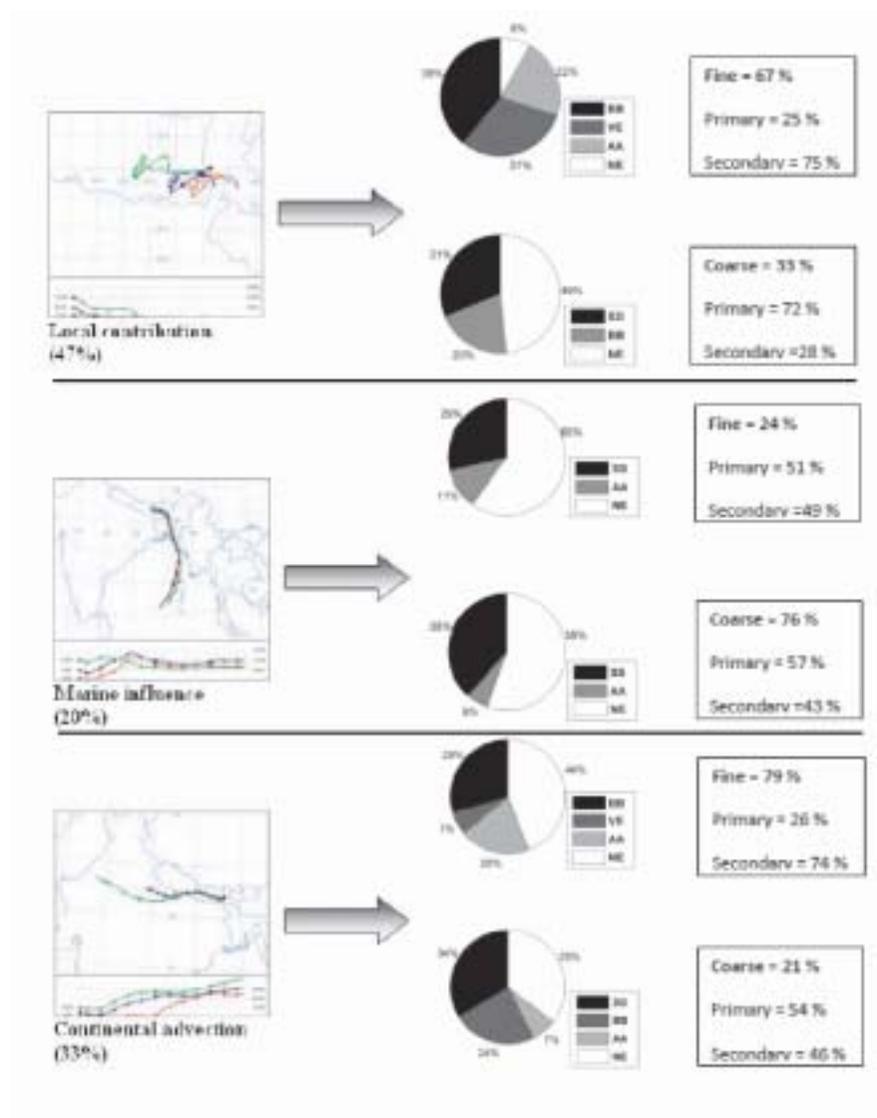


Fig. 2.14: Source Apportionment of Aerosols

Biomass burning and vehicular emissions (non-sea-potassium, non-sea-sulphate, non-sea-chloride, nitrate) were the major sources for fine mode local and continental aerosols whereas dust particles (non-sea-calcium and magnesium) were the major source for coarse mode local and continental aerosols. On the other hand, the major source for fine and coarse mode marine aerosol was sea salt aerosols enriched mainly with sodium and chloride.

➤ **Study on Aerosol Optical Properties**

The monthly mean columnar AODs at five different wavelengths during the study period are shown in Fig 2.15 which shows two distinctly contrasting features in AOD spectra between dry (October – May) and wet (June – September) seasons. During dry season, AOD is found to decrease rapidly with wavelength whereas during wet season, there is a slow decrease of AOD with wavelength. Also, there is a weak increase in AOD at higher wavelength during wet season compared to dry season.

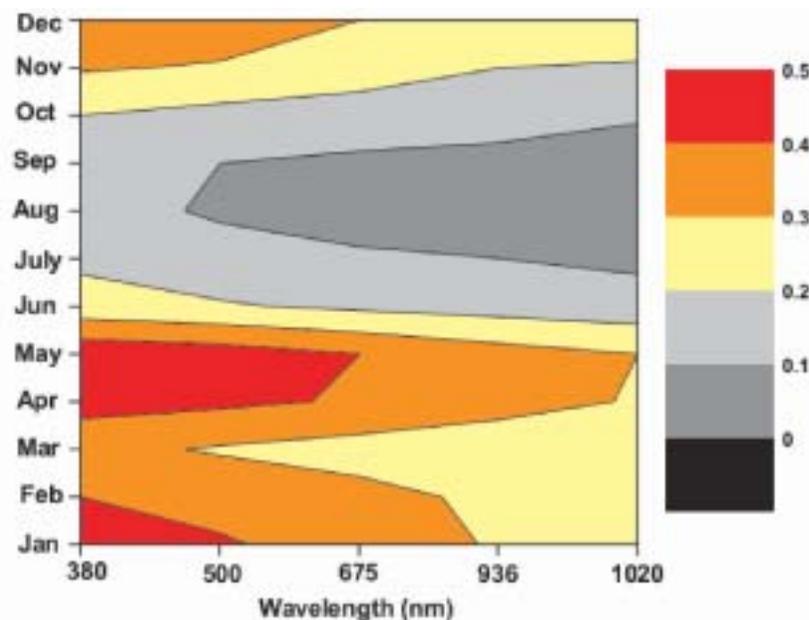


Fig. 2.15: Monthly Variation of Aerosol Optical Depth

➤ **Study on Diurnal Variation of Black Carbon (BC)**

The monthly variation of BC shows higher concentration during winter followed by summer, post-monsoon and pre-monsoon with the minimum during monsoon. The winter shows ~1.5 times higher in concentration than pre-monsoon and post-monsoon while it is ~10 times higher than monsoon. The diurnal variation of BC in different seasons during the entire study period is shown in Fig 2.16. It is observed that, the concentrations of BC peaked up during morning (0900 hours LT) hours and remained higher till early afternoon (1300 hours LT).

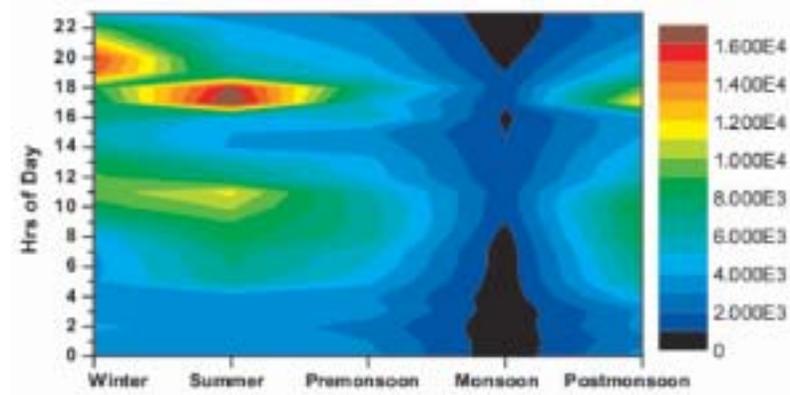


Fig. 2.16: Seasonal and diurnal variation of Black Carbon

During evening (1700 hours LT), it shows another peak in the dry season. The evening peaks during summer and post-monsoon were found to be dominant compared to morning peaks due to massive influx of tourists during evening. In winter, BC shows much higher concentrations during late evening (1900 hours LT) to night (2100 hours). Monsoon shows much lower concentrations compared to dry seasons.

➤ Ozone Measurements

Characteristics of surface ozone at Darjeeling (The Eastern Himalayas) have many key features. It shows large seasonal variation from 20 ppbv (July-August-September) to 70 ppbv (March-April-May). MATCH-MPIC model reproduce seasonal cycle of surface ozone reasonably. Such high surface ozone is rarely observed in India. However, presence of low carbon monoxide as well as non-availability of sunlight during September may explain the low value of surface ozone during monsoon period (Fig.2.17).

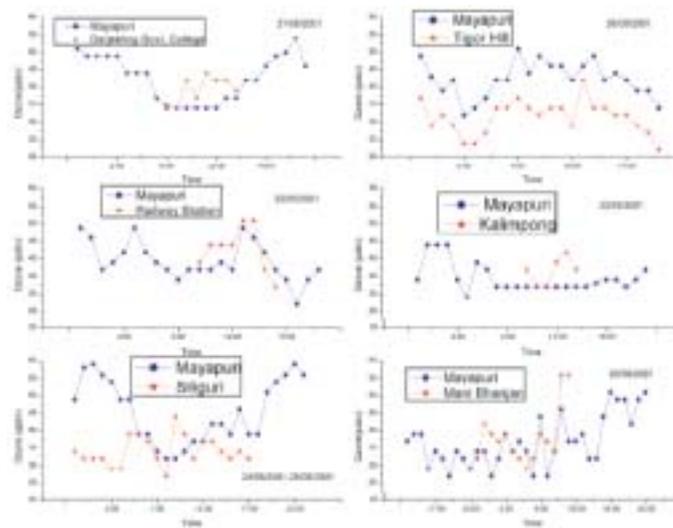


Fig. 2.17: Surface ozone comparison for different places in Darjeeling

➤ Rain related Measurements

Rain rate, liquid water content and drop size distribution is an important factor for the understanding of atmospheric phenomena. A micro-rain radar picture of rain at Darjeeling during AILA is shown in Fig. 2.18. The picture shows that rain events are mostly from larger height, a typical feature for transported clouds. The picture also shows presence of rain at higher altitudes when there is no rain at the surface.

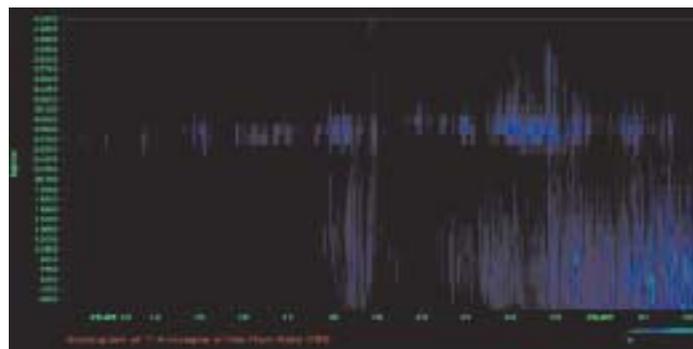


Fig. 2.18: Rain intensity with altitude

3. Children's science resource centre - dissemination of science, outreach programmes:

A new building consisting of children's resource centre, guest house for accommodation of participants and auditorium has been constructed recently at Darjeeling (Fig. 2.19).



Fig. 2.19: Children's resource centre

The Darjeeling centre of Bose Institute is also functioning as a nodal centre for Children's training in basic sciences for the North-eastern states. Every year, summer training programme on basic sciences is held at Darjeeling. In this programme, class IX-XII standard students are given hands-on training on basic physical, chemical and biological sciences. Students from Darjeeling area also participate in this training programme. Besides, meetings and training programmes are also organized for students of Darjeeling area to make them aware of present day environmental issues. Through these meetings, some insight are also given into the interesting aspects of career in science and encourage the students to take science as their career.



Fig. 2.20: Lecture-demonstration



Fig. 2.21: Biodiversity experience

4. Manpower development:

Every year, Bose Institute organizes a Winter School on Astroparticle Physics, in collaboration with Tata Institute for Fundamental Research (TIFR), Mumbai, for the graduate and post-graduate students of physics. The school is held alternately at Cosmic Ray Laboratory of TIFR at Ooty and the Darjeeling centre of Bose Institute. The major aim of this School is to impart basic training on the experimental high energy physics and expose the students to the state-of-the-art in all aspects of experimental high energy physics research. Training programmes are also been arranged to introduce students to various facets of Atmospheric Science research.

MEGA FACILITIES FOR BASIC RESEARCH

This programme was launched to create Mega Science facilities and launch Mega Science programmes in and out of the country to improve access to such state-of-the-art facilities for the Indian scientific community, especially from the academic sector.

Several important developments took place during the year under this programme.

On 4 October 2010, India joined a group of founder-member nations and signed the Convention to construct the Facility for Antiproton and Ion Research (FAIR) at Darmstadt in Germany. As the major portion of Indian contribution will be “in-kind”, it will give the Indian scientific community, and also industry, access to high technology by way of building accelerator and detector components. FAIR will allow Indian scientists to carry out scientific studies on cutting-edge topics, like QCD studies with cooled beams of antiprotons, nucleus- nucleus collisions at highest baryon density, nuclear structure and nuclear astrophysics investigations with nuclei far off stability, high density plasma physics, atomic and material science studies, radio-biological and other application-oriented studies. And, the Seed Funding extended earlier for R&D and prototyping work for the FAIR project continued during 2010-11.

Large aperture (in the range 25-40 metre) telescopes will mark the next giant leap in the field of Astronomy. Three major international bodies have taken up the challenge of setting up such facilities in the world. India was invited to participate in these endeavours. After careful assessment by its astronomy

community, India, in June 2010, decided to join the Thirty Metre Telescope (TMT) project at Mauna Kea in Hawaii as an “Observer”. This project is being piloted by the California Institute of Technology (Caltech), USA and has several international partners. The TMT is expected to be operational in roughly eight years. During the “Observer” period, the Indian astronomy community will develop a Detailed Project Report and explore possible in-kind contributions from the Indian institutions and the industry.

Another project was sanctioned during the year for setting up a twin beam line for macromolecular crystallography and high pressure physics at the Elettra Synchrotron Radiation Facility at Trieste, Italy.

Funding for the CMS, ALICE and LHC Grid projects at the Large Hadron Collider at CERN, Geneva continued. LHC has already gone beyond its expected luminosity and, despite operating at present at lower than the planned energy, it is giving extremely good quality data. Significant results have already started coming. The machine is functioning as per expectations and, finally, about 20 years of Indian engagement in the project has started bearing fruits.

The process of site-selection for the India-based Neutrino Observatory (INO) also got completed during the year.

SPECIAL PROGRAMME FOR NE AND J&K

Special S&T Packages

While two special package programs one for the states in the North-East Region in 2008 and another for Jammu & Kashmir (J&K) state in 2009 were initiated for augmentation of the teaching and research at the S&T departments of the Colleges and Universities, the third Special Package has been initiated in the current year for the state of Bihar at an estimated cost of about Rs 70 crores.

In the **NER Special Package** apart from supporting NER Universities for ‘Teaching Support’, support for one-time Power Quality Improvement, various Fellowships support & support for Workshops etc., 58 Colleges in this region each of Rs 40 lakh have been supported for augmentation of teaching equipment and general facilities in the College. The equipments in these Colleges have been installed and started already functioning. Apart from Major Facilities like Transmission Electron Microscope, Single Crystal X-ray Facility, High Power Computational Facility and NMR Facility have also been established at four different Universities of this region.

In **Jammu & Kashmir Special Package**, basic support towards augmenting teaching facilities in 34 Colleges of Rs 20 lakh to each College in the State have been made available and these are presently being acquired to install these Colleges. Apart from this, ‘Teaching Support’ and ‘one-time support Power Quality Improvement & Generation’ to the seven Universities in this state are also in process on implementation.

In the **Bihar Special Package**, the detailing of the support and identification of the College etc. are in the process in consultation with the Standing Committee and stake-holders of the State. Shortly, this would be started for its implementation.

STRENGTHENING OF HUMAN CAPACITY IN RESEARCH

The size of the R&D base of India is assessed to be globally non-competitive with an estimate Full Time Equivalent R&D professional strength of only 150 million population while the corresponding numbers for China, Korea, USA, UK, and Finland are 1180, 2900, 4300, 2880 and 7300, respectively. Highly skilled and specialized human talents and resources are essential needs for Research and Development to sustain the flow of knowledge into the manufacturing sector. Technological progress, economic growth and environmental well being of a country are often related to the quality and quantum of R&D manpower strength.

Recognizing the criticality of an ambience and creation of suitable conditions for attracting and nurturing young talent to study of science and undertake research as a career, the Department has initiated a number of unique pioneering initiatives. They include a large national programme called “Innovation in Science Pursuit for Inspired Research,” (INSPIRE), revision of PhD fellowships, support to International Olympiads Fast Track Scheme for Young Scientists. The JC Bose National Fellowships, The Ramanujan Fellowships and Swarna Jayanti Fellowship Scheme, and were implemented aimed at increasing the size and expertise base of the scientific community necessary for meeting future challenges.

In order to address the issues like brain drain and brain circulation, the Department has initiated some programmes like BOYSCAST. The Department has also initiated a special Programme for Scientists and Technologists of Indian Origin (STIO) for connecting Indian DIASPORA with national scientific research groups. Utilization of Scientific Expertise of Retired Scientists (USERS) is a scheme implemented by the Department for efficient utilization of scientific capacity among retired scientists.

Under INSPIRE scheme total of 3.03 lakh students in the age group of 10-15 have been awarded INSPIRE Awards for undertaking small science projects enabling the to participate in project competitions at district, state and national levels. Nearly 200 science camps were organized during the period up to December 2010 for toppers in the board examination at class X level. More than 54000 youth have been participated. Total of 4500 students are pursuing science courses at BSc and MSc levels and 499 university toppers have registered for doctoral research in 2010. Ramujam fellowships has attracted more than 70 Indians living abroad to shift their research efforts to India.

A significant increase in the PhD outputs of India in science and engineering sector has been reported during the last three years. Some evidence of the benefits of strengthening human capacity is realized.

INNOVATION IN SCIENCE PURSUIT FOR INSPIRED RESEARCH

“**Innovation in Science Pursuit for Inspired Research (INSPIRE)**” is an innovative program developed by the Department of Science & Technology for to attract talent to science which has three components namely i) **Scheme for Early Attraction of Talents for Science (SEATS)**, b) **Scholarship**

for Higher Education (SHE) and c) Assured Opportunity for Research Careers (AORC). The basic objective of INSPIRE is to communicate to the youth of the country the excitement of creative pursuit of science and thereby attract talent to the study of science at an early stage with a aim to build the required critical human resource pool for strengthening and expanding the Science & Technology system and R&D base in the country.

This programme was approved by the Government of India in November 2008 at a total cost of Rs 1979.25 crores in the 11th Plan Period. The Program was launched by the Hon'ble Prime Minister on 13th December 2008.

The Scheme for Early Attraction of Talent for Science (SEATS) is one of the schemes of Innovation in Science Pursuit for Inspired Research (INSPIRE) being implemented by the Department of Science & Technology (DST). SEATS has two components. The first component envisages providing once in a lifetime award of Rs. 5000/- per student in the age group of 10 to 15 years (INSPIRE Award component). In the second component, top one per cent of meritorious students in their Class X Board Examinations in the age group 16-18 and pursuing Science in Standard XI would be selected by the Department of Science & Technology for Summer/Winter camps on an annual basis.

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 also by arranging a summer camp for about 50,000 science students of Class XI who are toppers in Class X board examinations with global leaders in science to experience the joy of innovations on an annual basis through **INSPIRE Internship**.

Objectives

The objective of INSPIRE Award Component is to motivate and catch the students in the age group of 10-15 and facilitate them in experiencing the joy of innovating and thereby attract them to pursue careers in Science. The awardees will be required to utilize approximately 50% of the award money of Rs. 5000/- to make a project/model which will subsequently be displayed at the exhibitions to be organized at various levels. All Awardees will be required to participate in the District Level Exhibition. Best 5 to 10% entries from the District will be selected for participation in a State Level exhibition. Best 5% entries from the State, subject to a minimum of 5, would be invited to participate at the National Level Exhibition. The projects exhibited would be evaluated by a jury of experts. Commendation Certificates would be issued to selected awardees of District / State / National Level Exhibitions and the teachers who guided them for the preparation of projects. The entire cost of organizing exhibitions at District and State level will be borne by the Department of Science and Technology (DST).

The INSPIRE Award component envisages to cover 2 lakh students per financial year, thereby benefiting ten lakh students in a span of five years (2007-08 to 2011-12).

Strategy for INSPIRE Award Component

In the current year the **INSPIRE Award** for the students in the class ranging from 6th to 10th students standard has now been finalized for many States and UTs in the country and a total of about 3.02 lakh has been recommended for this Award.

Students in the age group of 10-15 and studying in Classes VI to X in any school in India, which includes Central Govt. schools, State Govt. schools, aided schools, private management schools, etc., will be eligible to receive the Award. The Principals of each school, through a transparent system of selection based on merit, will identify five (5) students (limited to one student from each Standard) for the Award and forward their names to the District/Zonal/Regional authorities. The District/Zonal/Regional authorities will

compile the details of the nominated students in their jurisdiction in the prescribed proforma and forward the same to the State/UT authorities, as the case may be, who in their turn, will compile the details of the nominated students for the entire State/ UT and forward the same to the Department of Science & Technology, for final selection of the two students to be given the INSPIRE Award.

The award money will be disbursed by the DST through debit warrants prepared by the State Bank of India in favour of each selected student, which will be sent to the State/UT Nodal Officers, specially nominated for the purpose, as the case may be, who in their turn, will arrange for distribution of the awards to the students through the respective school authorities.

In 2009-10, 1,26,468 students were covered, throughout the country. During the current year i.e. 2010-11, till December 31, 2010, 1,76,243 students from 27 States/UTs have already been selected for these awards.

Under **INSPIRE Internship** in the current year so far **145 Science Camps** including VIJYOSHI 2 at Bangalore, Asian Science Camp at Mumbai and Science Conclave 3 at Allahabad have been organized at different locations across the country and **more than 30,000 science students** of Class XI attended in these Camps who were toppers of Class X from various State & Central Boards in the country. Many such Science Camps are also in the pipeline in next 3 months i.e. till March 2011 to achieve the target for this purpose. In this Science Camps the school students were given an opportunity for 5 days to interact with global science leaders from India and abroad including ten Noble Laureates.

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**. In the current year about **2400 INSPIRE Scholars** are receiving scholarship who are pursuing their 5 years Integrated MS or M.Sc. degree in basic & natural science courses at the national institutes like IISERs, IITs and Universities in the country. In addition to this, about **2100 INSPIRE Scholars** who are pursuing their undergraduate studies in basic and natural science courses at various colleges and universities in the country, have also been enrolled for offering this scholarship under SHE. The INSPIRE Scholars have been given their scholarships through State Bank of India via Smart Card system.

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. **INSPIRE Fellowships** in the both basic and applied sciences including engineering, agriculture, veterinary and medicine are offered to students who are First Rank holder in their university level post-graduate programs, for pursuing doctoral degree at any recognized University or any other academic Institutions in the country. In the current year out of more than 1500 applications received, **499 Fellowships have already been offered** to those who are already enrolled in to doctoral program at different Universities and academic Institutions in the country. Another **more than 600 students** who are also first rank holder but waiting for enrollment into doctoral program, have also been identified provisionally for this Fellowship.

For post-doctoral researchers through contractual and tenure track positions for 5 years in both basic and applied sciences areas, **INSPIRE Faculty Scheme** has been initiated. Presently in consultation with Academies the detailing of this component is being worked out for its implementation and will be initiated shortly.

Related Activities

Kishore Vaigyanik Prothsaan Yojana (KVPY) which is being implemented by Indian Institute of Science, Bangalore, is a program to attract and train bright students in all areas of Basic Science, Engineering and Medicine. In the current year out of more than 60000 applicants, 1717 students have been short listed for interview now. Finally approximately 600 students would be selected based on interview which is expected to be completed by February 2011.

International Olympiads in areas of Physics, Chemistry, Biology, Astronomy & Astrophysics and Mathematics are represented by young students in the country. While this program is managed by the Homi Bhabha Centre for Science Education, Mumbai, the Department of Science & Technology is one of the partners of the whole process. This year also Indian students performed very well in all areas. They bagged 5 Gold Medals, 11 Silver Medals, 5 Bronze Medals and 3 Honorable Mention out of 24 students participated in five areas.

FELLOWSHIPS

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.

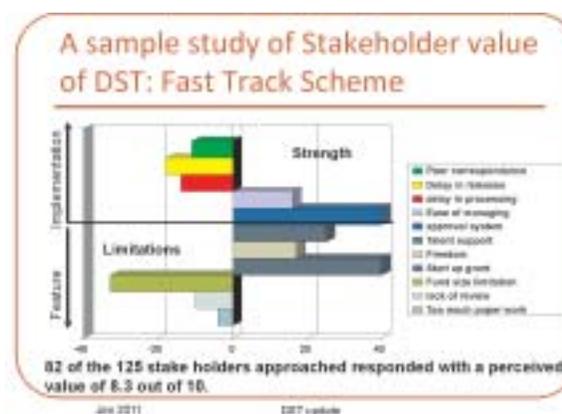
FAST TRACK SCHEME FOR YOUNG SCIENTISTS

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.

Several projects in frontier areas were supported. This support has helped young researchers to undertake independent research. The budget limit for a project was increased to Rs. 23 lakh (from Rs. 17 lakh) while the individual fellowship amount has been increased from 20,000/- pm to Rs. 35,000/ pm. Stakeholder evaluation was done for this scheme. A questionnaire was prepared and sent to 125 researchers (25 each in Life, Chemical, Physical & Mathematical, Engineering and Earth & Atmospheric) requesting them to evaluate the scheme on a scale of 1 to 10 (10 being the maximum). Eighty two responses were received with the overall grading of 8.3.

Majority of Scientists opined that the size of the grant was too small and involved lengthy processes. Based on the study, the department has revised the budget limit for a project to Rs. 23 lakh from Rs. 17 lakh, while the individual fellowship amount has been increased from 20,000/- pm to Rs. 35,000/- pm. This shows the goodwill of the scheme among the young researchers.

The salient highlights from the projects are given below:



- ❖ Phosphine free synthesis of highly emitting Mn doped ZnSe nanocrystals with more than 50% quantum yield has been achieved. Cu doped ZnSe which gives tunable blue-green emission and the only green emitting nanocrystals alternative to CdSe in group II-VI semiconductor nanocrystals has been synthesized. These crystals undergo photooxidation and have been protected by using only 10% S at the surface ZnSE by blocking Se with S.
- ❖ A one pot method for the synthesis of carbon branched oligosaccharide has been developed. A novel glycosylation reaction has been developed by using 1,2-cyclopropanated sugars as glycosyl donors towards the synthesis of heptano-hexoses and this method has been successfully applied to the formation of a pool of disaccharide units.
- ❖ Lanthanide oxo-hydroxo clusters have been synthesized by slow deprotonation of the coordinated water molecules of hydration in lanthanum salts like $\text{LnCl}_3 \cdot x\text{H}_2\text{O}$ in the presence of suitable ligands by addition of a base adopting literature methods. β -diketones have been used as ligands to synthesize a large number of lanthanide clusters whose solid state structures vary from tetra to tetra decanuclear forms. Some of these clusters have been shown to exhibit single molecule magnet (SMM) behavior.
- ❖ Gold catalysis has been employed to explore its synthetic potential utilizing its carbophilicity. Although gold has considerable oxophilicity, it has not been utilized much. The author combined these two Lewis acidities for synthetic applications. It has been found that the reaction of aryl alkynes with phenylacetaldehydes/phenylmethyl ketones in the presence of $\text{AuCl}_3/\text{AgSbF}_6$ catalytic system generated 1-arylnaphthalenes efficiently. Gold was found to be a better catalyst than other transition metal Lewis acids as it can bring both alkyne and the carbonyl close to each other to effect the reaction. Since there are many 1-aryl naphthalene lignans found in nature which show a wide range of biological applications, the above methodology was used further and a collection for 1-arylnaphthalenes of biochemical evaluations have been made.
- ❖ Nafion/copper particulates chemically modified glassy carbon electrode has been prepared by *in situ* electrochemical deposition. The electrode is found to be successful for selective amperometric sensing of hydrogen peroxide at -0.2 V vs Ag/AgCl at physiological pH without interference from uric acid, ascorbic acid, catechol, cysteine, nitrite and nitrate. Application to real samples analysis is demonstrated for milk, urine and tea samples with appreciable recovery values. A patent has been filed for this discovery.
- ❖ Low temperature synthesis of nearly monodispersed NiCo_2O_4 nanoparticles by a combustion method utilizing glycine as a fuel and nitrate as oxidizer has been reported. These nanoparticles show a high (~83%) infrared transparency that is useful for specific solar and fuel cell electrode applications as well as significant radiofrequency (FR) absorption causing substantial heating of their aqueous dispersion that should have potential applications for magnetic hyperthermia. The interesting evolution of the phase and magnetic properties of such nanoparticles upon annealing treatment has been observed. Specifically, the samples annealed at 573 K show an increase in the magnetization, whereas those annealed at 773 K exhibit a decrease in magnetization due to the precipitation of fine
- ❖ Stereoselective total syntheses of natural (+)-varitriol, (-)-varitriol, 5'-*epi*-(+)-varitriol and 4'-*epi*-(-)-varitriol have been accomplished with use of D-manitol as chiral pool material. The Heck reaction was used to assemble the olefinic sugar moiety and the aromatic triflate moiety.

- ❖ A robust and reproducible metal-carboxylate non-cluster type secondary building unit (SBU) designed with the proper utilization of the complimentary hydrogen bonding of the H_2MDP molecule and carboxylate group has been identified. Subsequently, a series of zinc(II) coordination polymers based on this tailor-made SBU using homologous alkanedicarboxylic acids as auxiliary ligands have also been synthesized. It has been observed that the conformational freedom of the linker molecules plays a crucial role in determining both the dimensionality and topology of the final structure. The structural studies of the complexes clearly outline a roadmap for the synthesis of MOFs with desired topology and dimensionality using this SBU as vertex.

THE JC BOSE NATIONAL FELLOWSHIPS

To recognize active scientists and engineers for their outstanding performance and contributions and to recognize active scientists and engineers for their outstanding performance and contributions, a few years ago the department 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 fellowships are granted for a period of five years. The value of the fellowship has been enhanced to Rs.25,000/- from Rs.20,000/- per month in addition to the Fellow's regular income. In addition, it carries a Research Grant. The Research Grant has been enhanced to Rs.10.00 lakh from Rs. 5.00 lakh per annum. 17 scientists were awarded this fellowship this financial year. About 25 JC Bose fellows are supported every year. Till date 30% are supported in Chemical Sciences, 30% in Life Sciences, 18% in Physical Sciences, 10% in Mathematical Sciences, 9% in Engineering Sciences and 3% in Earth & Atmospheric Sciences. JC Bose Fellows are supported at 41 prestigious institutions in the country.

THE RAMANUJAN FELLOWSHIPS

A few years ago the department instituted Ramanujan Fellowships to attract 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 five years. The value of the fellowship is Rs.75,000/- per month for five years. Each Fellow, in addition, receives a Research Grant of Rs.5.00 lakh per annum. 18 scientists were selected for the award of this prestigious fellowship this year. About 15 Ramanujan Fellows are supported every year till date. 26 prestigious institutions in the country have been able to attract new recruits with higher academic credentials from USA, Germany, Japan, Canada, Netherlands, Singapore, UK, Israel and South Africa. Ramanujan Fellows are supported 37% in Physical Sciences, 32% in Life Sciences, 18% in Chemical Sciences, 5% each in Mathematical & Engineering Sciences, 3% in Earth & Atmospheric Sciences.

SWARNA JAYANTI FELLOWSHIP SCHEME

The scheme was launched by the Government in 1997-98 to commemorate the 50th year of 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/- 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 85 such fellowship since 1997-98 and many of the fellows that were selected were subsequently

selected as Bhatnagar Fellow or were selected as INSA or Academic Fellows. **In fact, out of the 9 Bhatnagar Awardees during the year 2010, 7 were SwarnaJayanti Fellows.**

During the year we had received 236 applications in various areas as against 202 applications last year. The selection process has 3 levels of scrutiny:

- (i) The Subject Expert Committees in each discipline;
- (ii) The National Core Committee for all shortlisted candidates; and
- (iii) The Empowered Committee of Secretaries consisting of Secretary – DST, Secretary – Planning Commission, Secretary – MHRD and Secretary – Expenditure.

During the current year, the following candidates have been awarded the SwarnaJayanti Fellowship:

Swarna Jayanti Fellowship Awards – Year 2010

SL. No.	PI Name & Address	Subject Area
1	Dr Srinivas Hotha, IISER, Pune	Chemical Sciences
2	Dr N Ravishankar, IISc, Bangalore	Engineering Sciences
3	Dr Anurag Agrawal, IGIB, New Delhi	Life Sciences
4	Dr Kaushal Verma, IISc, Bangalore	Mathematical Sciences
5	Professor Amol Dighe, TIFR, Mumbai	Physical Sciences

UTILIZATION OF SCIENTIFIC EXPERTISE OF RETIRED SCIENTISTS

A large number of eminent scientists in the country remain active and deeply motivated to participate in S&T development activities even after their retirement. In order to utilize their expertise and potential, a specific scheme named ‘Utilization of the Scientific Expertise of Retired Scientists (USERS) is implemented by the department. The main activity under this programme is preparation of books/monographs and state of art-reports. Several retired scientists have been supported and 13 projects were sanctioned during this financial year and 11 other are under consideration for support. Some of the important projects commissioned during the year include : Bignoniaceae in India; Northeast Monsoon; The history of marine geology in India (1871 to 2009); Physiological and molecular plant pathology; The Indian horseshoe crab- A treasure trove; Coffee breeding; Problems and solutions in electromagnetic theory physics; Basic Algebraic Topology and its Applications; Textbook on Noise and Vibration Control; Essentials of Lectins : Diagnostic and Therapeutic Tools for Health and Disease; Droughts : Impacts, Assessment, Vulnerability, Monitoring and their Management on Agricultural Production; The Impact of the Major Geo-Physical Changes of Paleo-Times; Reaction Mechanism in Organic Chemistry.

Some of the major publications during the period are: Scientific Humanism: Repositioning Indian Education; Quest for Pest Management – From Green Revolution to Gene Revolution; The Reptile Fauna

of India – a Source Book; Seismic Imaging of the Indian Continental and Oceanic Crust; High Energy Materials – Propellants, Explosives and Pyrotechnics.

BETTER OPPORTUNITIES FOR YOUNG SCIENTISTS IN CHOSEN AREAS OF SCIENCE AND TECHNOLOGY

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. About 100 BOYSCAST fellows selected for the year 2009-10 joined the leading institutions abroad and have started working 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 cytogenetics, Industrial microbiology, Drug development, Drug delivery system, Vaccine research, Evolution and dynamics of Indian Lithosphere, Geotectonic models and experiments, Seismology, Paleobiogeochimistry, 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 BOYSCAST fellows for the year 2010-11 are in the process of being selected in the following broad areas: Atmospheric & Earth Sciences, Chemical Sciences, Engineering Sciences, Life Sciences, Mathematical Sciences and Physical Sciences.

TRAINING CELL

Department of Science & Technology, in consultation with DOPT and other Scientific Departments and Organizations, is implementing an ambitious project of Human Resource Development namely “*National Programme for Training of Scientists and Technologists working in the Government sector*” to meet the challenges of national development and international competitiveness in S&T area. Short term training courses focusing in both scientific areas as well as areas of science management & HR were imparted to scientists and technologists working in various institutions of the country. The courses were very popular with the participants.

TECHNOLOGY DEVELOPMENT

Technology leads are gained through research in large number of public funded institutions in the country. The Department has been undertaking a responsibility to promote the demonstration of various technology leads after due diligence under real field conditions and promote the utilization and adoption of technology leads emanating from public funded research under Technology Development Schemes.

One of the focused areas for intervention by the department has been Drug and Pharmaceutical Research. In recent times, the Department has also added technologies for water, security, solar energy, potash fertilizer, climate change sensitive actions and cognition science. DST has been an active promoter of indigenous capacity to design and develop a range of scientific instruments required for analysis and health care.

One of the strategic directional changes brought about by the Department in the Technology Development Programmes has been in the focus on implementing sustainable convergent technology solutions rather than limiting interventions to technology demonstrations.

Establishment of Test-beds for solar energy based on hybrid technologies as well as potash fertilizers from sea water have been identified for support by the Department. These interventions offer opportunities for providing scientific inputs to policy development in the areas of fertilizers and viability gap and generation-based subsidy of solar energy in the country. The Department has been directed by the Supreme Court to implement water technology Mission. Under the Mission “Winning, Augmentation and Renovation (WAR) for water innovative deployment of technology solutions for 26 types of water challenges is being attempted.

A technology compendium listing technology assets available with various scientific departments of the Government has been prepared and technology portal launched for the benefit of states to assess the local needs and build technology partnerships with states. The Department has developed new concepts for fostering technology partnerships with states and the National Science and Technology Sector.

Some of the recent initiatives of the Department in technology development sector has focused on strengthening linkages among academy-research and industry. As a result of various initiatives of the Department, new mechanisms and models for technology diffusion and adoption in the user sector are emerging.

Promotion of Public-Private Partnerships for R&D sector and clean energy is accorded high priority in selection of projects and interventions by the Department. DPRP as a scheme has promoted a number of PPP initiatives in drug research. More than 100 collaborative projects under PPP have been supported by the Department.

Technology Development Board mechanism has been leveraged to promote an innovation support system and invest into “Fund of Funds” to create an angel financing system needed for promoting an innovation eco system.

DRUGS AND PHARMACEUTICALS RESEARCH PROGRAMME (DPRP)

The programme was launched in 1994-95 for promoting R&D in drugs and pharmaceuticals sector with the objective to Forge public private partnership (PPP) in Drugs & Pharmaceuticals R&D covering both modern and Indian systems of medicine including veterinary drug development, To create state-of-the-art R&D infrastructure in this sector in public funded laboratory/university, extend loan at 3% simple interest to pharma Industry R&D projects and grants-in-aid for clinical trials to pharma industry projects on developing drugs for neglected diseases like malaria, TB, Kalaazar, Filariasis, etc.

This activity has forged 101 collaborative projects (public private partnership) in the area of Tuberculosis, Malaria, Diarrhoea, Diabetes, Psychosomatic disorders, Kala Azar, Cataract, Dementia, HIV/AIDS, Anti-fungal, Anti-virals, Anti-cancer, Anti-bacteria, Anti-rabies, Anti-obesity, Anti-asthma, arthritis, vaccine for dengue, Japanese Encephalitis, Hepatitis-B, etc.

43 state-of-the-art R&D infrastructure have been created in different premier institutions and universities like NIPER, CCMB, ICT, CDRI, NIV, IISc, Jadavpur University, Saurashtra University, University of Madras, JNCASR, Sree Chitra Thirunal Institute of Medical Sciences, TANUVAS, etc., on Bio-availability, Pharmacoinformatics, Regulatory Toxicology, Safety Pharmacology, Pharmacokinetic and Metabolic Studies, Regulatory Pharmacology and Toxicology, Medium throughput screening, Transgenic and gene knockout mice, Clinical Research facility to Stem Cell technologies and regenerative medicine, BSL-4 laboratory Bioequivalence, Pharmacovigilance, New Chemical Entities development, etc.

Since 2004-05, the programme extended 61 loans to the tune of Rs.168.00 crores as DST's contribution to Indian Pharma Industry R&D projects for the development of drugs on dengue, HIV/AIDS, vascular complication, diabetes, Hepatitis-B, cancer, rabies vaccine, Japanese Encephalitis vaccine, tetanus, malaria, clot specific streptokinase, respiratory tract infection, anti-glaucoma, clinical research on newer antibiotics, kidney diseases, psoriasis, etc. Two grants-in-aid projects were funded for conducting clinical trials in neglected diseases such as Malaria and Kala Azar.

The following products have been commercialized – Alquit (A herbal product for the control of animal ecto-parasites) by M/s. Natural Remedies Pvt. Ltd., Bangalore; Bonista (Parathyroid Hormone as injectable for Osteoporosis) by M/s. Virchow Biotech Pvt. Ltd., Hyderabad; Receptol (A colostrums based protein for the management of HIV/AIDS) by M/s. Biomix Networks Ltd., Mumbai; Rhoclone (Anti-Rho-D immunoglobulin Injection (Monoclonal) 300 mcg developed for hemolytic disease of the new born) by M/s. Bharat Serums & Vaccines Ltd., Mumbai; Leucet (for allergic rhinitis and asthma and Zemet – for diabetes) by M/s. Indigene Pharmaceuticals Ltd., Hyderabad.

During 2010-11, the following new projects were initiated:

Collaborative projects

- Development of Drugs for the Medical Management of Diabetic Retinopathy using Active Constituents of Ayurvedic Drugs between Delhi Institute of Pharmaceutical Science & Research, New Delhi and M/s. Promed Export Pvt. Ltd., New Delhi.

- Development of *Artemisia annua* L. Plants with high artemisinin content through genetic modulation of key enzymes of artemisinin biosynthesis between Jamia Hamdard University and M/s. IPCA Laboratories Ltd., Ratlam
- Development of Novel Adjuvants between Indian Institute of Chemical Technology, Hyderabad and M/s. Bharat Biotech International Ltd., Hyderabad

Facility projects

- 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
- National facility for drug development for academia, pharmaceutical and allied industries by Anna University of Technology, Tiruchirappalli
- Facility for clinical trials with international GLP and GCP standards for globalizing Ayurveda, Siddha and Unani formulation at SRM University, Chennai

Loan projects

- Early clinical development of ADV-1002401 (glucokinase modulator), a New Chemical Entity discovered in India, for providing effective oral therapy to patients suffering from Type-2 diabetes mellitus (T2DM) by M/s. Advinus Therapeutics Private Limited, Bangalore
- Setting up a clinical research facility at Gangtok, Sikkim by M/s. Magnus Specialty Research Laboratories, Gangtok
- A Phase III Randomized, Double Blind, Placebo Controlled, one way Crossover, Multi-Dose, Multi-center, Safety and Efficacy study of T1h mAB administered intravenously in subjects with active moderate to severe Psoriasis by M/s. Biocon Ltd., Bangalore.
- WCK 2349, an oral anti-MRSA NCE clinical development – Phase II a Clinical Study ... by M/s. Wockhardt Ltd., Mumbai
- Process up-scaling, pre-clinical & clinical evaluation of PBL-2270: A novel oxazolidinone for the treatment of gram positive resistant pathogens by M/s. Panacea Biotech Ltd., New Delhi
- Upgradation of rodent and Beagle dog housing facility for breeding and pre-clinical evaluation with pharmaceuticals, agrochemicals, biocides, etc in compliance with GLP by M/s. IIBAT, Kancheepuram.

Completed projects

National Facility for Regulatory Pharmacology & Toxicology funded to CDRI, Lucknow has achieved its objectives. This facility comprises of Quality Assurance System and facilities for Regulatory Pharmacology and Toxicology, Animal House Facility, Central Documentation Control Unit for archiving of Regulatory Data as per guidelines and CDRI GLP Directive Document to provide basic GLP guidelines for conduct of regulatory studies and possible GLP Certification in future.



Fig. 4.1: Controlled Laboratory Area for “SD Rats” for regulatory experiments, CDRI, Lucknow

Regulatory studies of an anti-malarial drug α, β -arteether (CDRI product) which has been marketed have been carried out. Regulatory studies have also been carried out on other CDRI products which are in different stages of clinical trials (IND Stage, Phase-I, Phase-II and Phase-III). Several sponsored regulatory studies/projects for Pharma Company products have also been taken up. Regulatory studies of in-house candidate drugs/ leads for different activity (anti-diabetic, osteogenic, anti-thrombotic) have also been taken up which are in different stages of drug development.



Fig. 4.2 : Animal Facility as per GLP norms: Overview of controlled experimental area, CDRI, Lucknow

In one of the collaborative projects, a novel self-emulsifying delivery system of curcumin has been developed and the formulation has been optimized for particle size of the emulsion formed, drug uptake and stability. Pharmacokinetics studies on large group of wistar rats were carried out for this formulation. Five times increase in bioavailability of curcumin was observed. One Indian patent titled “Self emulsifying drug delivery system for a curcuminoid based composition was filed.

Interaction, meetings, conferences & workshops

Financial 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:

- A Conclave on “Drug Discovery Research and Development” by Confederation of Indian Industry in New Delhi during 18-19 Aug. 2010
- Workshop on “Application of Chromatography and Mass Spectrometry in Clinical Research” at Bioequivalence Study Centre, Jadavpur University, Kolkata during 20-24 September 2010
- Conference on “Hidden Treasures of Microbial World” by Indian Association of Applied Microbiologists (IAAM) at Bharathidasan University, Tiruchirappalli during 24-25 Sep. 2010
- Conference on “Recent trends and future perspective in high altitude pulmonary research” at SNM Govt. Hospital, Leh, Ladakh by Institute of Genomics and Integrative Biology, Delhi during 27-30 Sep. 2010
- Conference on “Drug Discovery Clinical Research” and Workshop on “Good Practices in Clinical Research” by Institute of Clinical Research (India), New Delhi during 10-11 Nov. 2010

INSTRUMENTATION DEVELOPMENT PROGRAMME (IDP)

Under the area of industrial instrumentation, the 6 projects were initiated - Design and Fabrication of SOI-MEMS (Silicon-on-insulator Micro-electromechanical systems) Capacitive Accelerometer at IIT, Kharagpur; Development of online image processing system for finding size distribution of pellets in a pelletization plant at Institute of Minerals and Materials Technology, Bhubaneswar; Development of Surface Plasmon Resonance Instrument with a Novel Optical Design at BITS – Pilani; Development of automated Assay unit for Anti-Mitotic Activities at IISc, Bangalore; Design and development of a computerized instrument for measurement of fabric handle by nozzle extraction at IIT-Delhi; and to study the commercial viability of Table-top Light Fastness testing equipment developed earlier from the IDP, DST support at The Synthetic & Art Silk Mills’ Research Association (SASMIRA), Mumbai.

Under medical and healthcare sector, the developmental activities on 10 projects were focused - Low Cost Wireless Polysomnograph; Wireless Sensor based communication for Multi-channel EEG Recording; Health and Physical Fitness Monitor (PSG College of Technology, Coimbatore); Fabrication and Testing of Low Power Analog Front-End Chip for Heart Rate Detection, Carbon Nanotubes/Ultrahigh Molecular Weight Polyethylene Nano-composites for Total Joint Replacements (Indian Institute of Technology, Guwahati, Assam); an Embedded Low Cost Portable Continuous Wave (CW) Doppler Ultrasonography System Design (IIT, Kharagpur); Healthy and Safe Home based on Wireless Sensor System for Elderly People (Bengal Engineering and Science University, Shibpur, Howrah); In vivo, non-invasive 3D imaging of posterior segment of human eye by using high speed ultra-high resolution 1µm

Swept Source Optical Coherence Tomography (SSOCT) Birla Institute of Technology & Science, Mesra, Ranchi and development of Autonomous Cancerous Cell detection in Pap smear using cellular level electrical response characteristics (IIT, Delhi & AIIMS, New Delhi). The instrumentation development for Indian system of medicine namely, Sara Nadi “Non-Invasive Scientific Diagnostic Approach based on correlation of Nasal Cycle Rhythm with Three Radial Pulses” (SCAD College of Engineering & Technology, Cheranmahadevi, Tirunelveli District, Tamil Nadu) was also initiated.

Under sensor and allied instrumentation 4 projects are initiated to develop DLN based Phosphine and Arsine Gas Sensor using plasma assisted chemical vapor deposition, Diamond-Like Nanocomposite (PACVD – DLN) coating technology in solid state gas sensors at Dr. Meghnad Saha Institute of Technology (Techno India Group); Tailored Portable Lead Sensor Based on Stripping Voltametry at CSMCRI, Bhavnagar; Oil estimation instrument for oil seed and meal at Oil Seed research Institute, Dwarka, New Delhi; and Sensor Technology for Biochemical Oxygen Demand (BOD) measurement at Jai Narain Vyas University, Jodhpur.

Under R&D capacity building, the following training programmes/workshops and brainstorming sessions were conducted:

1. Four training programmes on Repair and Maintenance of Biomedical Instruments for Technocrats/Users from Armed Forces at Delhi and Vadodara by Central Scientific Instruments Organisation S&M Centre, Pusa, New Delhi.
2. Brain storming meetings for the development of recommendations for setting up a mission mode programme for medical instrumentation and devices development through Science and Technology by Sree Chitra Tirunal Institute for Medical Sciences & Technology, Thiruvananthapuram.
3. A workshop on ‘Rapid measurement of tea quality by optical and electronic method’ was organized on 3-4th September 2010 at Tea Research Association, Toklai Experimental Station, Jorhat, Assam
4. A consultation meeting of experts to develop indigenous Surface Plasma Resonance instrument on 1st May, 2010 at Department of Physics & Astrophysics, Delhi University
5. Workshop on Thin Film Coatings and its applications during August 25-27, 2010 (Three days) at Instrument Design, Development and Facilities Centre (IDDC)- Haryana State Electronics Development Corporation Limited (HATRON), Staff Road, Ambala Cantt.

CLUSTER OF PROJECTS MEETING

To encourage the Indian Scientists/Technologists to put efforts in design and development of textiles and allied instrumentation such as testing instruments, process control instruments, plasma textile treatment, pollution monitoring and control in textile industry etc., a project cluster meet was organized by DST on 7-8 September 2010 at The Synthetic and Art Silk Mills’ Research Association (SASMIRA), Mumbai. Around 30 new ideas, for instrumentation related to natural textiles/fibers like jute, cotton, wool, silk etc. as well as synthetic ones, submitted by Scientists/Technologists from different organizations were discussed.

Sensor Hub, Kolkata

The Sensor Hub was established at Central Glass and Ceramic Research Institute (CGCRI), Kolkata with the grant from the Department of Science & Technology (DST), Government of India and Council of Scientific & Industrial Research (CSIR), New Delhi for a period of five years. The sensor hub will take the

batch production of sensor and related instruments leading to commercialization of laboratory prototypes developed in the research laboratories. The participating institutions are CGCRI, Kolkata; C-DAC, Kolkata; Jadavpur University, Kolkata; University of Kolkata; and Bengal Engineering and Science University, Shibpur, Kolkata. The work plan primarily included development of products such as Tea Sensors and Sensor Array with associated electronic nose; Gas Sensing Devices for Methane and Carbon-monoxide; and Polymer based Gas Sensor for detection of Carbon monoxide etc.

REPRESENTATIVE PROTOTYPES DEVELOPED DURING THIS PERIOD

1. Computerized Spectrophotometric Sperm Motility Analyzer at Indian Institute of Chemical Biology, CSIR, Jadavpur, Kolkata



Fig. 4.3 : Modified SPERMA

Internal system of modified SPERMA

Testing of gear system for multiple heights

The modified SPERMA is a multi-cuvette and multi-height exposures instrumental system, which is capable of testing multiple samples for multi height exposures. It can help to observe the effects of different doses of regulators on the spermatozoa sample simultaneously. Such simultaneous multi sample testing saves the time span of experiments, thus, produces more reliable results.

2. Controlled Atmosphere (CA) Cold Storage System for Increasing the Shelf life of Apples by National Research & Technology Consortium, Parwanoo



Fig. 4.4 : Computerized Control System for CA stores

Control Panel

This new method maintains and monitors other important parameters such as humidity, oxygen, and carbon dioxide levels along with the specified temperature such that, it allows apples to be kept in as good condition as fresh for 10-12 months, with high juice content, sweetness etc. This helps to avoid glut in market in month of September when new crop of apple comes out. The near commercial model of CA storage system for capacity up to twenty tones of apples storage is being installed at RHRS Mashobra, Shimla. It is proposed to use two cold rooms (5.4m × 3.9m × 2.25m) and (4.2m × 3.0m × 2.25m) of total storage volume 56.75m³. The apples are being stored since Sept'2010.

3. A Portable Device for Electrically Enhanced Trans-dermal Drug Delivery at IIT-Delhi

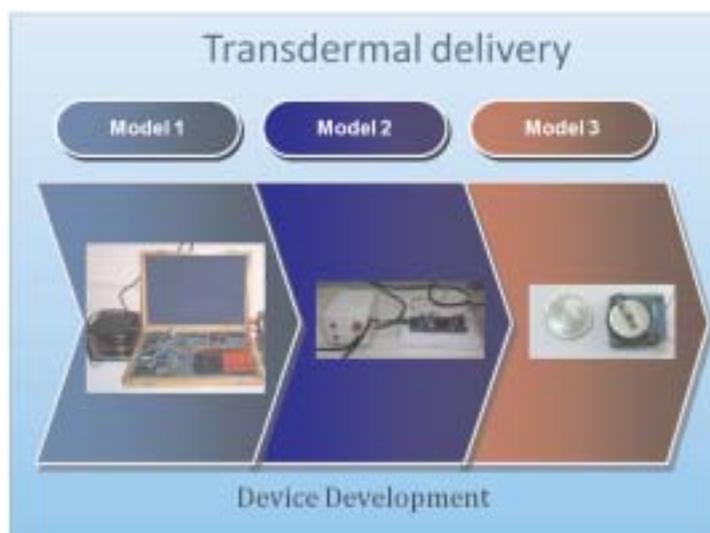


Fig. 4.5 : Portable device for Electrically enhanced transdermal drug delivery

Application of Electric Field [Iontophoresis] is used to facilitate the drug delivery. It involves application of low intensity current for long durations. A miniature unit (footprint slightly bigger than a 1 INR coin) for iontophoretic delivery of insulin has been developed. The device is designed around a PIC micro-controller and has been pre-programmed for parameters [voltage, current, frequency and waveform] best suited for delivery of insulin. Besides the above protein drug, the device has been used for the delivery of Methotrexate. Recently M/s Troikka Pharmaceuticals Ltd., Satya Marg, Bodakdev, Ahmedabad has funded a project to deliver Diclofenac Diethylamine across the skin and formalities for the Know-how are underway.

4. Noise Pollution Level Monitoring System for Textile Industry at IIT, Kanpur



Fig. 4.6 : Noise pollution level monitoring system for textile industry

The developed noise level monitoring system continuously monitors and records the amplitude and time duration of the noise level at work place in case it exceeds the prescribed limit. The system also provides audio/visual indications. It also records if corrective action has been taken in prescribed time limits. Periodic downloading of data to a computer system may be done using communication port. Data may be periodically transmitted to a central computer system through LAN, internet or CDMA/GSM wireless networks.

5. Continuous Feed Equipment for Extraction of Aloe vera Gel at Central Institute of Agricultural Engineering Regional Centre- Industrial Extension Project, TNAU Campus, Coimbatore, Tamil Nadu .



Fig. 4.7 : Continous feed equipment for extraction of Aloe Vera Gel

The equipment consists of a set of two pressure rollers on the top and a set of two rollers at the bottom, to flatten the aloe vera leaf fed between rollers to make it devoid of curvature. The bottom set of pressure rollers could be rotated manually by means of a handle or by means of three phase one 1hp motor through gear transmission mechanism. Sliding bearing arrangements were provided to adjust the gap between the two set of rollers based on the average thickness of the aloe vera leaf. The outer skin at the bottom of the aloe vera leaf got peeled up as the leaf moved forward between the rollers. The peeling of both top and bottom skins took place in a single pass. The capacity of the equipment is about 150-175 kgs when motorized and 75-100kg/h by hand.

6. Gas sensor array for electronic nose at IIT, Delhi

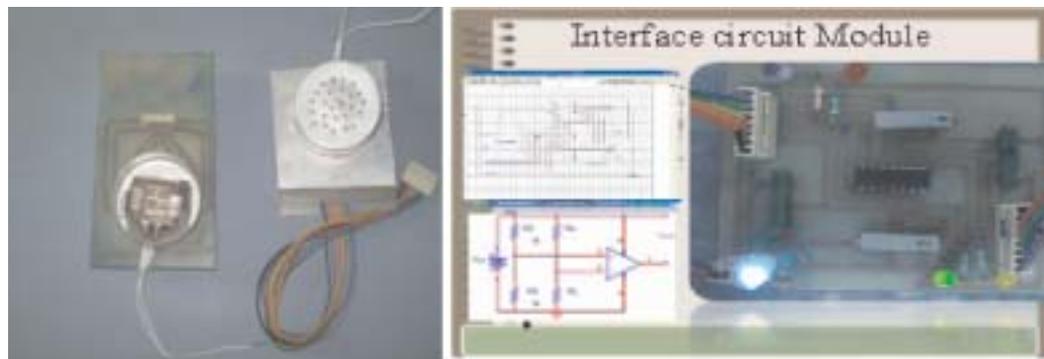


Fig. 4.8 : Gas sensor array for electronic nose

A thick film sensor array of 10 x 10 mm has been developed using highly gas sensing materials to sense CO, NO₂, ethanol and ammonia. The sensing performance has been studied. An associated

electronics has been developed to procure data from all the sensors and interface with PC. The prototype sensor assembly and interface electronic circuit has been shown below.

7. Development of Automatic Remote Accessible Rain-Gauge at IISc, Bangalore



Tipping Mechanism

Automatic Raingauge

Fig. 4.9 : Automatic Remote Accessible Rain-Gauge

The Automatic Remote Accessible Rain-gauge has been developed to store data at high temporal resolution, communicate directly with a PC and remotely through GSM technology. The rain gauge can measure both the rain rate and the total amount of rain. Further, it will consume very low electrical power so that it can run on few dry cells for a period of several months. The low power design makes the dry cells' life span inherently longer. In the absence of external cables, chances of the sensor getting affected by electrical shocks (line voltage fluctuations, lightning, etc.) are reduced substantially increasing the reliability of the system.

8. Improved non-electronic Soil Testing Kit with Soil Health Card and Fertilizer recommendation software at Raja Balwant Singh College, Agra



Fig. 4.10 : Non-Electronic Soil Testing Kit

The improved version of Ferticheck™ soil testing kit has additional facility for analyzing soil micronutrients-Zinc (Zn), Chloride (Cl), Sulphate (SO₄), Copper (Cu), Manganese (Mn), Boron(B) and Iron (Fe) along with existing macronutrients - pH, Carbon(OC), Nitrogen(N), Phosphorus (P) and Potash (K) in soil ,on color chart basis by chemical reactions. The kit also contains a Soil Health Card for the farmers for soil quality assessment and data record for future assessment of his field and a fertilizer recommendation chart on the basis of soil characters and important crops of India and a complete software is also developed for interpretation of soil quality status and balanced fertilizer recommendation based on this soil testing kit. The Industrial collaborator M/s Bio-link Overseas Co., Agra has taken up the technology for manufacturing & marketing under the trademark “Ferticheck”. This kit is used at soil testing laboratories for qualitative assessment of soil quality. The kit is much helpful to farmers who can use it directly without any assistance and decide the health of soil and apply the suitable fertilizer and in appropriate quantity.

9. Near Infra Red Spectroscopy (NIRS) based on-line instrument for quality assessment in edible oil industry at Central Electrical and Electronics Research Institute, Chennai centre and the Central Food Technological Research Institute, Mysore



Fig. 4.11 : Near Infra red spectroscopy based on-line instrument

The technique is based on the selective absorption of the NIR spectrum by these chemical constituents, namely, free fatty acids, hydroperoxides and oryzanol. Appropriate IR light sources, spectrophotometer and flow cells were procured and these were integrated to work on-line in an industrial environment. The user industry has been continuously supplying a number of samples (sun flower oil) with corresponding constituent data. Every sample was obtained in two sets. One set was sent to CFTRI in order to confirm the data given by the industry using analytical methods and the other is used in CEERI to get the spectral data. Then the spectral data was correlated against the analytical data to get the calibration constants using the chemometric tools. Then the calibration constants are used to compute FFA and PV values of test samples. The tests are highly encouraging and the results are closely matching the analytical values and the accuracy levels are satisfactory.

COMMERCIAL VIABILITY ASSESSMENT

1) Real time evaluation of X-ray imaging based mango sorting system.



Fig. 4.12

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. The real time evaluation was done by Central Electronics Engineering Research Institute (CEERI), Chennai was done at Mango Export Facility Centre of Maharashtra State Agricultural Marketing Board (MSAMB), Ratnagiri, Maharashtra for optimization of system performance.

2) Commissioning and installation of already developed membrane separation system for textile industry to reduce pollution by recycling.



Fig. 4.13

SASMIRA had already developed prototype of the membrane filtration system under DST funded project. As a first step towards commercialization, the developed model of capacity to suit the industrial

requirement is envisaged to be installed in two wet processing units. Two wet processing units have been identified at Surat Gujarat. Membrane filtration systems suitable for water recycling at these units have been developed. The units have been installed and commissioned. Running trials at the shop floor are ongoing. Periodic data of effluent is being collected and analysed from both the units to evaluate the efficacy of the developed systems.

3) **Commissioning and Installation of 2No's already developed Ultrasonic low energy dyeing technique**



Fig. 4.14

SASMIRA had already developed prototype of the low energy dyeing machine shown above, both winch and open width dyeing machine under DST. Under this project commercial viability of the developed technology would be studied by installing this machine at two wet processing units. Two dyeing units have been identified at Surat. Ultrasonic dyeing machine specifications have been designed as per the process requirement of the respective units. Fabrication of the machines is under progress. The running trials of the machines at the respective units would soon be undertaken.

Both the technologies are available for demonstrations to the textile processing units.

A brochure of the Instrumentation Development Programme (IDP) containing the information about the programme and salient achievements over the years was released by Dr. T. Ramasami, Secretary, DST on 23rd, November, 2010. The same is being circulated to various target groups to disseminate the information about the programme.

NATIONAL PROGRAMME ON CARBON SEQUESTRATION RESEARCH

The following projects were taken up under the programme:

i) **Predicting Soil Carbon changes under different bio-climatic systems in (NBSSLUP, Nagpur), India**

Approved objectives of the proposal

- Define, collate and format data set on soil, climate and land use of already identified BM spots to quantify carbon sequestration potential in the selected soil

- Estimate and predict the C change in the selected BM spot using C models.
- Quantify the impact of defined changes in land use on carbon sequestration in soil with a view to assisting in the formulation of improved policies to optimize resource use in the selected **Bench Mark (BM) spots**.

Important highlight/achievement of the work

The different bio-climatic system were selected viz. Indo-Gangetic Plains and Black Soil region of the country. A total 5 and 11 BM spots were selected respectively the details can be seen in the following figures:



Fig. 4.15

5 BM spots selected

1. Mohanpur (West Bengal)
2. Goupur (Pusa, Bihar)
3. Zarifa Viran (Haryana)
4. Holambi (New Delhi)
5. Barah (Kanpur, Uttar Pradesh)



Fig. 4.16

11 BM spots selected

1. Babhulgaon (Maharashtra)
2. Panjri (Maharashtra)
3. Mulegaon (Maharashtra)
4. Sawargaon (Maharashtra)
5. Kalwan (Maharashtra)
6. Kovilpatti (Tamil Nadu)
7. Nabibagh (Madhya Pradesh)
8. Sarol (Madhya Pradesh)
9. Palathurai (Andhra Pradesh)
10. Kasireddipalli (Andhra Pradesh)
11. Teligi (Karnataka)

The following data sets were collected. The soil data consisting of depth (cm), Bulk density ($Mg\ m^{-3}$), Organic Carbon (%) and Clay (%) and Long Term Fertilizer Experimental Data (LTFE) was also supplemented in data sets. The output was a comprehensive and useful Compendium entitled “**Soils, Land Use Management and Climatic Dataset of the selected Indo-Gangetic Plains and Black Soil regions, India for CENTURY and RothC Modelling**”

Climatic Data	RothC	Century
	Mean Annual Rainfall (mm)	Monthly Rainfall (cm)
	Mean Annual Temperature (Soil)	Monthly Data for Minimum and Maximum Temperature ($^{\circ}C$)
	Potential Evapo-transpiration (mm)	

Modeling studies

Two types of models were used to evaluate soil organic carbon changes in various bio-climatic zones viz. **ROTHAMSED C model** and **CENTURY C model**. The performance of these models was evaluated inputting the required data sets for each model. The observations made were as follows:

- A. In Indo Gangetic Plains (IGP), RothC captures the effect of different management interventions on TOC changes in all the sites represented by different bioclimatic regions.
- B. It was the first time that Century C model was used in Black Soil Region having soils with more than 50% cracking clay.
- C. The Century model was parameterized using regional crop data from semi-arid sites of India dominated by black soils (Vertisols).

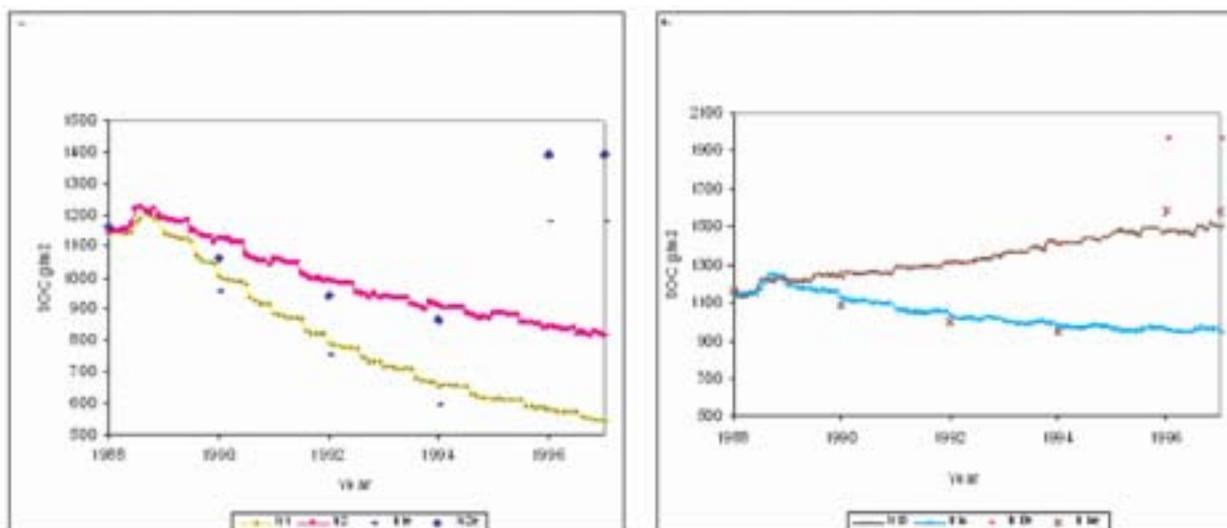


Fig. 4.17: Modelled and estimated soil carbon over time for four management regimes included in the long term fertilizer trial at Akola, Maharashtra

In addition the quantitative evaluation of both the models mentioned above was also carried out. Based on the evaluation carbon sequestration potential of various BM spots in IGP and Black Soil regions was estimated as depicted in the figure below.

The major findings of the work carried out so far are listed below:

- ❖ The Century and RothC model evaluation showed that these models can work in selected BM spots of IGP and BSR.
- ❖ The Century model was more successful when applied to SH climate for example in Mohanpur than those in drier climate represented by soils with high amount of cracking clay while *RothC works in both humid and semi-arid bioclimatic systems.*
- ❖ The prediction of soil carbon status in sub-humid (Sarol) and humid (Mohanpur) bioclimatic system was similar when the RothC and Century carbon models were used.
- ❖ We have made recommendation for the management of cropping pattern and agronomic practices for selected BM spots keeping in view the modeled soil carbon output.

The partial work carried out under the project was also published in a reputed journal *Agriculture, Ecosystems and Environment*, **139 (264-272)** published by ELSEVIER. The title of the paper was **Evaluating the Century C model using two long-term fertilizer trials representing humid and semi-arid sites from India.**

- ii) **Carbon dioxide sequestration potential of agro-forestry systems under irrigated and rain fed conditions (National Research Center for Agro-forestry (ICAR), Jhansi)**

Important highlight/achievement of the work

Biomass (above and belowground), soil carbon, total carbon in plant and soil, carbon sequestered, CO₂ equivalent carbon sequestered in *Albizia procera*, *Dalbergia sissoo* (under irrigated conditions),

Hardwickia binnata and *Emblica officinalis* (under rainfed conditions) based agro-forestry systems were estimated for their rotation period (30, 50, 45 and 25-years, respectively) using CO2Fix Model (Photos of different system are given below). The results indicated that the biomass accumulation varied from 34.86 to 434.08 t biomass ha⁻¹ in different tree species and variation in biomass are due to their growth habit, application of agronomic inputs and tree density. Similarly soil carbon also varied from 11.57 to 43.02 t C per ha⁻¹.



Fig. 4.18 : *Albizia procera* + wheat as intercrop



Fig. 4.19 : *Dalbergia sissoo* intercropped with mustard



Fig. 4.20: *Hardwickia binata*



Fig. 4.21 : Aonla + greengram as intercrop

In *Dalbergia sissoo*, carbon stock in soil at beginning of the project was 8.87 t C ha⁻¹ and it reached up to 23.86 t C ha⁻¹ at end of rotation. The increment in carbon accumulation was 0.24 to 13.92 t C ha⁻¹ during different year. The carbon in baseline was 9.94 t C ha⁻¹ and it was reduced during first year when the tree was planted and cultivation of crop was begun. Similar observation was also observed in case of *Albizia procera*. In case of *Hardwickia binnata*, the soil carbon in baseline was 10.55 and increment in carbon was negative up to 12-years and after that soil carbon was increased @ 0.52 to 12.75 t C ha⁻¹ in different years. In case of aonla, increment in carbon was @ 1.82 t C ha⁻¹ in 1996 and it was 5.04 t C ha⁻¹ at end of rotation period (Figure 1).

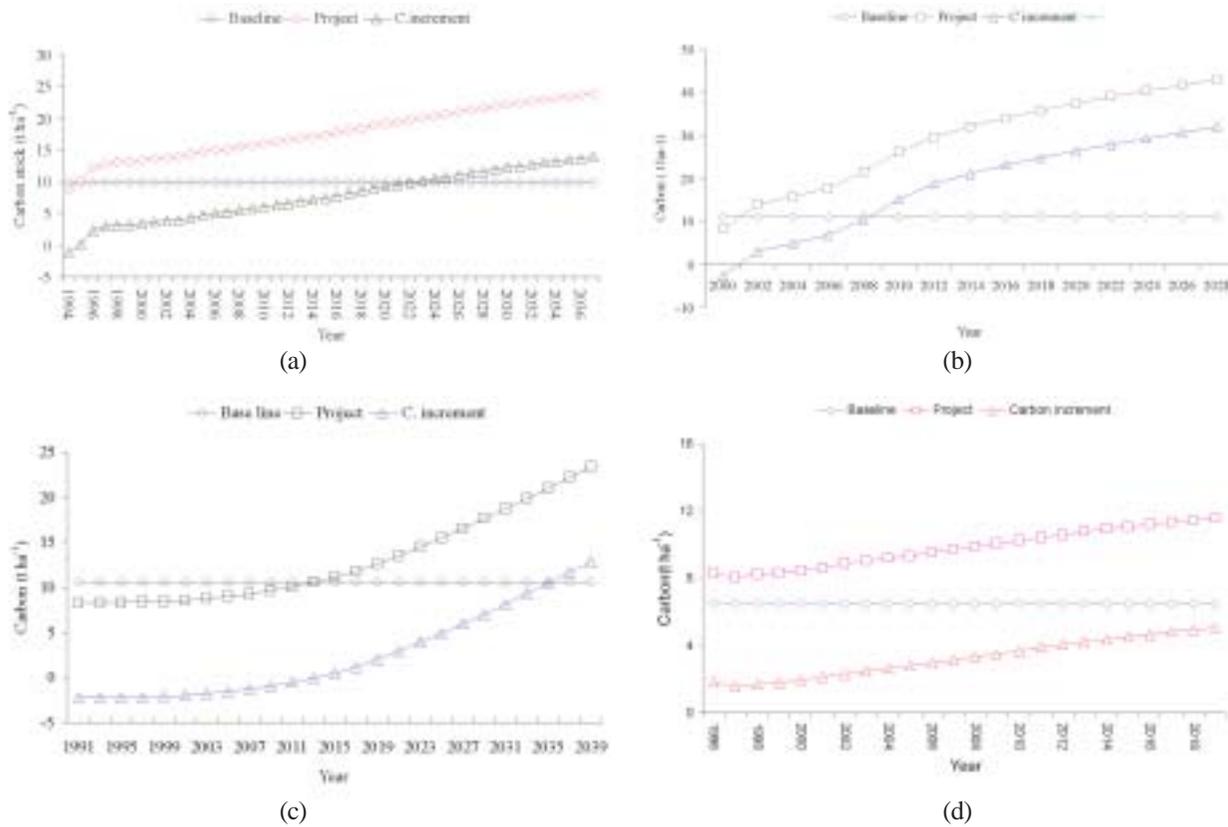


Fig. 4.22 : Carbon stock changes in soil including baseline and project scenario under various agrisilviculture system (a: *Dalbergia sissoo*, b: *Albizia procera* c: *Hardwickia binnata* and d: *Emblica officinalis*)

The Jhansi district was chosen to estimate carbon sequestration potential of agroforestry practices. The total carbon stock in above, belowground biomass, soil carbon, non-woody litter was 6.2, 4.95, 9.44 and 0.65 t C ha⁻¹, respectively during 2009 and the carbon stocks in these pools would be 12.03, 7.5, 16.21 and 2.34 t C ha⁻¹, respectively after 21-years. The carbon sequestration potential of agroforestry practices in Jhansi districts was 20.6 t C ha⁻¹ in 2009 and it would increase up to 35.74 t C ha⁻¹ after 21-years.

Thermal Dissipation Sap Velocity Probe was installed in aonla (*Emblica officinalis*) and anjan (*Hardwickia binata*) on 24th June 2010. Water flow in *Emblica officinalis* during July, August and September, 2010 was 41.49, 30.22 and 13.46 litres per day, respectively. Similarly for the *Hardwickia binata* water flow during the month of July, August and September, 2010 was 67.86, 63.77 and 37.41 litres per day, respectively. The patterns of sap flow in aonla and Hardwickia for 15 days (1-15 July, 2010) are given in Figures 2.

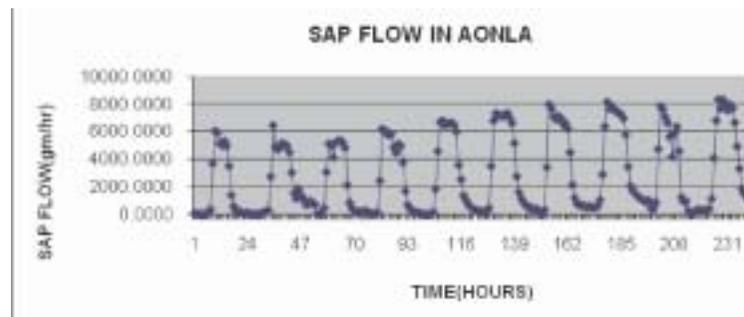


Fig. 4.23

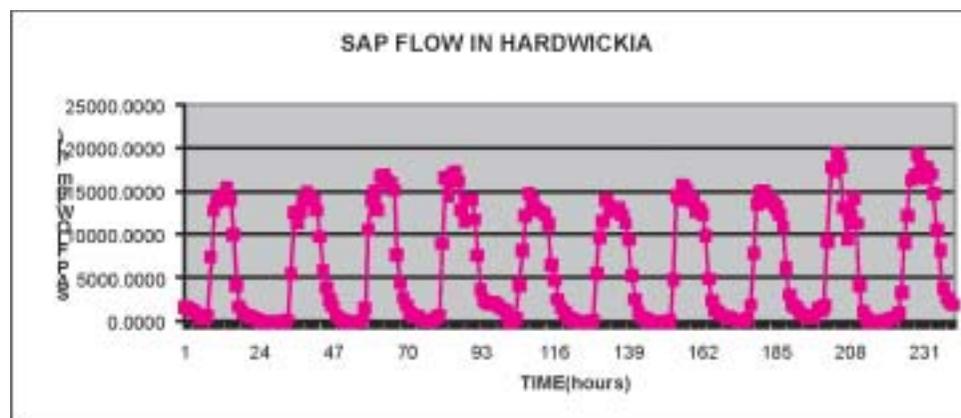


Fig. 4.24 : The patterns of sap flow in aonla and Hardwickia for 1-15 July, 2010

In addition THREE research publications were also brought out

- iii) **Experimental & Simulation Studies of CO₂ Sequestration using solar/chemical methods in Center for Environmental Science and Technology, National Institute of Technology, Tiruchirapalli – 620 015**

Approved objectives of the proposal

Evaluate key design criteria and the technical feasibility of bio-fixation using micro algae and to develop preliminary economic data.

Important highlight/achievement of the work

Bio sequestration lab established

Lab consisting of culture room, inoculation room, instrumentation room, culture preparation and chemical analysis facility was established. Sophisticated instruments required for finding out photosynthetic efficiency were purchased and installed.



Fig. 4.25 : Germ Plasm Room



Fig. 4.26 : Inoculation Room

Effect of various parameters on algae growth

Research work was undertaken to study the effect of parameters such as Light, CO₂, Mixing, pH, Temperature, Nutrients, Algae concentration.

Experiments under sunlight

Chlorella vulgaris is tested under Sun light, Room light, 2 tube light, 4 tube light using (NaNO₃ + KH₂PO₄) as nutrients. Under (actual) sunlight – discoloration was observed, still absorbance was found increasing. This is due to high light intensity. Experiments are repeated in diffused sunlight. Higher absorbance found and maximum reached on 3rd day. Cell colonizes and precipitation occurred. When experiments were conducted with BBM medium under sunlight, growth rate was maximum at 7th day and the species was found in suspension. More experimental runs are to be repeated to get the growth data with sunlight.

Assessment of CO₂ mass transfer: Effect of wind velocity on microalgae growth:

The wind speed causes loss of carbon dioxide from water solution during bio sequestration of carbon dioxide. The effect of wind velocity on the percentage loss of carbon dioxide from water was studied at wind speeds varying from 2.7 m/s to 10.5 m/s. The gas transfer velocity was evaluated at each wind speed. Empirical relation was determined between the wind speed (u) in m/s, gas transfer velocity (k) in m/s and Schmidt number (Sc). The correlation developed was:

$$k = 1.5 \times 10^{-6} u^{1.758} Sc^{-0.5}$$

The developed correlation was verified satisfactorily for percentage loss of carbon dioxide in open air.

Mass transfer simulation was undertaken using Parallel Plate absorption column. Mass transfer experimental studies were undertaken to estimate losses of CO₂ to atmosphere. The following were design specifications for Adsorption Column: Packing Height – 91.5 cm, Width – 7.5 cm, Thickness – 3 mm, Number of Plates – 15, Gas holdup volume – 672 cm³, Liquid holdup volume – 631 cm³, Nozzle diameter – 10 mm. The typical Adsorption Column is depicted below:

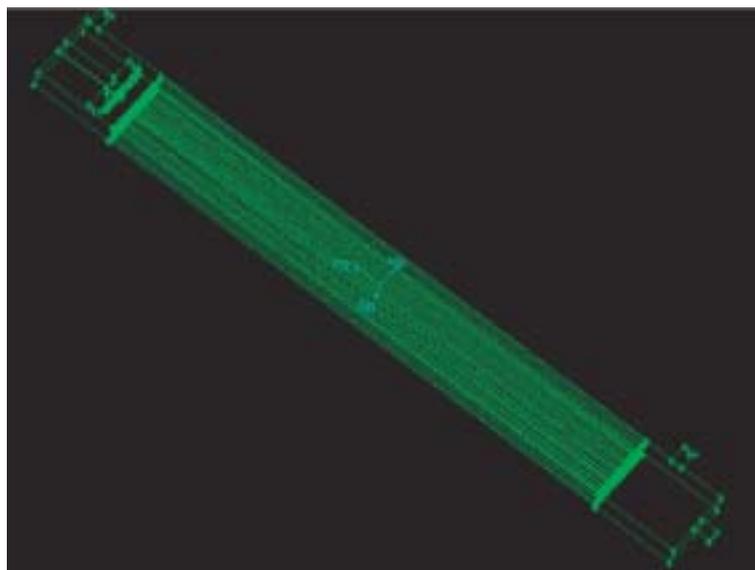


Fig. 4.27

Design Criteria for Photo Bio-reactor

The design criteria for Photo Bio-reactor was evolved keeping in view the following facts/parameters such as : Uniform concentration of CO₂, nutrient, light, High Concentration difference – (mass transfer), Required light intensity to cells – (Photosynthesis), Frequency of light dark cycle, System without mixing, Maintaining always optimum seed concentration and Overall process performance depending on Mixing time, Mass transfer time, , CO₂ fixation time, light energy supply time. A Thin Film Photo Bio-reactor was designed and fabricated with following specifications/characteristics:

- Stainless steel tray (dimension 30 x 23 x 2 cm)
- **Surface area to volume ratio : 478 m⁻¹**
- Absorption of CO₂ was studied by spreading 145 ml culture medium on the tray to 2 mm thickness.
- Covered airtight with polythene sheet to maintain the desired carbon dioxide air atmosphere inside the tray
- The polythene cover was fixed and a 14% CO₂-air mixture was admitted continuously through the inlet.
- CO₂ concentration in water was analyzed for every 5 seconds.
- Equilibrium concentration :1260 ppm (1650 ppm for pure water)
- Temperature : 32 °C

A typical experimental set up is depicted below:



Fig. 4.28 : Thin film reactor – Six trays

A new design for Solar Bio-reactor is under development. This bio-reactor will have following features : Surface area to volume ratio – 1000, Illuminated surface area per unit area : much higher than 1, Incorporated light to dark cycle ratio

The following new observations were made:

- Chlorella sp has been tested under sunlight condition and observed that species becomes colorless which may be due to very high sunlight intensity available than what is required by the species
- The growth study of the species under fluorescent lamps of 80 W and 160 W revealed that there is not much enhancement in growth compared with room light conditions.
- Scenedesmus sp is found to sustain the sunlight conditions better than chlorella
- K_2CO_3 medium gives higher growth rate than conventional BBM medium

The other significant achievements under the project were as follows:

List of publications

Book Chapter

- CO_2 Sequestration & Biofuel Production using microalgal technology, Sequestration Technology for Clean Energy, Daya publishing house, 2010, pp 85-94.

Papers under revision

- Theoretical productivity, Technical & Economic feasibility of Microalgae for CO_2 Sequestration in Indian context
- Simulation studies on parallel plates mass transfer column for CO_2 in water
- Studies on Effect of wind speed on loss of carbon dioxide during bio sequestration Thin layer Photo-bioreactor

Patents filed/to be filed

- New type of photo-bioreactor will be applied for patent after testing

No. of Ph.D produced: Two (registered)

Technical personnel trained: Three

iv) Improving carbon and nitrogen sequestration: a transgenic approach to lower green house gas

Approved objectives of the proposal

1. Construction of appropriate constructs over-expressing PEPCase, AspAT and GS
2. Transforming prevailing model system *Arabidopsis thaliana* and *Lotus corniculatus* with the above constructs.
3. Analysis of transgenic plants for adaptation and field testing.

IMPORTANT HIGHLIGHT/ACHIEVEMENT OF THE WORK

The proposal targeted to develop an alternative metabolic route to CO₂ sequestration in Arabidopsis. It was proposed to over express phosphoenol pyruvate carboxylase (PEPCase) in addition to ribulose 1,5-bi-phosphate (RuBP) carboxylase-oxygenase (Rubsico) to sequester CO₂. It is also proposed to over express, aspartate amino transferase (AAT) and glutamine synthetase (GS) to utilize the carbon for fixation of nitrogen, being evolved during metabolism, into amino acid and protein. It was reported that a construct carrying all the three genes under independent promoter and terminator in a transformation vector pCAMBIA 1302 and generated T3 generation of Arabidopsis co-over-expressing all the three genes. During the period the plants were analyzed. One of the lines shows increase in bio-mass and altered partitioning behavior, which was of great value.

Project Title: Carbon dioxide sequestration through culture of medically useful microalgae in photo-bioreactors linked to gas outlets of industries. (Andhra University Visakhapatnam 530 003)

Approved objectives of the proposal

The main aim of the investigation is to identify microalgal strains of medically (nutraceutically) important species suitable for mass cultivation and demonstrate the proof of concept that they can sequester CO₂ emitted from industrial set ups in substantial amounts.

The following research publications were brought out on the basis of work done under the project.

Number of papers published: 1 published, 2 revised manuscripts submitted.

1. “Utility of a reflector for energy saving in plant tissue and algal culture laboratories” published in *Current science* vol. 99, No.5, 10 Sep 2010, 569 – 70.
 2. Oleic acid rich biofuel from *Neochloris oleoabundans* grown mixotrophically on glycerol – a by product during biodiesel transesterification. Revised manuscript submitted in August 2010 to *Journal of Applied Phycology*.
 3. Impact of salinity on growth of two carotenogenic strains of *Dunaliella* isolated from evaporation salt pans fed by waters of western Bay of Bengal, a tropical environment. Revised manuscript submitted in September 2010 to *Botanica Marina*.
- v) Mechanism and the Dynamics of Carbon storage in the Sundarbans Mangrove Ecosystem (University of Calcutta, Kolkata)

Approved objectives of the proposal

1. To quantify spatial and temporal variation of carbon storage in different compartment such as atmosphere, soil, water, forest in the Sundarban Mangrove Ecosystem and their respective turn over time.
2. To study comparative efficiency of the biological pump for storing CO₂ as organic carbon and biogenous CaCO₃ in soil, water and forest in relation to their ambient condition.
3. To assess the effect of new nutrients on the carbon storage in the sediment in the form of geopolymers like humates and kerogen through diagenesis.

4. To apply reservoir models with nonlinear reservoir/flux relations and cycles.

Important highlight/achievement of the work

- ❖ The net accumulation of the carbon in the AGB, BGB and in soil was estimated to be 26.62 Tg which is 0.40% of the total carbon stored in India's forests (6621.55 Tg).
- ❖ Regression models developed in this study involving breast height diameter, height and density can be used to estimate the living above-ground and below-ground biomass of mangroves.
- ❖ Application of the model allows estimating the spatial variation of above-ground biomass and subsequent consideration of several aspects that affect above-ground biomass, particularly, the influence of resource availability and constraining.
- ❖ The net biosphere-atmosphere exchange of CO₂ (2.79 Tg C yr⁻¹) was found close to the value obtained by dbh increment (2.0Tg C yr⁻¹).
- ❖ Litter fall plays a pivotal role in mangrove ecosystem carbon dynamics and leads to a significant shift in the observed net carbon balance. The data show small net uptake (production –litter fall) of ~1.69 Mg C ha⁻¹ a⁻¹ leading to the conclusion that rate of accumulation carbon in Tropical mangrove forest is greater than the global mean of 0.49 Mg C ha⁻¹ a⁻¹ in tropical forests.
- ❖ Carbon storage in the Sundarban mangrove forest is estimated to be 0.40% of the total carbon storage in the Indian forest.
- ❖ Sundarban mangrove acted as a sink for atmospheric CO₂ and it sequesters 0.55% of the total carbon emission per year as fossil fuel from India (504.6TgC a⁻¹).
- ❖ Turnover time of carbon is limited to 8 - 9 years in the mangrove forest reservoir and 2 – 3 years in the soil.
- ❖ Humification of organic carbon for long term sequestration in the sediment is a slow process.

Program Advisory and Monitoring Committee (PAMC) of NPCSR

7th and 8th meeting of PAMC of NPCSR were organized on July 8-9th, 2010 and November 11-12th, 2010. 24 new proposals were considered out of which 14 were recommended for support in different research areas of Carbon sequestration in different universities and different research institutes such as ZIMI, Parwanoo & CSK University, Palampur, ICT, Hyderabad, North Eastern Institute of Science and Technology, Jorhat, Directorate of Groundnut Research, ICAR, Junagadh, Global Hydro-geological Solutions, New Delhi, NGRI, Hyderabad, Madaras Veterinary College, Chennai, University of Hyderabad, Hyderabad, Madurai University, Madurai, Department of Civil Engineering, IIT, Delhi, Bharathidasan University, Tiruchirappalli, CSSRI, Karnal, University of Kolkata, Kolkata, Annamali University, Annamali Nagar, Tamil Nadu.

TECHNOLOGY DEVELOPMENT BOARD

The Government of India constituted the Technology Development Board (TDB) in September 1996, under the provisions of the Technology Development Board Act, 1995. The mandate of the TDB is to

provide financial assistance to the industrial concerns and other agencies attempting development and 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; in exceptional cases, it may be grant. The loan assistance is provided up to 50 percent of the approved project cost and carries 5 percent simple rate of interest per annum. In the alternative, TDB may also subscribe by way of equity capital in a company, subject to maximum up to 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 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 also took growth-oriented initiative and provided financial assistance to Technology Business Incubators (TBIs) and Science & Technology Entrepreneurs Parks (STEPs) under Seed Support System for 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 incubators 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 STEP and Incubators in various fields.

During the year 2009-10, TDB signed 17 agreements (including 5 with STEP/TBIs for Seed Support) with commitment of ₹ 78.32 crore out of total project cost of ₹ 215.33 crores. TDB has disbursed ₹ 55.04 crore to the assisted companies for implementation of the projects. TDB's support covers the sectors of economy namely, Health, Biotech, Chemical, Engineering, Agriculture, Energy & Waste Utilization, Telecommunication and Information Technology.

In the current year as on 30th September, 2010, TDB has signed 2 agreements with commitment of ₹ 9.40 crore out of total project cost of ₹ 31.36 and disbursed ₹ 33.26 to the assisted companies.

MAJOR ACHIEVEMENTS

In the recent past TDB has provided financial support to commercialise following innovative technologies:

Fiber LASER Cutting System

M/s Sahajanand LASER Technology Limited, Gandhinagar, Gujarat has been provided financial assistance from TDB for setting up a facility for the production of Fiber LASER Cutting System of 1, 2 and 3 KW power for metal processing based on innovative process developed indigenously by the main promoter for higher cutting speed, better efficiency (higher thickness cutting at same LASER power) and three times more plug efficiency resulting into better absorption by any metal compared to CO₂ LASER and thus can be used for quality cutting in a cost effective manner with competitive specifications.

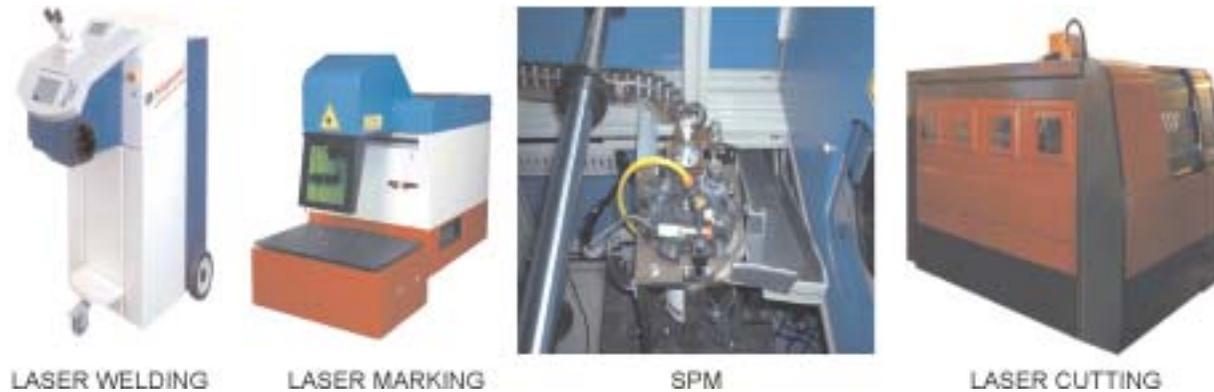


Fig. 4.29 : Fibre Laser Cutting System: SAHAJANAND LASER TECHNOLOGY

Vertical Pressure Filter (Horizontal Plates)

M/s Rotofilt Engineers Limited, Ahmedabad has been provided financial assistance by TDB to set up facility to manufacture 10 vertical pressure filters per year. The components/ raw materials for production of vertical pressure filter are indigenously developed by the company at its in-house R&D unit. The pressure filter would compete with the products of companies like, Larox Corp. (Finland), Progress (Ukraine) and Bethlehem (USA).

Small Unmanned Ariel Vehicles (UAVs)

M/s Aurora Integrated Systems Private Limited, Bangalore has been provided loan assistance by TDB for development and commercialization of small Unmanned Aerial Vehicles (UAVs) for military surveillance (Sky-I Mk-I) and homeland security (Urban Surveillance System - Urban View and Airship)'. The company is promoted by group of technocrats from IIT, Kanpur.



Fig. 4.30 : Unmanned Ariel Vehicle: AURORA INTEGRATED

FPGA (Field Programmable Gate Arrays) Based on-Line UPS (Uninterrupted Power Supply) Systems

M/s Su-Kam Power Systems Limited, Gurgaon has been provided loan assistance by TDB for “Commercialization of FPCA (Field Programmable Gate Arrays) Based on-Line UPS (Uninterrupted Power Supply) Systems”. The company proposes to set up a facility to produced FPGA based on line

UPS systems for the first time in the country by way of upgrading 3-Phase On-Line UPS systems (5KVA-100 KVA) already developed for heavy load applications like elevators, air-conditioners, refrigerators, operation theaters etc.

High Frequency X-Ray Generator and Vital Sign Monitor Technology

M/s Skanray Technologies Private Limited, Mysore has been provided loan assistance by TDB for commercialization of High Frequency X-Ray Generator and Vital Sign Monitor Technology. The company has developed an innovative x-ray shielding technology which reduces the radiation to extremely low level without use of excessive lead to shield. High frequency generators developed by the company are capable of generating very stable X-rays which can be precisely controlled and pulsed for reducing patient dose. High frequency X-ray generators are mostly imported in India which are very expensive and are not affordable for primary health care.



Fig. 4.31: High Frequency X-Ray Generator: SKANRAY TECHNOLOGIES

Software products AutoDCR & Opticon

M/s SoftTech Engineers Private Limited, Pune has been provided loan assistance by TDB for development and commercialization of products 'AutoDCR and Opticon'. AutoDCR is a software product for automation of building plan approval reading CAD drawing and mapping them to development control rules. Opticon is a web based tool for solving the end-to-end problems that exist in the construction and infrastructure industry. The company envisages development of generic/ advanced version of the product 'AutoDCR' by adding customization features and enabling the product to be used with multiple CAD platforms. The product 'Opticon' would service the specific needs of the construction industry, i.e preparation of estimates, planning and scheduling, purchase, inventory, accounts, sales and marketing, customer relationship and maintenance management.

LED Based Lighting Products as Green Energy Solutions

M/s MIC Electronics Limited, Hyderabad has been provided loan assistance by TDB for development and commercialization of LED lights, as an illumination product. The products are grid based street lights billboard lights and indoor lights; Off- grid based (solar powered) lantern, home lights and street lights; Off-grid products for railways; and other products for commercial/ industrial lighting. The developments are being done by the company with the support of its in-house R&D unit. The project aims at promoting clean and green energy solutions in the country.

Active Pharmaceutical Ingredients (APIs)

M/s Ogene Systems (I) Private Limited, Hyderabad approached TDB for setting up facilities for “Development and Manufacturing of Active Pharmaceutical Ingredients (APIs)” namely Cetrizine Dihydrochloride, D-Naproxin and Sumatriptan Succinate developed by IICT and Racecadortil and Amlodipine Besylate are developed by in-house R&D unit of the company. The indigenous technology enables optimizing the manufacturing process in terms of higher yields, reducing cycle times and number of stages, using a greener chemistry and thereby reducing the cost of production by an up scaled process by the company in association with IICT.

IRIS NGX – a new generation switching platform with Internet Protocol (IP)

M/s Coral Telecom Limited, Noida U.P., has been provided loan assistance by TDB for commercialization of IRIS NGX Switch that will meet New Generation Network (NGN) Requirements for Enterprise as well as Defense”. IRIS NGX is a new generation switching platform with Internet Protocol (IP) at its core to seamlessly support both the traditional Time Division Multiplexed (TDM) as well as Session Initiated Protocol (SIP) environments.

Sure Waves Media Convergence Solutions

M/s IndusEdge Innovations Private Limited, Bangalore has been provided Loan Assistance by TDB for the commercialization of SureWaves Media Convergence Solutions” based on technology developed in-house by the Company. The project aims at development of Media Grid for aggregation of content/text/advertisement material from diverse source and its delivery across different digital media such as “Out of Home” (OOH) display screens, mobile phone screens, local TVs, desk top screen etc. for targeted audience/ customers.

Pro-active Role

(a) Seed Support for STEP/TBIs

In 2005, Technology Development Board (TDB) took a growth-oriented proactive initiative by starting the Seed Support System for providing financial assistance for Start-ups in Incubators. The basic idea of the proposed financial assistance is to equip the STEP/ TBI with the much needed early stage financial assistance to be provided to deserving ideas/ technologies.

TDB decided to provide financial support to Technology Business Incubators (TBIs) and Science & Technology Entrepreneurs Parks (STEPS) to extend much needed early stage /start-up capital to young entrepreneurs to incubate and bring out innovative technology venture ideas under development to fruition and finally to reach the market place. This would enable some of these innovative ideas/ technologies to graduate to a level where they can then be fit for seeking normal lending through TDB/ FI’s route in their way to the successful commercialization process. Thus the proposed assistance is positioned to act as a bridge between development & commercialization of the technologies.

TDB provided financial assistance to five Technology Business Incubators (TBI’s) and Science & Technology Entrepreneurs Parks (STEP’s) under Seed Support System for Start-up in Incubators to

incubate technological ideas during 2005-06. This scheme progressed well and TDB extended the scheme and supported another five incubators for Rs.100 lakh each in the second round in 2007-08.

During 2009-10, five more STEP/TBI's namely NCL Pune, NITK-STEP Karnataka, Amity, Business Incubator Noida, Amrita technology Business Incubator Kerala and IITM, Chennai has been provided Seed Support fund of Rs.100 lakh in the third round of the scheme. To nurture the incubation of technological ideas, lab scale technologies and technological entrepreneurship, TDB has extended support to 15 Technology Business Incubators (TBIs) and STEPs. These Incubators have provided assistance to 62 Incubatee companies for their projects which are in the areas of telecom, software, robotics, agriculture, instrumentation, engineering, environment, pharma, food, solar, textile and biotechnology etc.

(b) Participation in the scheme “Global Innovation & Technology Alliance” (GITA)

TDB associated itself to support a scheme for Global Innovation & Technology Alliance popularity known as GITA jointly promoted by DST & CII to extend the benefits of international linkages of DST to the industry in terms of providing technology information, networking with overseas organization, facilitating joint research with foreign industry and research entities, organizing interaction through technology summits and technology platform and implementing bilateral industrial R&D programme.

Since, TDB has established fund flow mechanism to provide loan, grant or equity to Indian Industry as well as monitoring mechanism for repayment / return on investment, TDB join hands with DST & CII extending suitable fund flow mechanism for operation of GITA. It will help to bridge the gap and act as the catalyst to convert the proven scientific ideas into mature innovations resulting in their commercialization.

TECHNOLOGY DAY FUNCTION AND PRESENTATION OF AWARDS

The Technology Day Function 2010 celebrated on 11th May 2010 and former President of India Dr. A.P.J. Abdul Kalam was the Chief Guest. On this occasion the products from five companies supported by TDB viz. M/s United Nanotech Products Ltd, M/s NMS Works Software Pvt. Ltd., M/s. Cavera Systems India Pvt. Ltd., M/s. Realtime Systems Ltd., and M/s. Spray Engineering Devices Ltd., were released.

The Chief Guest in presence of Sh. Prithviraj Chavan, Minister of State, Science and Technology and Earth Sciences presented above Awards to the following award winners on this occasion.

National Award 2010 of Rs. 10 lakhs for the successful commercialization of indigenous technology by an industrial concern was awarded to:

Indian Oil Corporation Limited, R&D Centre, Faridabad, Haryana

For the indigenous development & commercialization of Multifunctional Additives for Premium Grade Diesel (SERVO-DMFA) & Lubricity Additives for Ultra-Low Sulphur Diesel (SERVO-LI) was given to Indian Oil Corporation Limited, R&D Centre, Faridabad, Haryana.



Fig. 4.32: Dr. A.P.J. Abdul Kalam presenting the trophy for the National Award 2010 to M/s Indian Oil Corporation Ltd., R&D Centre, Haryana on 11th May 2010.

Award to SSI Unit 2010 of ‘ 2 lakhs for the successful commercialization of a technology based product was given to the following units:

Panacea Medical Technologies Pvt. Ltd., Bangalore

For developing and commercializing BHABHATRON-II – Cobalt Teletherapy Unit with in built safety features for radiation treatment in Cancer Therapy, based on technology developed by Bhabha Atomic Research Centre (BARC) meeting standards of IEC, AERB and as per Medical Device Directive 93/42/EEC.



Fig. 4.33

TECHNOLOGY SYSTEMS DEVELOPMENT (TSD) PROGRAMME

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.

Summary of the progress made in some of the important areas, which were taken up for technology development is given below:

1. Bio-degradable/Bio-medical Polymers and Water Purification :

- a) Development and applications of hydrolyzed and unhydrolyzed polyacrylamide grafted tamarind kernel powder (TKP) as flocculants for waste water treatment.

The main objective of the project was to develop novel biodegradable polymeric flocculants based on Tamarind Kernel Polysaccharide (TKP). The emphasis was to develop three different types of flocculants namely - cationic, anionic and non-ionic based on TKP, so as to use for treatment of various wastewaters. Tamarind kernel polysaccharide (TKP) is derived from the seeds of the tree *Tamarindus indica*. TKP is amongst the most important common and commercially important tree that grows abundantly in the dry tracts of Central and South Indian States and also in other South East Asian Countries. In this project, it was envisaged to develop a high performance cationic flocculants based on Cationic TKP.

- b) Engineered Biofiber hybrid composites: Opportunities and challenges for environmental sustainability and high performance applications

The project primarily focused on developing commercially viable bio-fiber filled hybrid composites for automotive and other high end engineering as well as various commodity applications. The incorporation of natural fibers into polyolefins such as polyethylene and polypropylene can reduce the overall usage of these petroleum-derived materials, thereby

- Decreasing the release of sequestered carbon
- Increasing the use of renewable, carbon-neutral materials
- Reducing the environmental impact of non-biodegradable materials

This project was a successful attempt to develop cost-effective, eco-friendly composites, which could address these challenges and therefore can suitably substitute for composites with conventional fillers. Prototypes were successfully developed using sisal/banana based glass fiber hybrid PP composites that could meet all requirements for specialty applications. Also, a thorough investigation on the flammability characteristics and extent of biodegradation of the material has been carried out. Some of the prototypes successfully developed are:

Fig. 4.34: Automotive Air Filter of a motor bike (banana/glass-PP hybrid composites)



Fig. 4.35: Eco-friendly Garment Hangers (sisal/glass PP hybrid composites)



Fig. 4.36: Gas guiding paper used in Off-shore Oil Drilling (PP/Banana/Glass Hybrid composites)



Fig. 4.37: Automotive hinge component of M/s Hyundai, Chennai



- c) Flux enhancement and fouling reduction during effluent (leather and dye) treatment using membrane separation

A number of semi-empirical and detailed models (film theory based model, osmotic pressure model, solution diffusion model etc.) were developed to predict the efficiency of the separation process and their numerical solutions were successfully compared with the experimental data. The results were used to evaluate important transport parameters relevant to these processes. The validated models and relations were instrumental in the design and scale up of the fabricated membrane modules for pilot level studies and will be useful to design and develop complex industrial effluent treatment processes.



Fig. 4.38: Membrane Module

2. Alternate Fuels:

The department has carved out a niche area to address various technological aspects related to bio-fuels. The focus of activities under this programme is mainly on technology related applications and system integration in bio-fuels. Department has initially focused on potential and problems related to the application of Straight Vegetable Oils (SVOs). The department has the mandate to support R&D related to development, demonstration and field trials of various technologies related to bio-fuel for various applications and activities to promote the use of bio-fuels and utilization of their by-products to produce value added chemicals. Following projects were supported in this area during the year :

- Microbial fuel cell development for production of electricity from waste biomass.
- Development of new composite catalysts for the production of hydrogen glycerol.
- Production and characterization of biodiesel from micro algae as a renewable energy source
- Experimental Analysis and Modeling of Augmented Turbulence Combustion and Emission Characteristics of Bio-diesel fuelled C.I. Engine.

The progress of the following projects, supported in this area, was reviewed during the year:

- Integrated Project for development of process/technologies for value-added products from Karanja Leaves, flowers, Bark, Oil and Cake.
- Feasibility of blending of Straight Vegetable Oil (SVO) in petro diesel and its utilization in IDI engine.
- Indiegenous resource utilization : development of Direct-Ethanol-Vegitable oil hybrid fuel blends and field testing in commercial transport vehicles.
- Development of process for recovery of gasoline range hydrocarbons from waste plastics.
- Catalytic separation of carbon di oxide from raw biogas through selective adsorption process over special masoporous materials for development of green technology.
- Biodiesel production from hydrocarbon yeilding plants.
- Bioethanol production for alternative fuel from seleted Lignocellulostic raw materials using their thermotolerance yeists.
- Technology Development and optimization for bioethanol production from potato and petha waste.
- Study of the factors affecting the long term oxidation stability of jatropa and pongamia biodiesel.
- Screening of indigeneous tree borne oils as potential raw materials fo rthe preparation of biodiesel.
- Study of toxic constituents of Jatropha curcas (Oil, Oilcake and biodiesel).
- High rate biomethanation of de-oiled cake from non-edible oil seeds for rapid biogas production.
- Comparative chemical characterization and evaluation of toxic potential of metals and PAHs in both primary and secondary particulates emitted from combustion in diesel v/s biodiesel (from Jatropha) engines.
- Development of catalyst for conversion of glycerol to ethylene glycol.
- Technical performance analysis of ethanol diesel blends for use in Direct Injection (DI) diesel engine.
- Preparing status report on themes related to technical and scientific aspects of biofuel utilization.
- Pilot studies on optimization of biomethanation process parameters for biogas production from jatropa and pongamia oil seed cakes.
- Production of Karanja-Biodiesel and its products for agricultural application.
- Biodiesel production from Karanja oil and Jatropha oil using microbial lipase as catalyst and their characterization.
- Development of a stationary diesel engine for dual fuel operation of biodiesel and CNG fuel.
- Power generation with reduced emissions using deoiled cake and biodiesel from non-edible oil seeds.
- Combustion, Material Compatibility, and Engine Tribology Investigations in a Biodiesel Fuelled Turbo-charged Transportation Engine.

Production and utilization of bio-diesel from non-edible oil seeds and its application in agriculture in Assam



Fig. 4.39: Experimental test set up (5 nos) for single cylinder IDI diesel engine (Test fuels: Diesel, JSVO10, JSVO20, JSVO50 and neat Jatropha oil at University of Petroleum and Energy Studies, Dehradun)



Fig. 4.40: New variant of bench scale digester at ICT, Hyderabad

1. 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 evaluate effectiveness of diagnostic and management decision by teleophthalmology compared to in-clinic assessment of patients and validates the concept of teleophthalmology in Indian context.

2. 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 to 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. Following projects were supported in this area during the year:

- Development and Demonstration of eco-friendly plasma surface modification system for treatment of brass valves.
- Development and Performance Evaluation of an Industrial Scale Atmospheric Pressure Air Plasma System to Treat Angora Wool for Manufacture of 100% Products.

The progress of the following projects was reviewed during the year:

- Utilization of different industrial waste materials from sponge iron and power plant for making building blocks
- Plasma nitriding for the improved performance of cutting machinery in tyre industry
- Rejuvenation of traditional poultry making by applying advanced bio-techniques.
- Development of eco-friendly protective coatings for woodcraft in India.

3. Innovative Civil Infrastructure Technology Systems:

Under this activity, the focus is on development of multi-disciplinary, multi-institutional technology development projects in niche areas having relevance to the Indian needs and widespread potential for successful replication. The progress of the project entitled “Distress Dignostics, 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.

4. Glass Technology Upgradation:

Under this programme, projects aiming at technology upgradation and development have been initiated in the areas of optical glass, ophthalmic glass and unorganized small sector glass industry of consumer items (Firozabad glass industry).

Following projects were reviewed during the year:

- i) Development of technology for the production of extended wear contact lens/daily wear contact lens : Phase-II
- ii) Development of foldable Intra-ocular lens : Phase-II

- iii) Development of sol-gel based low e-indium Tin Oxide (ITO) coatings on glass for different applications.
- iv) Design and development of precision bi-spherical polycarbonate lenses for indirect ophthalmoscopy (20D & 28D)
- v) Development of contemporary design for unorganized small scale sector of Firozabad Glass Cluster.

5. **Molecular Electronics, conducting polymers and Non-invasive and other biosensors program:**

The Molecular electronics is a fast emerging area of nanotechnology which is concerned with the electronic and optoelectronic properties exhibited by several class of organic molecules, fullerenes, carbon nanotubes, graphene, conducting polymers and biological materials such as proteins and nucleic acids. Biomolecular electronics is a sub-area which integrates the biomolecules with the electronics through a transducer. A major outcome of research in biomolecular electronics is the development of biosensors for health care diagnostics especially of non-invasive type.

The large scale manufacturing of devices based on the molecular electronics is still in early stages, but recent developments in organic light emitting diodes (OLEDs) as displays and Organic solar cells show their immense potential to develop into next generation devices. An important class of molecular electronics materials is the conducting polymers. The electrically conducting polymers exhibit many interesting properties which have great potentials for device applications. For example, some of the conducting polymers exhibit electrochromism, where the color of the polymer changes with the applied voltage. This is important in the development of flexible cards, displays and color modulating windows etc., The conducting polymers either alone or in combination with carbon nanotubes are also studied as efficient electrode materials in supercapacitors which are new generation power devices. Due to the electrically conducting nature, high porosity, flexibility and chemical functionality they are also materials of choice for sensors and biosensors.

Some significant projects sanctioned during this year:

- I. Facility creation - Design and development and fabrication of OLED, Organic Solar Cells and Organic Thin Film Transistor (TFT) based on Molecular, Polymeric and composite materials

In order to keep pace with the world wide activity in the area of organic electronic materials such as Organic LEDs, Organic Solar cells etc., a major state-of-the art National fabrication facility has been sanctioned at IIT-Guwahati at a cost of about Rs. 5.00 crores. Such a facility will help not just the host investigators but also a network of several researchers working in this important topic in several academic and research institutions across the country.

Organic LEDs, TFTs Solar cells : Following projects were supported:

- Design and development of organic light emitting diodes (OLED) and photovoltaic (PV) devices.
- Fabrication and characterization of organic thin film transistors.
- Colored fluorescent conducting polymer for photovoltaic applications – Feasibility phase

- Development of cyclopenta [c] heterol based conjugated systems for dye-sensitized solar cells (DSSCs)
 - LED from Polyaniline Deposited on Porous Silicon Template.
 - Development of Semiconductor nanoparticles-Conducting Polymer composite for Organic Electronics application
- II. Electrochromic materials : Following projects were supported:
- Development of transparent conducting coatings on flexible substrates for electrochromic devices.
 - Design and characterization of electrochromic rear view mirrors using conducting polymers.
- III. Electrochemical supercapacitors : Following projects were supported:
- Development of electrochemical hybrid supercapacitors based on conducting polymer electrodes and polymer electrolytes for energy storage.
 - Polymer composites as advanced electrode material for supercapacitors
- IV. Chemical and Biomolecular sensors : Following projects were supported:
- Conducting polymer-carbon composite sensor for the determination of Na:K ratio in blood serum samples
 - Development of a low cost wireless plantar foot pressure monitoring system employing e-field sensors.
 - Immobilized rice-peroxidase biosensor for dopamine determination based on functionalized conducting polymers
 - Fluorometric sensor for cadmium in drinking water.
 - Design and Fabrication of a Conducting Polymer Ceramic Nanocomposites Gas Sensor.
 - Corrole-based sensors for halide ion recognition.

SOME SIGNIFICANT MILESTONES DURING THIS PERIOD:

i. Preparation of Bacteriorhodopsin (BR):

Photoactive biomolecules are in great demand for the development of optical and electro-optical sensors. In this regard, Rhodopsins which are proteins and vital to animal and human vision are particularly important owing to their sensitivity to light and optical capabilities unmatched by synthetic molecules. Ability to make and manufacture rhodopsin based photonic components for device applications go a long way in establishing technological supremacy in the areas of Molecular electronics devices. The program was funded with two major objectives. (a) To prepare BR molecules from purple bacteria (b) simultaneously develop photonic devices based on the already established properties and to use available films for the high-end applications. The focused efforts in this direction with optimal funding are yielding rich dividends as evidenced by success in isolating and purification of BR in small quantities. The aim is not only prepare the BR in larger quantities and produce films for device applications.

ii. Capacitance and conductance based sensor Instrumentation for biochemical Characterization

Reagent less measurement of reactions is close to the ideal situation in analytical chemistry and biochemistry. Measurement of many enzymatic biochemical reactions, including those of great clinical relevance, are not amenable for the conventional and currently popular spectrophotometric methods, which in many cases require external reagents to produce colour, fluorescence etc. However, many such reactions undergo changes in the charge status during the reaction depending on the charge associated with the substrates and products, which could be measured as changes in capacitance. This inherent property was exploited in this new approach using an indigenously made auto-range capacitance meter capable of measuring capacitance in the range of microfarads to tens of picofarads. The enzymatic reactions causing capacitance changes have been successfully studied and showed to be comparable to the spectrophotometric analysis.



Fig. 4.41: Portable auto-range capacitance meter for reagent less measurement of enzymatic reactions (left : capacitance meter ; right : Measurement set-up with reaction cuvette)

iii) Development of conducting polymer rechargeable battery for consumer applications

Under this project , a polyaniline (PANI) based rechargeable battery was developed, fabricated and tested. The battery shows very desirable features such as good cycle ability, high capacity and quick charge retention. The doped PANI electrode based battery is expected to be of low cost, eco-friendly and lighter weight than the conventional dry cell batteries in the market. The performance of the battery has been tested under laboratory conditions and found to be capable of meeting the requirements of portable electronic devices. The battery has been demonstrated in Industry interaction meeting at Ambala which invited keen interest from Industries. Further field trials and up scaling studies would establish its potential for commercialization.

iv) Development and characterization of super elastic Ni-Ti shape memory alloys for biomedical and dental applications

Homogeneous binary/ternary shape memory alloys based on binary Ni-Ti and ternary Ni-Ti-Cu with the desired composition and free from harmful impurities were achieved through vacuum induction melting by controlling process parameters. It was observed that castings produced entirely in high

vacuum (10^{-5} torr.) were of superior quality and free from gas as well as shrinkage porosity. The alloy sheets, strips and wires exhibit shape memory and superelastic effect.

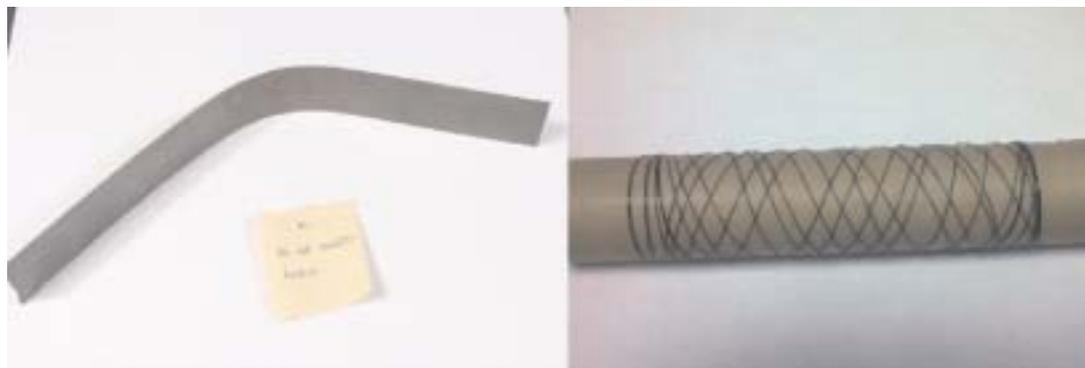


Fig. 4.42: Thin sheet ($t < 1\text{mm}$) obtained by rolling and wire ($d=0.5\text{mm}$) obtained by wire drawing

8. Waste utilization, recycling and Management:

The aim of this area was to develop technologies and processes which not only dispose off the waste but are also equally effective in value recovery from the waste. Under this programme, three areas (i.e. Electronic Waste, Hospital Waste, and Plastic Waste) were identified for inviting the project proposals during the year. In addition, certain Hazardous Waste with industry focus was also identified for technology development.

A project on **Utilization of Banana Stem for Paper Making** was funded. Banana is an annual crop and offers a significant source of income to the farmers. India is the largest banana producing country in the world. Paper Industry has been facing acute shortage of pulping raw material, presently $\frac{1}{3}$ rd of the paper is produced from wood based raw material, $\frac{1}{3}$ rd from agro residue like bagasse, wheat straw and rice straw and $\frac{1}{3}$ rd from recycled fiber.

9. Ceramic Technology Upgradation Programme:

a) **Developmental Aspect of Double Fired wall Tiles by Suitable Substitution of Various Ceramic Waste for it's Gainful Utilization.**

The developmental work initiated with characterization and evaluation of sludge of various sources and other raw materials and then utilized in the wall tile body composition. A detailed study on rheological properties of the body as well as fired properties of various tile formulations are under progress.

b) **Development of low cost sanitaryware for the under privileged utilizing locally available raw materials.**

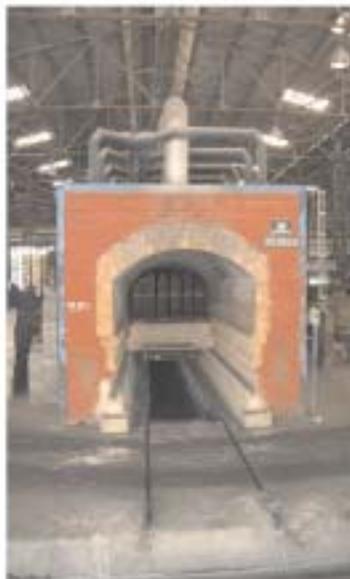
Sanitaryware items have been developed with matching glazes in the laboratory scale utilizing locally available lean variety clays. Products are at least 40% cheaper than those available commercially. Sanitary ware is one of the most important components of the rapidly growing building industry of this country. Large deposits of inferior variety of kaolinitic clays (containing various impurities) as well as red clay (terracotta clay), which are more abundantly available and are widely dispersed throughout the country, are normally considered unsuitable for the production of sanitary ware. It will be highly beneficial if these low cost raw materials can be



Mixing



Pressing



Tempering

Fig. 4.43: Different steps of Upscaling work of Al_2O_3 - MgAl_2O_4 -C brick at Burn Standard Co. Ltd.

gainfully utilized for the production of utility items such as sanitary ware. With this technology these clays may be gainfully utilized for production of high value added products. In the eastern region there is hardly any unit which produce sanitary wares although large quantity of these types of product comes to this sector from Rajasthan, Gujarat or Andhra Pradesh. With the new technology, it may be possible to produce sanitary ware products conforming to different BIS Specifications and thereby catering to the need of the people in the entire eastern and north-eastern region. Products made from locally available raw materials will reduce the cost of production substantially and socially relevant as it generates employment in rural sector.

c) Development of Al_2O_3 -MgO- $MgAl_2O_4$ Group of Refractories with and without Carbon for Metallurgical & Ceramic Industries

Under the project, Al_2O_3 - $MgAl_2O_4$ -C bricks were developed from its constituent oxides for application in the area where joint erosion / corrosion is high. The developed Al_2O_3 - $MgAl_2O_4$ -C consists of 80-85% Al_2O_3 , 5-8% MgO, 5-8% C and 2-4% antioxidants. Before taking up the project, target properties were formulated in consultation with the industrial partner, M/s. Burn Standard Company Ltd., Salem. The properties include bulk density, apparent porosity, coked porosity, cold crushing strength and PLCR. At the end of the project all these properties were achieved by selection of appropriate granulometry, selection of magnesia type.

The up scaling work at Burn Standard Co. Ltd. (industrial partner) was carried out with the above process. The level of upscaling work was done up to 10 tons. The results of upscaled product shows superior properties compared to the laboratory developed one.

The field trial of this refractory was carried out in ladle furnace of an integrated steel plant. The developed Al_2O_3 - $MgAl_2O_4$ -C refractory was lined in striking pad zone of the furnace. The life of the furnace was significantly improved up to 85 heats.

d) DEVELOPMENT OF CARBON-CARBON and CARBON-CERAMIC COMPOSITES FOR FRICTION AS WELL AS HIGH TEMPERATURE INDUSTRIAL APPLICATIONS

Carbon fiber reinforced carbon matrix (Carbon-Carbon) and ceramic powder reinforced carbons (Carbon-Ceramic) composites have been developed by using phenolic resin as matrix precursor, carbon fibers, oxide and carbide powders as fillers. These composites have been developed in different dimensions and thicknesses shown below as per end application.

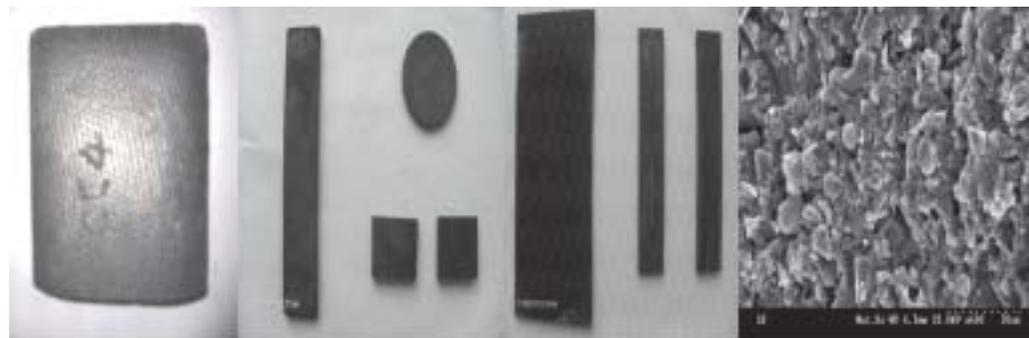


Fig. 4.44

High α low β

These composites have been developed using Powder metallurgical technique as well as liquid infiltration technique depending on the type of the composites followed by heat treatment to 1000-1400°C.

These composites have been developed for variety of applications such as for friction and wear applications in submersible pumps, brake linings or applications requiring handling high temperatures such as Fingers in Glass industries, furnace linings etc.

e) Project entitled “Development of manufacturing technology of SiALON cutting tools”

Effective metal removal requires strong, hard, wear resistant tools. The increasing demand for higher productivity and lower manufacturing cost is imposing a need for the development of improved cutting tools capable of operating at high machining speeds which increase the temperature at the tool- work piece interface. This need has, since the turn of the century, resulted in the development of high speed steel, cemented carbide and coated carbide cutting tools and has become progressively oriented toward more refractory materials- ceramics, predominantly based on nitrides and oxynitrides.

Metal cation stabilized α -form of silicon aluminium oxynitride (SiALON) ceramics has excellent hardness and strength. In fact, this material is one amongst the hardest known nitride materials and is considered to be an excellent candidate for wear resistant and cutting applications. Unfortunately, the fracture toughness of the material, as it happens to the hard materials, is low. The other variety of the SiALON materials, viz., β -SiALON has elongated grain morphology and is able to contribute improved toughness in the α -SiALON material. In this project work, an in-situ combination of multiphase ceramic composite based on different α - β SiALON materials has been developed.

10. Development of Microwave based systems: Design and Development of Gyrotron

First time in the country, the technological gap in the millimetre-wave band of frequencies is filled with the help of Department of Science and Technology (DST) through the project entitled, “Design and development of Gyrotron”. The millimeter-wave band devices are also called fast wave microwave devices which can deliver very high powers (~1-2 MW, CW) up to very high frequencies (~170 GHz). The applications are long-range communication, high-information-density communication, high-resolution radar, plasma heating for thermonuclear energy generation, industrial heating and material processing. CEERI-Pilani is designated as the Nodal Centre with other companion participating institutions: BHU, Varanasi; IIT, Roorkee; SAMEER, Mumbai; and IPR, Gandhinagar. Thus, the project is also created a consortium of the universities and national laboratories. IPR, Gandhinagar is the user of gyrotron for plasma heating applications and thus, the specifications of the gyrotron under development in the project are decided as per the specific requirements of IPR.

The developed gyrotron as the outcome of the present project will thus provide an import substitution and would create a scope for the export of the gyrotron in future. In addition, the execution of the project would create a design base not only for the gyrotron but also for its individual components/ subassemblies.

11. Miscellaneous Technologies: The Programme also supported the following projects for developing technologies:

- a) Development of a low cost wireless plantar foot pressure monitoring system employing e-field sensors

- b) Facility for Rheo Pressure Die Casting System
- c) Preparation of Useful Products for Leather Products Industry Using Leather Portion of Used Shoes / Chappals.
- d) Development of metal nanoparticles doped carbon aerogel based new hydrogen gas storage system for fuel cell & other applications
- e) Development of disc rotor type permanent magnet stepper motor
- f) **Convergence of Technologies - Production of Potassic fertilizer (Sulphate of Potash) from Sea Water**

Potassium is an essential plant nutrient. MOP (Muriate of Potash – KCl) and SOP (Sulphate of Potash - K_2SO_4) are the popular forms of Potassic Fertilizers. MOP is cheap and whereas SOP contains twin nutrients. India imports all its potash requirements. Bittern produced after harvesting of common salt contains 20-25g/L of KCl. India produces about 17 million tones of common salt annually, this can yield theoretically 2.8 lakhs tones of KCl which is equivalent to 10% of demand of this fertilizer in India. CSMCRI has developed an integrated process for recovering SOP from the bittern along with other co-products such as ammonium sulphate and high purity magnesia.

A project entitled “Test bed for integrated production of 0.75 TPD FCO grade SOP, 0.75 TPD of ammonium sulphate and 0.3 TPD of ultra pure magnesia from sea water bitter-based mixed salt through patented process” was formulated with the help of NMCC-New Delhi and finally sponsored to CSMCRI, Bhavnagar during this year at a total cost of Rs. 8.02 crores for a duration of three years during September 2010. Similarly, a 3 TPD Joint Test Bed will be established in the premises of M/s Tata Chemicals Ltd. 75% of the final erection cost of the Test Bed will be borne by DST and the rest 25% by TCL.

This project will serve the purpose of demonstrating and collection of data from the existing 15 kg of SOP from 150 ltrs batch process to 0.75 TPD/3 TPD FCO grade SOP a scaled up unit for validating technical and economical feasibility with an aim to keep the selling price of SOP at Rs. 17,000/- per MT.

- g) **Solar Hydrogen: Energy from Water**

In order to develop a practical and economically viable device for the production of Hydrogen from photolysis of water using solar energy, a programme for generation of “Solar Hydrogen : Energy from Water” was initiated during the year with an objectives to build a solar energy regime in India with Solar Hydrogen Technology as an important supporting pillar.

WATER TECHNOLOGY INITIATIVE PROGRAMME

DST is implementing Water Technology Initiative, a research based programme aimed at development and proving of low cost convergent technology solutions for domestic applications to ensure safe drinking water quality under real life conditions. The programme encourages indigenous research initiatives for addressing issues related to water availability, water purification and water reuse and recycling. The initiative also encourages scientific evaluation of technologies and preparing of database of technologies for referencing them in specific social context. Capacity Building of Academic/ R&D Institutions and State S&T Councils

in conducting R&D activities for addressing water challenges also falls in the mandate of the programme. The programme activities thus include development of database to recognize and rank water purification technologies for decentralized applications; capacity building of indigenous R&D institutions and academics; development, field assessment & pilot testing of technology options for drinking water purification. In addition, the quantity aspects such as per capita availability, surface runoff, storage capacity, rainwater harvesting etc. are also addressed. The focus of the programme has been on design and development of low cost solutions for domestic use of technologies for ensuring safe drinking water quality. The salient activities taken up during the year include the following:

1. DEVELOPMENT AND PROVING OF CONVERGENT TECHNOLOGY SOLUTIONS

- i) Technical solution for a cluster covering 7937 people at Satpuli in Uttarakhand using Riverbank filtration technique is already provided completely. The intervention has resulted in increasing per capita water availability from 44 lpcd to 103 lpcd. The quality of water has also improved and only disinfection is required as against coagulation/ filtration along with disinfection, required previously. The system had functioned effectively even during the torrential rains in Uttarakhand.

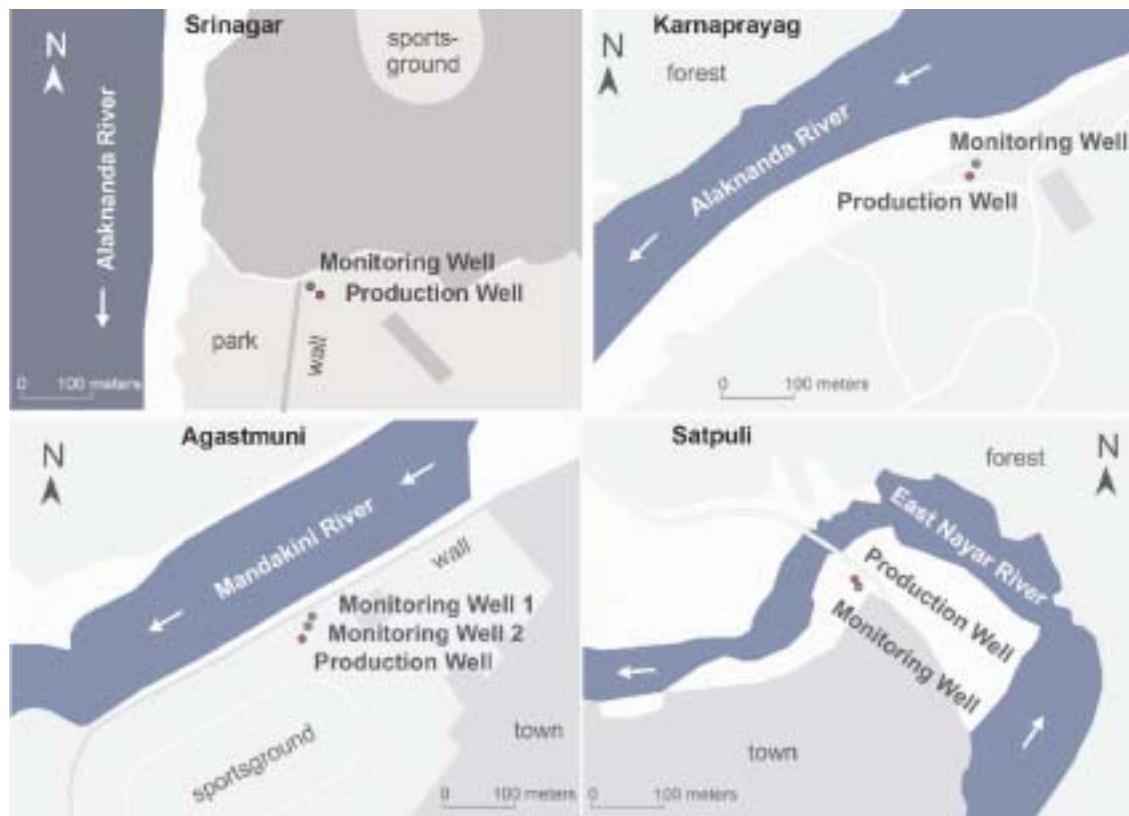


Fig. 4.45 : RBF Sites selected for scientific interventions in Uttarakhand

- ii) Technical solution for a cluster of 12 villages of Chirawa block in Rajasthan covering 20,000 people has already been initiated to address the problem of scarcity of potable water through innovative water conservation techniques. Progress is underway.



Fig. 4.46: Model of Rain water conservation

- iii) Technical Solution for village Sethukkarai in Ramanathapuram, Tamil Nadu has already been initiated. The research attempt is to develop and demonstrate a method by which steam generated by concentrating solar energy can be used to produce desalinated water.
- iv) Development of remotely monitored and controlled high capacity (6000 lph) two stage indigenous RO systems for sea water desalination is underway. The concept of energy recovery and reject management is proposed to be integrated with this state-of-art system.
- v) In order to provide iron free and bacteria free water at affordable cost, the domestic filter developed by IMMT, Bhubaneswar is being integrated with nano silver coatings developed by ARCI, Hyderabad . The initial results are encouraging. Under the on-going project, 15000 domestic filters in the containers fabricated by CIPET with candles developed locally with IMMT support would be disseminated for field trials in the States of Tamil Nadu, Gujarat, Orissa, Uttar Pradesh and Karnataka.

2. TRAINING PROGRAMME FOR WATER MANAGER IN STATES AND OTHER STAKEHOLDERS

Recognising the need for taking informed decisions in the water segment, Department has conceptualized training programmes for various target groups. These training programme will be tailored to the training needs for various groups. Such training groups could be for policy makers, engineers, chemists, technicians, panchyati- raj institutions, NGOs etc. Under the programme, DST will develop Core Group of trainers and involve social scientists in the activity. Hands on activity will be given due importance in the training module. Dissemination of rapid practical methods for microbial detection for judging potability of water would also be included in the programmes. Development of training programmes would require consensus on modules and aim at development of local capabilities with due consideration to technology environment in location specific context. Problem specific mobile unit for demonstration are proposed to be utilized for such training programmes Such training programme are proposed to be conducted by State S&T Council in consultation with line departments.

Efforts shall be put to identify a Committed Core Groups of trainers composing of superannuated academicians and scientists, social engineers, technicians etc. with focus on development of manpower in the Water Sector.

Recognising the importance of utilization of rainwater, Department of Science and Technology has consciously attempted to provide scientific inputs for rainwater harvesting and water recharge. With the support of Department of Science and Technology, Karnataka State Council for Science and Technology (KSCST) has implemented sustainable rainwater harvesting and ground water recharge programmes in Karnataka which include rooftop rainwater harvesting, rainwater harvesting in paved and unpaved areas and rainwater harvesting in lakes and tanks. A training programme has also been designed to train master trainers and rainwater harvesting professional from various parts of the country. The course material includes practices being followed in different parts of the country as well as other countries. In order to document the practices being followed in other parts of the world, a training programme involving 26 delegates from 15 developing countries was organized in February 2010. Two training programmes on the similar lines are being organized for Indian participants in early 2011.

3. CAPACITY BUILDING OF ACADEMIC/R&D INSTITUTIONS

The programme aims to bridge gaps in R&D efforts related to water through development of adequate research capacity in the area of water both in academic as well as R&D institutions. DST aims to invite proposals aimed at capacity building in terms of human resources as well as equipment support for such institutions. In order to coherently promote state level efforts, concerned State S&T Council are proposed to be actively involved. Broad based capacity building programmes are mounted which would contribute both for breakthrough research as well as field level implementation. The approaches include identification of R&D challenge and matching the technical capabilities of institutions. The R&D capacity should have due balance between basic research, applied research and field level implementation. Department has already catalysed development of water testing laboratory in Uttarakhand in association with Uttarakhand State Council for Science and Technology and Uttarakhand Jal Sansthan. Similar activities are planned for other states.

4. IDENTIFICATION OF PRIORITY AREAS FOR R&D

In order to develop R&D activities, brainstorming was done with various stakeholders on topics such as water treatment, water supply, contaminant removal nationally. The brain storming sessions were organized involving state implementing agencies and other stake holders to address state specific challenges like water logging in Haryana, fluoride contamination in Rajasthan and also generic challenges such as improvement of water cycle in country perspective. Also, discussion meetings were held to identify areas of mutual interest in the field of water technology, research and innovation collaboration with European Union, Germany, Netherlands. Consultations are also likely to take place with Canada and Israel. These discussions focused both on identification of readily deployable solutions for water challenges relevant to India as well as mutually identified priorities for joint research in water sector.

5. RESEARCH BASED SOLUTION FOR VARIOUS WATER CHALLENGES

Department has identified a number of clusters/sites which were hotspots in terms of water challenges in the opinion of States. In order to address the water challenges in these locations where the

problem was severe and viable alternatives were not available/provided, a solution science based approach is mounted in association with state councils, local institutions and other stakeholders in such a way that entire unit (e.g. village) is provided a solution for drinking water taking into account viability of the solution, responsible extraction and purification, local capability as well as model for sustaining the solution.

6. SCIENTIFIC EVALUATION/STUDIES

- i. Department has supported few research projects to assess water quality in the water harvesting structures. Scientific studies have also been supported for optimum utilization of traditional structures for rainwater harvesting and rejuvenation of tanks for water conservation. The project besides making sustainable intervention following scientific practices would also scientifically document impact of intervention and extent to which the intervention could augment the water need.
- ii. State Councils of Punjab, Maharashtra, Uttarakhand, Manipur, Tamil Nadu, Tripura, Arunachal Pradesh, Madhya Pradesh, Assam, Haryana, Sikkim, Andhra Pradesh, Goa, Kerala, Himachal Pradesh & Orissa have achieved the successful completion of Phase-I activities and are in the process of initiating the Phase-II activities towards evaluation of stand-alone water purification systems for schools.
- iii. Indigenous low cost Jal Tara water filters is being scientific evaluated in 5 schools and 5 community locations in Uttarakhand to develop a revenue based model.
- iv. Evaluation of comparative performance of available commercial as well as household technologies for removal of pathogens, turbidity etc. was initiated.
- v. Assessment of performance of existing rainwater harvesting structures and ground water recharging in the rural and urban areas and development of methodologies for efficient sustainable rain water harvesting system
- vi. Comprehensive study of presence of Arsenic in the underground Drinking Water in Punjab is in progress
- vii. Evaluation of candle filters available in commercial market

7. R&D PROJECTS

- i. A website <http://neerjal.org> has been hosted for trial and feedback. The website has been developed with participation of local villagers trained for testing. All the existing reports and multimedia content have been uploaded. Five types of reports viz. Water Quality, Drinking Water Adequacy, Water Harvesting Pattern, Local Water Source Statistics and Impurity Distribution Level Indicator could be generated from the input data.
- ii. Prototype development Water Quality Monitoring System having innovative technical architecture has been experimented in the laboratory. A prototype Wireless Sensor Network based water quality monitoring system based on the Dissolved Oxygen (DO), pH value and TDS has been achieved in lab scale. The system can continuously collect the data through sensors deployed at water body and send it to the central server through wireless communication in an intelligent and energy saving mode. The central server will monitor the data for unusual events and raise alerts in terms of SMS to the concerned user.

- iii. Development of bio-sorbents for water purification and assessment of solar stills was initiated. Also, Electro coagulation based Continuous- Flow Systems for removal of Drinking Water Contaminants has been initiated
- iv. Research projects based on membranes, adsorption, etc. for treatment of waste water including industrial waste water were also initiated.

8. WINNING, AUGMENTATION AND RENOVATION (WAR) FOR WATER

In pursuance of directives of Hon'ble Supreme Court to find out research based technological solutions to address various water challenges in the country, Technology Mission on 'Winning, Augmentation and Renovation (WAR) for Water' has thus been launched with focus on assessment and evaluation of technologies for safe drinking water for decentralized applications, creation of databases on various types of water purification technologies, etc. This initiative focuses on cost effective, socially viable and sustainable techno-management solutions for solving problems of water scarcity through:

- i. Winning water from sustainable resources
- ii. Augmentation of quality of water from available and accessible sources
- iii. Renovation for recycle.

34 States and Union Territories responded to the request of DST in identifying major water problems and locations requiring necessary interventions and listed 168 clusters (each having about 10,000 population) facing 20 types of challenges for establishing treatment facility to meet water needed for human consumption, livestock, agriculture, and industry. 89 clusters have been shortlisted to put up pilot scale facilities initially around 10,000 size of population and later upscale it to cover about 100,000 level of population.

Enterprises and Non-Governmental Organisations (NGOs) were invited to offer solutions to various water challenges in the identified clusters. So far water treatment and distribution facility has been initiated to address problems like low per capita availability, excess total dissolved solids, contamination due to Fluorides, bacterial load, alkaline earth metals salt and salinity, etc. in 8 Clusters, having a total population of 120,000, to be ready by October 2011. NGOs are also involved in addressing water management solutions in about 20 clusters.

A seawater based farming system, allowing cultivation of halophytes and culture of fish, has been launched in east coast near Vedaranyam in Tamilnadu. This provides an opportunity to integrate livelihood and mangrove bioshield thus strengthening the resilience of coastal communities to coastal storms and tsunamis. It also provides some tangible solutions to make coastal aquaculture sustainable and helps to find a more meaningful use of abandoned aqua farms.

SOLAR ENERGY RESEARCH INITIATIVE

DST's initiative on Solar Energy is positioned upstream with thrust on enabling knowledge based R&D activities for entire gamut of solar technologies including balance of systems.

Solar Energy utilization for applications both for power as well as other than power generation with a view to provide convergent technology solutions under real-life conditions are being explored and assessed. This is expected to be achieved through nurturing of R&D groups, formation of consortia and setting up of State-of-art facilities.

I) PAN-IIT PROGRAMME ON R&D IN SOLAR ENERGY

PAN IIT initiative aims at developing pre-competitive research capacity and improving current status of technology in Solar Power generation and attempt cost reduction through technology paradigm rather than scaling up. Mobilization effort in terms of a national initiative has been mounted by developing knowledge network of 40 researchers from elite institutions to reduce costs through technology innovation. The strength of the programme is its strong academic - industry partnership. NTPC Energy Technology Research Alliance (NETRA) has been roped in as the industrial partner. A synergy between NTPC and the PAN-IIT group is a win-win combination, as the core strength of IITs which primarily lie in technology innovation and professional competence of NTPC in design, development and delivery of MW scale power plant are together. In this endeavour of academy-industry partnership, NTPC and PAN IIT partners intend to focus on technology innovations to drive the costs of delivered power from solar energy plants for supplementing the National Solar Energy Mission in driving the costs down through scaling. A 1 MW Solar Thermal Plant with innovative configuration complete with various storage options will be set up at NETRA, Greater Noida as an outcome of this initiative. As a part of the initiative, Modular Solution for Islanding, paralleling and resynchronisation – 1 MW Autonomous Grid (featuring innovative protection systems, local sensing of grid and grid isolation capability in case of grid failure) is also proposed to be developed.

II) SOLAR- BIOMASS HYBRID POWER PLANT

DST in Public-Private Partnership mode has supported a 256 kW Solar Thermal Technology Demonstration Project at village Shive, Pune. Through this plant, DST in association with M/s. Thermax Ltd, aims to arrive at reliable estimates of the investments required for rural decentralized power using solar energy, reducing the cost by use of solar-biomass hybrid option. Accordingly, Foundation stone of Solar Thermal– Biomass Hybrid Plant was laid on 20 December 2009. The Solar Thermal Power Generation Plant is designed for delivering 200kW of electrical net output for 24X7 hybridized with Biomass system to be used during non-sunny hours. During the year indigenously developed parabolic troughs have been developed and 100 have already been produced. Performance testing of improved solar tracking system is in progress.



Fig. 4.47: Pilot Testing of Parabolic Troughs at Shive Village, Pune

III) SOLAR –MED DESALINATION

DST has supported KG Design Services (KGDS), Coimbatore and National Institute of Ocean Technology (NIOT) to develop and demonstrate a solar thermal desalination plant which harnesses solar energy, concentrates it and produces steam which in turn is used for desalination of sea water. Solar desalination system consists of a Linear Fresnel Reflector (LFR), in which solar energy is concentrated and the corresponding receiver produces the steam which directly is fed into the Multi Effect Distillation (MED) with Thermo Vapour Compressor (TVC) desalination system. The sea water is sprinkled onto the series of tubes inside the MED-TVC system where the steam produced by the LFR runs through the series of tubes and converts the sea water into vapors which is then condensed, cooled and re-mineralized for consumption. The plant will produce desalinated water at the rate of 6000 liters/ hour. Land has been identified in Kuthiraimozhi village near Narippaiyur, Ramanathapuram where it will be installed after successful trial run at Coimbatore.



Fig. 4.48: Technology Demonstration setup at KG Design Services at Coimbatore (Left) & Generation of Steam using Solar Energy (Right)

IV) ENABLING R&D FOR SOLAR TECHNOLOGIES

- DST constituted an Expert Group to mount knowledge based research initiative for Solar Energy and to promote enabling R&D for the development of Solar Technologies. The Group would strive to strengthen R&D capabilities of academic/R&D institutions with the objective of providing enabling environment for development of Solar Technologies. In order to promote R&D in the area of Solar Energy, 33 R&D concept notes have been mobilized from various IITs.
- The consortium of institutions has been formed up to set up a Solar Energy Hub at Bengal Engineering & Science University, Kolkata for development of next generation Solar Cell Technologies like Plasmonics and nano-structured solar cells.
- “National Status Document and Aspirational Document” outlining ‘Grand Challenges on Solar Energy is expected to be ready during the year.
- DST has also leveraged International Cooperation for furthering Solar Energy Research. A Joint Initiative has been taken up in partnership with UK for collaborative R&D for technology trade and industrial partnership. The initiative is based on Intellectual Property Right (IPR) sharing on reciprocity and parity principle. Initiative in partnership with EU on the other hand aims at enabling Indian science systems to achieved global benchmarks.

SECURITY TECHNOLOGY INITIATIVES

Indian Institute of Science, Bangalore was entrusted with the job of co-ordination of the R&D and system development activities under the Security technology Initiatives with the setting up of a Centre for Strategic Initiatives. This center has identified five most important areas of homeland security namely Technologies for Materials detection, Video Surveillance and Video Analytics, Large-scale data mining, Information Security and Sensors for Homeland Security

During the year a brain-storming workshop was organized to identify the thrust areas of research in the areas of security technologies. Two white papers were published in areas of Sensors for Front End detection and Video Analytics were brought out. Proposals have been invited and received for the development of an embedded solution in this area.

COGNITIVE SCIENCE RESEARCH INITIATIVE

Cognitive Science Research Initiative (CSI) aims to provide support for R & D, infrastructure development and human resource development. Since its inception in 11th Five Year Plan, the Department has received good response from the scientific community working in this area and has been receiving a significant number of individual proposals. Since 2008, the Department has received 245 proposals and sanctioned 42 projects. During 2010, the Department has sanctioned 26 individual projects out of 68 proposals received. These individual projects cover various fields of Cognitive Science like psychology, linguistics, neuroscience, social engineering, education, bio-engineering, philosophy, artificial intelligence etc. Not only this, 27 academic and research institutions, from various parts of the country, are supported through these projects. This year, department has received 135 proposals for financial support, which are under evaluation.

Besides individual projects, the Department has also supported two major multidisciplinary and multi-institutional projects on 'Language and Cognition' and on 'Cognitive Network' under top-down approach. It is expected that first project will be able to find out the relationship between language and cognition as a human capacity with special reference to the linguistic and cognitive diversity of India. On the other hand, second project would be able to answer some issues related to integration of mental functions like emotion, thought and social cognition as well as the evolution of these functions through involved inputs from computational theory and modelling, psychophysics, animal behaviour, cognitive and cellular neuroscience.

Since this is a relatively new area of research, presently this field has dearth of young researchers. Department took this issue as a challenge and introduced a 2 year 'Post Doctoral Fellowship (PDF)' in 2009 with the objectives to attract youngsters to pursue research in this field and to generate well trained human resource for future. During 1st year, Department received 24 PDF applications for consideration and 4 PDF applicants got financial support. In 2010, 32 applications received are under consideration.

In addition to this, Department also provided financial support to seminars, conferences, workshops and schools organized in Cognitive Science.

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.

Ongoing activities and some of the achievements during the year are described below:

Initiatives in Information & Communication Technology (ICT) cluster of Delhi-NCR have led to comprehensive mapping of more than 4000 cluster stakeholders including more than 300 early stage start-ups. A Network of ICT Entrepreneurs and enterprises (NITEE) has been formed by a group of early stage entrepreneurs to undertake institutional level dialogue with private and public stakeholders, organise networking/market development events and capacity building initiatives. Mentoring support to more than 50 innovative entrepreneurs, support to more than 100 entrepreneurs for participation in market development and networking events was provided. Conceptualisation and initiating development of cluster-wide business development and networking portal *nitee.org* are among the outputs of the initiative. BDS and management experts have been involved into mentoring start-ups and to outline long duration training program with handholding support to start up entrepreneurs for business linkages (under development).

Study reports on innovative SMEs from the pharmaceutical sector in Hyderabad cluster resulted in case study of 14 SMEs and comprehensive report on Hyderabad cluster with SWOT analysis for better planning and executing developmental interventions. For medical device cluster of Hyderabad, an analysis of 19 cluster-based firms was done for existence of 'innovation cluster' dynamism. Development of Prototype Solvent Recovery system was supported and has been successfully demonstrated with dissemination of technology in the cluster. This has wide reliability potential. Development of a herbal formulation as food supplement for the treatment of sub-lethal chronic systematic arsenic poisoning is going on. Other ongoing activities include (a) mapping of effluent and waste recovery technologies (b) business plan competition involving teams registered from across top B-schools of India as a platform to facilitate students to develop robust business plan for 9 technologies

Activities at Pharmaceutical Cluster Ahmedabad have led to establishment of a molecular bank with Saurashtra University with more than 5000 molecules collected from more than 10 Universities. Identification of 100 novel technologies ready for commercialisation is on with more than 60 technologies identified so far. A technology road-show 'Tech-transfer 2010' involving presentations on identified technologies organised with 3 queries on technologies, one non-disclosure agreement has been finalised. A mentor pool has been set up with 18 mentors identified to support budding innovator(s) in Ahmedabad, Vadodara and Rajkot. Competitions on most innovative research thesis, innovative medical devices have been planned at state and national level respectively.

Initial successful work undertaken to support up-gradation of Foundry technology in Samalkha and best practices had led to scaling up of this initiative at Faridabad, Kaithal and other adjoining locations in Haryana with support drawn from GTZ, Germany. With a total of 52 enterprises having adopted new technology and better practices savings of 2000MT per annum of coal have already been achieved and the numbers are being scaled up rapidly to reach more than 100 enterprises. Initiatives on Clean Development Mechanism (CDM) through bundling CERs have resulted in a study by two consulting organisations. Awareness on the subject has been created among 26 firms whose cupolas have been upgraded under the project and a better understanding and clarity has emerged on the issue of bundling of CDM in Foundry SMEs. Two New Products Development, 6 new BDS providers and 2 new technical institutional linkages have been introduced to the clusters. Machining process has been improved for making the shaft, jigs and fixtures in two units and handholding support provided to the units in Samalkha in making new products, new models of chaff cutters through reverse engineering are at initial stage.

New raw materials (malleable steel and cast iron) have been introduced in the melting process. Initiatives have motivated owners to take up test trials in new processes, products and markets. On market

development, discussions with organised retail (like DCM-Haryali and Godrej-Aadhaar), development of website www.samalkhaindustrialassociation.org etc have yielded positive results. New ways to utilise solid waste in the foundry are being worked upon involving technical institutions like Development Alternatives, IIT,-Delhi, BIMTECH and CGCRI.

JOINT TECHNOLOGY PROJECTS WITH OTHER SOCIO-ECONOMIC MINISTRIES

The following two new projects were approved during the year with Ministry of Mines:

- i. Bauxite Technical Data Bank Phase-III
[Jawaharlal Nehru Aluminium Research Development and Design Center (JNARDDC), Nagpur]
- ii. Friction Stir Welding Technique for Aluminium-Steel
[Jawaharlal Nehru Aluminium Research Development and Design Center (JNARDDC), Nagpur]

STEEL TECHNOLOGY CENTER AT IIT, KHARAGPUR

It is an ongoing project with Ministry of Steel. During the year following technical achievements were made:

i) Pearlitic Steel

Fully pearlitic steels are applied in engineering structures in the form of strong cables. They conventionally contain 0.8 wt% of carbon and therefore can have poor ductility. The aim of the present work is to develop fully pearlitic steel with better ductility. Hultgren extrapolation has been applied to the calculated equilibrium as well as para-equilibrium phase boundaries to study the transformation behaviour at various supercoolings. A fully pearlitic microstructure is developed in a steel with suitable alloying additions. An average pearlitic spacing of this steel is 0.33 μm . Transformation studies have been done for different austenitization temperatures and at various isothermal transformation temperatures in the pearlite transformation range. Dilatation curves obtained from dilatometric data were used to determine the transformation temperatures for the given thermal cycles. Formation of degenerated pearlite was observed in certain cases and the details are being examined. As expected, a decrease in interlamellar spacing was observed with increase in undercooling together with an increase in hardness.

In addition, work is being carried out to study the effect of heat evolution during pearlite transformation on the transformation behaviour and its effect on the final microstructure. Further work has been planned to study the effect of thermal cycle on microstructure and final mechanical properties of the material.

ii) Ultra fast cooling for hot steel plate

High cooling rate is one of the main requirements for the production of low weight and high tensile strength steel. The requirement of high cooling rate is the main thrust for the invention of ultra fast cooling technique. In the current research work, different cooling processes for getting ultra fast cooling rate of a hot static plain carbon steel plate at two different surface temperatures have been studied. Depending upon the initial surface temperature and the final microstructures of dual phase steel, the first type of ultra fast cooling is late ultra fast cooling and second type is early ultra fast

cooling. Late ultra fast cooling is studied by water spray and air assisted spray cooling process, and the early ultra fast cooling is studied by air assisted spray only. For both type of ultra fast cooling, the effect of air pressure and impingement density on rate of cooling has also been studied. The heat transfer analysis on the above cooling processes shows that air assisted spray has an excellent control on the rate of cooling. Furthermore, the heat transfer analysis also shows that for early ultra fast cooling air atomised spray operates in transition boiling regime whereas for late ultra fast cooling it operates in nucleate boiling regime. In addition to above, the effects of plate thickness and nozzle height on rate of cooling are being studied. A mathematical model has been developed to get surface heat flux and surface temperature during cooling.

S&T AND SOCIO-ECONOMIC DEVELOPMENT

The Department has many types of programmes relating Science and Technology for socio-economic development to include S&T Entrepreneurship Development, Science for Equity, Empowerment & Development, Natural Resources Data Management System, Science & Technology Communication and Gender initiatives. Towards societal interventions of science and technology, department supports science based voluntary organizations and institutions for technology adaptation for improving the quality of life at the grassroots level as well as promoting innovation and entrepreneurship. Activities and programmes of the department have led to skill upgradation and improved livelihoods of weaker sections of the society especially scheduled caste and tribal population including women and elderly population. Creation of knowledge based and technology driven entrepreneurship amongst the S&T persons and establishment of S&T Entrepreneurship Parks and Technology Business Incubators have been a flagship programmes of the department. Popularization of science and technology and inculcating scientific temper in society has been done with a new concept and idea of running a train named 'Science Express' which run through the length and the breadth of the country. The train in the third consecutive year has attracted more than 51 lakhs visitors especially school children. The gender initiatives of the department focus on aspects of providing technology for rural women for enhanced livelihood opportunity as well as providing opportunities to women scientists to continue in science through well designed fellowship schemes. The department has pioneered gender budgeting in scientific departments and has well organized and defined targets under women component plan. The department is also promoting R&D in emerging areas of Geo Information Science and Technology to develop methods and techniques for operationalising the concept of local level planning (sector-specific - hydrology, health geo-web services etc.) in support of the 73rd and 74th Constitutional Amendment Acts relating to the Panchayati Raj Institutions and Urban Local Bodies.

SCIENCE FOR EQUITY, EMPOWERMENT & DEVELOPMENT (SEED)

The initiatives under Science for Equity, Empowerment & Development play a critical role in supporting field action projects aimed at providing technology solutions to issues in rural and urban area for the disadvantaged sections of the society. These initiatives provide an opportunity to motivated scientists and technologist to take-up time bound and action oriented developmental projects with inputs of Science & Technology. The projects/programmes are implemented through S&T institutions, universities and S&T based voluntary organizations under various schemes. Highlights of various schemes are given below:

1. Technology Development/Adaptation Related Schemes:

1.1. Long Term Core Support: Under this unique scheme of SEED Division, long term core support has been extended to seventeen science based voluntary organizations working in different parts of the rural India to address location specific problems through need based S&T solutions. The core support is being utilized by each field group to nurture and sustain scientific manpower to take up

challenges to work on issues/problems related to rural livelihood security covering both farm as well as non farm sector. These core supported groups (CSGs) have major focus on **technology innovations, incubation and delivery** in respective geographical coverage area to train and empower local community in location specific and need based technologies and packages like bio-fertilizer production and application; application of improved and sustainable agriculture practices with post harvest processing for value addition; renewable energy/IT technologies etc. and linking them for micro-enterprise creation involving rural youths. With systems approach involving PRA, each group is also engaged to strengthen local skills and knowledge to revive traditional occupations like pottery, black smithy and other rural engineering sectors to improve the working and efficiency of local production system with reduced drudgery by exploring proper linkages and support from S & T Institutions/Labs. To make wider outreach of this network to innovate and disseminate location specific rural technologies in different parts of the country, efforts are also being made by CSGs for horizontal transfer of such field based technology packages through state govt. and other line function departments.

The Centre for Technology & Development, Delhi having field operations in Uttarakhand has developed **multi-fibre machine for mechanical extraction of natural plant-based fibres** like Bhimal (*Grewia optiva*), Bhang or Hemp (*Cannabis sativa*) Himalayan Nettle (*Urtica dioica*) besides Sisal (*Agaves spp.*) so as to replace the traditional retting method and minimize use of increasingly scarce water resources, optimize processes for improving fibre quality, develop suitable composites, evolve designs and production techniques for diverse low-volume high-margin 'beautility' products, and evolve and demonstrate viable rural enterprise and business model. Vigyan Asharm, another core supported group based in Pune has been able to develop simple and low cost **Solar powered domestic egg incubator** suitable for small entrepreneurs, SHG's, farmers etc. Prototype is ready with 85 % success rate and provisional patent has been filed.

1. II. Technology Interventions for addressing Societal Needs (TIASN): To develop and facilitate Innovative research and application of S&T based solutions to identified problems and societal needs in different parts of the country, some specific programmes/schemes covered have targeted objectives as follows:

a. Technology Interventions for Elderly (TIE):

- To promote research, development and adaptation of technology for improving quality of life for benefit of Elderly population both in rural and urban areas of the country.

Under TIE programme "**Think Elderly**", a workshop-cum exhibition for Older Persons was organized "**On the occasion of International Day of Older Persons**" on 1st October, 2010 by DST in collaboration with HelpAge India in Delhi. The Minister of State for Science & Technology (IC) Sh. Prirthviraj Chavan inaugurated the event. The technologies at display developed under this programme included non-invasive diagnostic technique for diabetes, the pilot project of mobile multipurpose eldercare unit, assistive devices (gait assessment system for fall prediction, hip protective device, kitchen unit for elderly women, modular bathing stool, single touch dialer, multi facility bed, staircase climbing walker, modular wheel chair with low-cost sensor system and cycle for elderly etc), web portal capturing technologies for elders and related matters, guidebook on nutritious recipes for healthy eating in old age, etc. This is first time in the country that young students and faculty from IITs, AIIMS and SPA have been involved in such an initiative.



Fig. 5.1: Then Minister of State (Independent Charge) for Science & Technology and Earth Sciences, Shri Prithviraj Chavan inaugurated the workshop cum exhibition, at the International Day of Older Persons (Related to the Technology Interventions for Elderly TIE initiatives of DST), in New Delhi on October 01, 2010.

- Support has been provided to Help Age India for a project for pilot testing of a Mobile Elderly Unit (MEU) to meet elderly health needs through promotion of health care and wellness activities by screening and providing medical facilities at their door step. MEU has provided preventive, promotive and curative health care through a combination of different systems of treatment and motivating people practicing a healthy lifestyle. It has also provided a multi-purpose service to rehabilitate the people in Leh & Ladakh region during recent cloud burst in August, 2010.

b. S&T Interventions Involving Jawahar Navodaya Vidyalayas (JNVs):

- Under this programme, students of Jawahar Navodaya Vidyalayas (JNVs) were exposed to the real life problems prevailing in the village adjoining their school using S&T based solutions. At each project location, a team of students and teachers participated alongwith the local villagers - using local resources, traditional knowledge (TK) and appropriate technology interventions. The programme 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 long lasting impact in the young minds.



Fig. 5.2 : Local solution with local resources through a judicious combination of TK and S&T : School kids involved in land and check dam preparation

c. Scheme for Young Scientists and Technologists (SYST):

The SYST 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, one sensitization workshop was conducted to create awareness about the scheme including the other schemes of the Division. Salient achievements under some projects supported under this scheme are:-

- Under a project on cost effective mass culture technique of Rotifer *Brachionus plicatilis*, technology for ultra-high density rotifer production has been developed including the hatchery protocols to validate HUFA content of enriched rotifers as well as techniques to store rotifer eggs, to provide potential access to off-the-shelf product.
- A study on *Eco-Friendly Management Practices of White Grub in Uttarkashi District of Uttarakhand* by Krishi Vigyan Kendra, Vivekananda Parvatiya Krishi Anusandhan Sansthan proved to have very positive impact on spore forming bacteria using talc based formulation i.e. WGPSB-2 as well as through introduction of VL kurmula trap-1 for mechanical control of white grubs.
- Under a project “*Economic impact assessment of Fasciolosis and Mastitis in Uttarakhand*” by G.B. Pant University of Agriculture and Technology, Pantnagar, survey on prevalence rate of Fasciolosis and Mastitis has been assessed in 7 districts of Uttarakhand which resulted in identification and documentation of factors significantly influencing incidence of Fasciolosis in animals by fitting a binary choice (Logit) model followed by strategic treatment programme for Fasciolosis.
- Under a project on *Technology Development for Mass Multiplication using Tissue Culture and Sex Determination using Molecular Markers in Papaya (Carica papaya L)* an efficient tissue culture protocol for mass multiplication of genetically superior planting material of assured sex through plant tissue culture has been developed.



Fig. 5.3 : Micro propagation of genetically superior Papaya

- Under another project on production and application of vermi-wash as a source of income for women in Sagar Island, Sunderbans a model production unit has been established involving SHGs.

- Under another project, optimization of the tapping of Nypa palm was achieved.
- **Co-ordinated Programme Non-Edible Oils (AICRP-NEO)** : A generic technology package with a focus on development of business plan for utilization of non-edible oil seeds has been optimized, and being implemented at ten locations under diverse field conditions involving VOs.



Fig. 5.4: Ghani in Operation



Fig. 5.5: Trial Demonstration at Distillation unit in progress



Fig. 5.6 : Extraction of Oil

Other Individual Projects:

- A project entitled, “Artificial Glacier Technology” in Leh covering two blocks of Leh & Kharu [i.e Villages of Saboo (Leh Block), Nang, Sakti (Kharu Block)] , is in operation with an aim to conserve, manage and make sustainable use of water and land resources for livelihood by creating adequate irrigation potential to convert land holdings into source of adequate income for the rural mountain community.



Fig. 5.7 : Diversion canal for artificial glacier & community mobilization at Saboo village, Leh to tap water for addressing local irrigation needs

- Under a project “*Livelihood Improvement of Marginal Farmers through Pilot Demonstration on Cultivation and Post Harvested Processing of Tulsi in Hardwar District (Uttarakhand)*” being implemented by Society for Environment Conservation and Rural Development, Kankhal, Hardwar, different varieties of Tulsi viz; *Ocimum sanctum*, *O. canum* and *O.kilmandscharicum* were planted involving local people. Practices of intercropping with orchard crops and rotational

cropping were tried. Farmers have been trained on value addition aspects like making necklace, basil oil and herbal tea.

- In another project being implemented by Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (HP), efforts are being made for standardization of Drying Technology of Wild Pomegranate for the Sustainable Livelihood of Weaker Sections of the Society in Mid Hill Region of Himachal Pradesh”.
- As a new initiative, creation of a new programme called “*Application of Geo-Sciences and other Relevant Areas for Weaker Sections of Society (AGSWSS)*” is under active consideration.

2. Beneficiary Oriented Schemes:

2.I. Tribal Sub-Plan (TSP): The Scheme “Tribal Sub Plan” of the Department of Science & Technology aims at improving living conditions of Scheduled tribes based on sustainable science and technology activities. Fifteen new projects were sanctioned during the year. In a majority of projects, the emphasis has been on creating sustainable livelihood base through use of locally available resources and materials. Salient features of some of the projects supported for socio-economic upliftment of tribal communities are:-

- **Action Research on Demonstration of Broom Grass (*Thysanolaena maxima*) to enhance Livelihood Opportunities in the Tribal Areas of Visakhapatnam District** – Project aims to promote demonstration cum seed production site with germplasm of *Thysanolaena maxima* species (Broom grass) and monitor all growth parameters for standardization of propagation methods. Accordingly, domestication/cultivation was promoted in degraded forest lands/hill slopes. 57 trained farmers have adopted/domesticated grass cultivation from 12 villages covering Paderu, Hukumpet and Pedabayalu mandals. So far 202 tribals have been trained in project area on cultivation, broom weaving methods and to add value in marketing of quality brooms. It can be promoted as commercial crop for tribal communities residing in and around the forests (Eastern Ghats, Western Ghats and the Himalayan Region) particularly in mountain regions.



Fig. 5.8: Broom grass cultivation in degraded forest lands and harvesting inflorescence to make quality brooms

- **Traditional Indian plant based remedy for Prevention of Malaria: A Community based Approach** – This ongoing project aims to evaluate traditional plant based local remedy of malaria in tribal villages in selected malaria endemic villages of Orissa and Chhattisgarh through community based approach. The Project has resulted in documentation of 16 malaria management practices from traditional healers in selected malaria endemic areas. Further, efforts are being made towards standardization of selected traditional malaria preventive remedy by FRLHT,

Bangalore using physico-chemical and phyto-chemical assays on selected plants as per Ayurvedic Pharmacopoeia of India. After the standardization, *in vitro* study will be conducted to assess the safety of the remedy.

- **Income Generation for Rural Women through Production of High Value Paper and Paper Products from Banana Stem Fibres** – Under this project, three types of activities are being undertaken i.e. extraction of fibre from banana stem waste, production of high quality paper from banana fibre and making value added fibre craft products of different utility. The project is being implemented in Yeotmal and Wardha districts of Maharashtra involving six SHGs leading towards alternative livelihood opportunities.



Fig. 5.9: Tribal women group engaged in extraction of banana fibre

- **Making Natural Dyeing Pollution free Process by replacing Metal Mordant by Enzyme based Mordant** – Under this innovative project being implemented by Magan Sangrahalaya Samiti, Wardha in technical collaboration with IIT, Kanpur, efforts are being made to develop enzyme based mordant in place of metal mordant for dyeing cotton and silk fabric on industrial scale to make natural dying an eco-friendly and environmentally safe enterprise.
- **Upgradation of Indigenous Weaving Skills, Design, Fabrication and Improvement of Traditional Tools, Implements used by Tribal Women for Preservation of Traditional Tribal Handicrafts of Arunachal Pradesh:** This project has led to documentation of traditional tools and implements used by the Nishyis, Apatanis, Galos and Tagins tribes in traditional weaving and handloom sector. Major focus has been given on capacity building for local unemployed youths particularly the girls and trains them on improved weaving techniques and textile crafts and craftsmanship for self-employment, empowerment and income generation.
- **Integrated Duck, Fish Farming along with Horticultural Crops through Intervention of Appropriate Technologies for Socio-Economic Development of Apatani Tribal People of Ziro, Lower Subansiri District, Arunachal Pradesh:** Proposed intervention for integrated farming system has benefited the marginalized section among the rural tribal people of Ziro area as an alternative source of income to people who were earlier depending upon the primitive type of cultivation, i.e Jhumming. One hundred sixty (160) Kiwi plant cuttings and around five hundred (500) plant cuttings of different varieties of Apples have been planted by trained farmers in their orchards. Seasonal crops like capsicum, chilli, gourd, brinjal etc. are also being cultivated

Technological Interventions for Conservation and Sustainable Livelihoods in Partnership with Tribal Communities around Protected Areas: A DST-WWF Initiatives



RATIONALE: This multi-locational network programme, "People and Protected Areas (PAs): Conservation and Sustainable livelihoods in partnership with local communities" is a joint initiative of the SEED, DST and WWF-India to coordinate and support the efforts of local and grassroots VOs promoting innovative mechanisms through appropriate technological inputs that enhance sustainable local livelihoods for local and indigenous communities living around PAs across the country. Focus is to support and build capacity of VOs implementing these initiatives for enhancing links between conservation and sustainable livelihoods for tribal communities around PAs.



OVERVIEW:

- **13 Protected Areas** from different eco-systems along with 13 partners have been identified to work under this project.
- A total of **50 villages** have been covered under this project with a population of around **25000**.
- More than **2000 tribal households** have been involved directly in the project. Overall, the project has engaged with over 66 existing village level institutions and created around **40 new groups/institutions**.

MAJOR S & T BASED ACTIVITIES UNDERTAKEN AND NUMBER OF BENEFICIARIES:

- MFP Value Addition, Herbal Products, Nursery Raising and Medicinal Plant Cultivation = 900
- Floriculture, Agro-forestry, Composting, Vegetable and Mushroom Cultivation, Agriculture and Forest Home Garden = 1000
 - Animal Husbandry and Fodder = 175
 - Millet, Pulse, Cereal and Oilseed Processing = 112
 - Safe Drinking Water = 80 (does not include tourists and other indirect users)
 - Weaving and Craft = 180
 - Improved Chulhas, Biogas, Dhaba digester, Bio-globule, Charcoal making = 140
 - Sea weed cultivation and improved fishing = 135



Fig. 5.10: Use of natural fibres by Tharus tribes living around Suhelwa Wildlife Sanctuary in Uttar Pradesh to make Woolen Durries (Mats) as an alternative enterprise.



Fig. 5.11: Value addition with quality control to make Jam from Mahua (*Madhuca Indica*) flowers to provide livelihood sustenance for the tribes in Orissa.



Fig. 5.12: Women engaged in making Bio-globules from waste biomass for self use and sale: Eco-friendly technology with reduced dependency on forest for fuel wood around Senchal Sanctuary, Darjeeling, WB.

simultaneously. Initial results show that the integrated farming technology has helped in conservation of soil particularly by developing the abandoned jhum fields in the hill slopes through cultivation and planting of horticultural crops and also by making use of available ponds for fish farming.

2. II. Scheduled Caste Sub-Plan for the Development of Scheduled Caste Population (SCSP):

Under this scheme, specific projects have been supported with the application of science and technology for the empowerment of Scheduled Caste population. Promotion and development of innovative technology as well as improvement in existing technology for the benefit of the poor, underdeveloped, landless labour of scheduled caste population are the main objectives of the scheme. Numerous priority areas, with SC community as specific target groups, have been identified for proper scientific/technical interventions in the existing methodologies for empowerment and sustainable livelihood. A number of coordinated programmes have been launched to have a foothold on science and technological interventions in various aspects relating to agriculture, horticulture, sericulture, floriculture, aquaculture, skill development, capacity building and occupational hazards etc. The following are some of the projects undertaken during the year:

- Development & Application of Appropriate Technology for Economic Empowerment of Rural Scheduled Caste Women through Mushroom Cultivation** – This project is being implemented at Dasarathpur in Jajpur district of Orissa. Under this project, 240 SC-women of the villages were trained in Mushroom Cultivation through field level technical trainings with appropriate inputs of Science & Technology in consultation with National Institute of Mushroom & Biological Science, Bhubaneswar ; Krishi Vigyan Kendra, Badachana ; Pandit Nilakantha Yuva Parishada and Maa Tarini Gramya Jala O Parimala Mission. 8 Self Help Groups have been formed. Spawn production units have also been set up.



Fig. 5.13

- Fattening of Lobster Juveniles for Technology Demonstration at the Selected Coastal Villages in Gulf of Mannar** –The large scale availability of *Panulirus* of commercially important

spiny lobsters has been reported from the west coast and Gulf of Mannar region on the east coast of India. During a survey conducted, it is found that there is a lot of scope for job generation for Scheduled Caste women in the field of coastal aquaculture. Hence it was proposed to carry out a project by procuring the necessary seeds through wild collection from the trawl catches or from set gill nets from the near shore waters of the coastal villages of Bembar, Beppalodai, Tharuvaikulam, Vellapatty and Pattina Maruthur. The objective of this project is to find out (i) the impact of stocking density on the growth and moulting of lobsters *Panulirus homarus*; (ii) the impact of eyestock ablation on the growth and moulting frequency in Lobster *Panulirus*; and (iii) to formulate the pellet diet to replace eco-destructive natural diet and to find out the optimum dietary protein level requirements for the maximum growth of the lobsters. Under this project, a Central unit at Thoothukudi and three peripheral units of Lobster fattening was constructed for technology demonstration at Ayyanarpuram and Valarpatty village, Tamil Nadu. The units were provided with high tech facilities like all time aeration and biofilter system so that bioenergetics' studies on the impact of stocking density, dietary variations with natural feed and artificial feed could be carried out effectively in laboratory conditions. Intensive training programme on lobster fattening for 60 beneficiaries was conducted at Ayyanarpuram and Valarpatty village.

- **Coordinated Programme on Resource Management and Development for the Empowerment of Scheduled Castes** – This programme has been initiated aiming to develop SC Community by mobilizing them, utilizing the local resources, and transferring appropriate technologies. The programme has been initiated through an orientation workshop to hundreds of VOs from the twelve states of country in 2007, 2008 and 2009. This has led to the study on the current status of development in 60-65 selected villages where SC communities are predominantly residing. Projects under this programme are located in Andhra Pradesh, Gujarat, Himachal Pradesh, Jammu & Kashmir, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu and Uttarakhand where the selected SC communities are mostly engaged in unskilled seasonal labour. The target area includes coastal villages, hilly areas, and plain/drought areas. Participation of the community in planning and implementing the programs has been ensured from pre project activities onwards to ensure their 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 enterprise development by utilizing local resources. The unique outcomes of the programme are:

1. Mobilized the community towards a common goal and established people's institutions /developed leaders for the program.
2. Networked with local training centers and production/ service units for market based skill development and placement of local youth and semi skilled/unskilled workers.
3. Local skill based livelihood programs for women has been introduced in target villages which includes nutrition garden, poultry, goatry, rabbit rearing, azolla and mushroom cultivation, composting & soap making etc



Fig. 5.14

4. Introduced technologies in the field of 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.
5. Initiated 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 local community and created ownership among them through towards self help activities. The community at each location has also been motivated to share the knowledge and materials freely to other deprived villages as ‘Shridan’, as a community initiative.

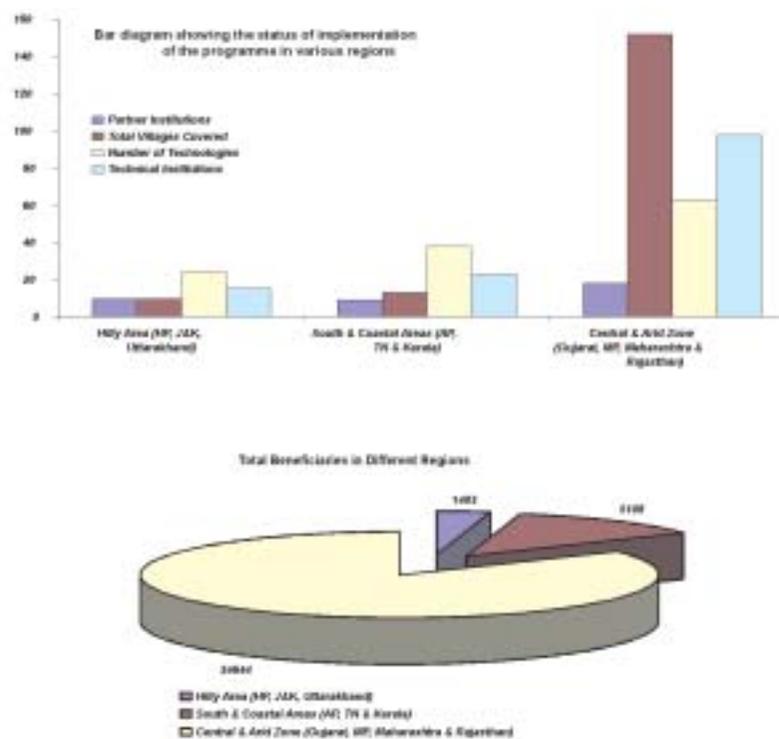


Fig. 5.15

Based on the progress of the first three phases of projects, DST is initiating the programme in the States of Bihar, Orissa and West Bengal for which brain storming cum project formulation workshops are being organized.

For functional capacity development of scheduled castes, 2nd phase project on science & technology participatory development and peace action - as an innovative income generation programmes have been implemented in four states of the North East. The idea is to expose the younger generation to possibilities of technology based production units using local resources. In these projects, only those technologies have been taken up which have ready acceptability and also market. The following activities were taken up:

- **Manipur** - Spinning and weaving of cotton, silk and woolen textiles, Kauna Grass mat manufacturing and development and dissemination of developed technology of Lion Looms and shuttle frame looms.

- **Tripura** - Lion looms for weaving and also improved frame looms, Bamboo related and Bee Keeping based income generation.
 - **Arunachal Pradesh** - Lion Looms, Improved frame looms, spinning of cotton and Silk Yarn.
 - **Assam** – Improved technologies developed for Eri and Muga Silk Yarn.
- 3. Monitoring Mechanism and Sensitization about the SEED Programme:** For effective implementation of individual as well as network programme/projects, participatory group-monitoring workshops were organized from time to time. During this participatory and interactive review, it was ensured that each project should meet overall objectives and deliverables to ultimately benefit and empower local community and should contribute towards strengthening of rural economy. During these workshops, sensitization meets were also organized with local VOs, experts and institutions to discuss innovative technology intervention ideas and formulation of proposal(s) for support under SEED programme of DST.

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, 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 the adjoining region.

The rate of incubator formation which was a trickle in the 80s and 90s has gained momentum in the current decade. During last three years new Incubators have been set up and now the number has grown to over 55. Various efforts are underway to build an appropriate ecosystem to nurture and grow techno-entrepreneurship in the country for tapping the existing and futuristic market opportunities in various sectors.

Seed Support System for Incubators and Incubatees:

During F.Y. 2010-2011, the seed support has been given to the following TBIs/STEPS:

Indian Institute of Management, Bengaluru; Vellore Institute of Technology (VIT-TBI), Vellore and TREC-STEP, Trichy

Establishment of new TBIs in the F.Y. 2010-11:

Following new TBIs were accorded approval for establishment in the F.Y. 2010-2011:

- **IAN Mentoring and Incubation Services** focusing on IT, ITES, Internet/Web, Telecom, Mobile VAS, Education Technologies, Healthcare Technologies, Retail Technologies, Cloud Computing, Clean technology to **Indian Angel Network(IAN), New Delhi.**
- **Vel Tech –Technology Incubator** in the area of E-waste, Bio and non-degradable waste management at **Vel Tech Dr. RR & Dr. S. R. Technical University, Chennai.**

- **Management Development Institute (MDI), Gurgaon** in the area of Information and Communication Technology.
- **Sri Ramachandran University (SRU), Chennai** in the area of Healthcare, Diagnostics and Pharmaceuticals.
- **Tamil Nadu Agriculture University (TNAU), Coimbatore** focussing on seed business, food processing, farm mechanisation, and bio-energy.

Following new models and variants of TBIs, which aims to strengthen the research commercialization chain by integrating research, innovation, Intellectual property management, commercialization, new venture and entrepreneurship development were also accorded approval for establishment in F.Y. 2010-11:

1. TBI: Nanotechnology Research Innovation and Incubation Centre (NRIIC) at PSG-STEP, PSG College of Technology Coimbatore

The NRIIC aims to strengthen Indian capabilities and promote applications of nanotechnology in the area of Plastic Printed Electronics, Hybrid Renewable Energy Systems, Health Care Devices & Smart Textiles with knowledge partnership from University of Arkansas. Unique facilities and the state-of-the-art equipments would be set up and available for student and entrepreneur's training, research, product development, commercialization and new venture promotion related work.

2. TBI in Aerospace Engineering - 'National Centre for Aerospace Innovation and Research', IIT Mumbai:

In one of its first kind of initiative in the country and a unique step in strengthening the capabilities of Indian manufacturing and allied sector industries in Aerospace engineering, a TBI in Aerospace Engineering - 'National Centre for Aerospace Innovation and Research (NCAIR)' is being hosted at IIT Mumbai in partnership with The Boeing Company, U.S.A. To finalize the infrastructural/specialized equipment requirement, three industry meets have been organized in Bangalore, Pune and Mumbai with participation of 175 Aerospace Manufacturing Industries operating in the country.

NCAIR would offer various services to its members; these include: Technical know-how by R&D projects and technology transfers, Aerospace manufacturing and testing facilities, Technical advice and specialized training, Business & mentoring services etc. This collaboration between DST, Boeing and IIT Mumbai is expected to give a shape to the vision of NCAIR to create a world class Aerospace Ecosystem in India.

3. TBI at Technovate India Innovations, Bengaluru:

A virtual TBI in collaboration with Imperial Innovations, India is being hosted in 'Technovate India Innovations', Bengaluru. The TBI would not set-up another physical incubator, but will focus on providing complimenting services like technology sourcing, independent validation, prototype funding and seed investing to the innovators & entrepreneurs. The TBI will focus to proactively source, best of the breed technologies from international standard research institutions which are relevant to address immediate national needs. The thrust area of the TBI is on Clean & Health care technologies and other potential market/applications that leverages from unique Indian demographics.

International Event

Workshop on Fundamentals of Technology Transfer- *A course by PraxisUnico, UK:* To bring together best scientists and engineers to focus on how industry can use new scientific discoveries to transform their businesses, a workshop on ‘Fundamentals of Technology Transfer’ in association with British High Commission and PraxisUnico, UK was organized during November 28 - December 1, 2010. The three day technology transfer course to exposed the Indian Scientific Community to UK’s best practices in innovation management and knowledge transfer. The course benefited 50 delegates from different sectors in the country.

The Power of Ideas Programme- *A NSTEDB -Economic Times and IIM Ahmedabad partnership:* NSTEDB partnered with The Economic Times and IIM, Ahmedabad to implement ‘The Power of Ideas’ programme. The overall objective of the ‘The Power of Ideas’ is to build the much-needed entrepreneurial ecosystem in the country. It is aimed to facilitate the conversion of ideas into enterprises and scaling up of existing ones.



Fig. 5.16: Shri Narayan Murthy conferred the Power of Ideas Awards to the Innovators at the Convocation Ceremony on 30th Oct 2010 in New Delhi

There was a tremendous response from the innovators across the country as more than 16000 innovators participated in the contest. The programme concluded successfully at the ‘‘Convocation Ceremony’’ organized on 30th October, 2010 in New Delhi. Mr. Narayan Murthy (Chief Mentor, Infosys), Prof Samir Barua (Director, IIMA) and Mr. Samir Magar (Founder, Magarpatta Township) were the chief guests at the event. During the event, 35 awards of Rs 5 lakhs each and 10 awards of Rs 2 lakhs each were announced.

Next Big Idea Programme- *Intel-NSTEDB and IIM Bengaluru Joint Initiative:* NSTEDB in partnership with Intel is implementing Next Big Idea programme with the help of IIM, Bengaluru. The main objective is to identify innovations among the student community and build an ecosystem for innovation promotion in academic institution.

India Innovation Growth Programme- *A collaborative project of NSTEDB and Lockheed Martin Global Inc.:*



Fig. 5.17: Shri Prithviraj Chavan conferring Awards to the winners of the India Innovation Growth Programme in May 2010

India Innovation Growth Program, a collaborative project of NSTEDB and Lockheed Martin Global Inc., aims to identify, award and accelerate innovative new Indian technologies into the market space. During the year, 15 winners were announced and given medals in May 2010. The medallists received professional business development assistance from IC2 Institute, University of Texas. Technology Expos were organised to showcase the commercial success achieved under this programme.

Entrepreneurship and Innovation Programmes

Innovation and Entrepreneurship Development Centres (IEDCs): Innovation and Entrepreneurship Development Centres (IEDCs) have been promoted in education institutions to develop institutional mechanism to create entrepreneurial culture in academic institutions to foster growth of innovation and entrepreneurship amongst the faculty and students. The IEDCs aim to promote innovation amongst the students of S&T. The students are encouraged to take up innovative projects as a part of their curriculum and are supported to develop a working prototype. 15 IEDCs have been supported so far across the country.

Entrepreneurship Development Cell (EDC): EDCs have been promoted by NSTEDB in educational institutions and institutions of higher learning to create entrepreneurial culture in the parent institution and other institutions in the region and to act as an institutional mechanism for providing information and assistance to budding S&T entrepreneurs. About 15 EDCs are currently operational.

Science & Technology Entrepreneurship Development (STED) Project: 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. With the support to 48 STED Projects in the current financial year 2010-11, it is expected to establish more than 2500 micro-enterprises / units all over the country. Seven new projects were established in Kamrup (Assam), Gurdaspur (Punjab), Tiruvarur (Tamil Nadu), Pudukkottai (Tamil Nadu), Amravati (Maharashtra), Nellore (Andhra Pradesh) and Tuticorin (Tamil Nadu).

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 8,400 youth are expected to be trained during 2010-11.

Technology Based Entrepreneurship Development Programme (TEDP): Technology Based Entrepreneurship Development Programme (TEDP) is a programme in which training is given on specific products/technologies/processes, which have commercial viability and which have been developed by R&D labs or other academic institutions. Besides the hands on training, the potential entrepreneurs are given entrepreneurial, motivational and managerial inputs. The duration of this programme is 6-8 weeks depending upon the nature of technology and training needed. This programme provides state-of-the-art inputs to the entrepreneurs about the technology to be employed and they can also develop their skills in application of the technology. The EDP conducting organization can concentrate in a specific discipline of technology and thus can have a more effective control over the programme. The R&D institutions having commercially viable technologies get potential entrepreneurs as its takers and thus ideas/technologies get converted into wealth generating products and services. During 2010-11, 110 TEDPs were organized with the support from NSTEDB.

Entrepreneurship Development Programme (EDP): The Entrepreneurship Development Programme (EDP) is an important innovative break-through in the strategy for developing human resources for promoting economic progress in India as well as in other under-developed countries. The EDP is an innovation in that those persons who possess certain identifiable qualities of entrepreneurship are counselled, motivated and trained to strengthen their self confidence, seize a business opportunity, initiate an enterprise and be the masters of their own i.e. to become 'entrepreneurs' instead passively waiting for a suitable employment.

The EDP is not just an extended version of (Business) management training programme the primary aim of which is to provide theoretical and practical knowledge to manage production, finance, marketing and personnel of an existing enterprise with a view to minimize costs and maximize profits and/or growth of sales under given environment. In contrast, an EDP brings about a sound combination of techniques of behavioural psychology, tools of management science and available information on technology with a view to identify entrepreneurs, particularly 'first generation' entrepreneurs, strengthen their achievement motivation and train them in enterprise management so that they can confidently start and successfully run their own business ventures. Further, an EDP also ensures that on completion of the training, the potential entrepreneurs are helped in making loan application, securing available incentives, seeking government approvals, choice of location, etc. During 2010-11, 101 EDPs including dedicated programmes for women have been held.

Entrepreneurship Awareness Camps (EAC): NSTEDB sponsors Entrepreneurship Awareness Camps of 2-3 days duration in educational institutions to inculcate spirit of entrepreneurship amongst students pursuing degree/diploma course in S&T streams and also amongst the faculty. During 2010-11, about 450 EACs have been supported for the benefit of students and faculty.

Faculty Development Programme (FDP): Faculty Development Programme 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 Organizations are trained for a duration of two weeks. During the year 2010-11, 80 FDPs have been conducted all over the country.

Science Tech Entrepreneur: *A Monthly Publication of National Science & Technology Entrepreneurship Development Board (NSTEDB):* The Science Tech Entrepreneur Magazine is brought out to disseminate information about various aspects of entrepreneurship technology finance and management to budding as well as established entrepreneurs which meets the objectives of NSTEDB. The Science Tech Entrepreneur magazine is published as E-magazine. This E-magazine is available on the NSTEDB Website namely www.nstedb.com and www.techno-preneur.net.

NATURAL RESOURCES DATA MANAGEMENT SYSTEM (NRDMS)

NRDMS Programme aims at promoting R&D in emerging areas of Geo Information Science and Technology. The R & D studies contribute to the development of methods and techniques for operationalising the concept of local level planning. The outputs are useful in drawing up local level planning strategies in support of the 73rd and 74th Constitutional Amendment Acts relating to the Panchayati Raj Institutions (PRIs) and Urban Local Bodies (ULBs). Sharing of spatial data by data providing agencies in the framework of Spatial Data Infrastructure (SDI) is an essential prerequisite.

Several activities have been completed towards the above goal during the year 2010-11. A set of broad parameters has been approved by the Union Cabinet to help evolve a National Policy on Data Sharing and Accessibility. District geo portal prototypes have been developed and their utility demonstrated using standards-based open source software packages to provide end users with accessibility to information vital to local level planning. Sector-specific geo-information services have been validated and made accessible to the end user community in the sectors of Health and Hydrology. Studies have been completed in areas like Cartographic Generalisation, Disaster Management (floods and landslides), Biodiversity, Lake Ecosystem, and Pollution Modelling. Fresh studies have been initiated in areas like Spatio-temporal Data Analysis, Sensor Web Enablement, Marine GIS, Digital Heritage, and Hyper Spectral Remote Sensing. Technical capacity has been built through a series of training and user awareness workshops amongst the scientific and the end user communities towards operationalising National and State level SDIs.

National Policy on Data Sharing & Accessibility

Sharing of spatial data between data providers and end users has been a major bottleneck in its use in planning and decision-making. In order to improve sharing and accessibility, a set of broad parameters has been approved by the Union Cabinet for devising a National Policy. Some of the items covered in the approval include (i) the requirement for the data providing agencies or programmes/ schemes funded by Government to classify feature data sets into 'classified' and 'non-classified' categories from the angle of national security, (ii) publishing the classified features as an 'exclusion list', and (iii) provision of non-classified features in the public domain for use in developmental planning. DST is working with various Ministries/ Departments and concerned organisations towards evolving the National Policy.

Various NSDI nodal agencies have been provided with the required technical and financial support for operationalising their data/ metadata nodes using NSDI standards to facilitate spatial data sharing. A draft content standard has been drawn up and shared with the stakeholders for finalization.

District Geo Portals

In a typical district, different Line Departments and other agencies acquire and process spatial data sets on a day-to-day basis for field/ local level applications. Some of these data sets relate to watersheds, plots, weather, crime, irrigation, and facilities etc. (e.g. educational, health, public distribution system).

Inadequate access to these data sets inhibits their use and integration with other relevant layers. At times, these data sets are compiled and consolidated for use at higher area levels where a generalized representation is adequate for decision-making. In order to make the detailed data sets accessible to the end-users at lower area levels, there is a need for improving the related data access procedures. District Geo portal prototypes have thus been developed and demonstrated to user agencies for districts like Prakasam (Andhra Pradesh) (Figure 5.18), Almora (Uttarakhand) and Jammu (Jammu & Kashmir). While the Prakasam and Almora Geo portals have been developed on OGC-compliant Open Source software packages, the Jammu Geo portal has been developed on a commercial-off-the-shelf product. Various thematic layers acquired from different sources including remote sensing have been made accessible to users using OGC-compliant Web Map Service (WMS).

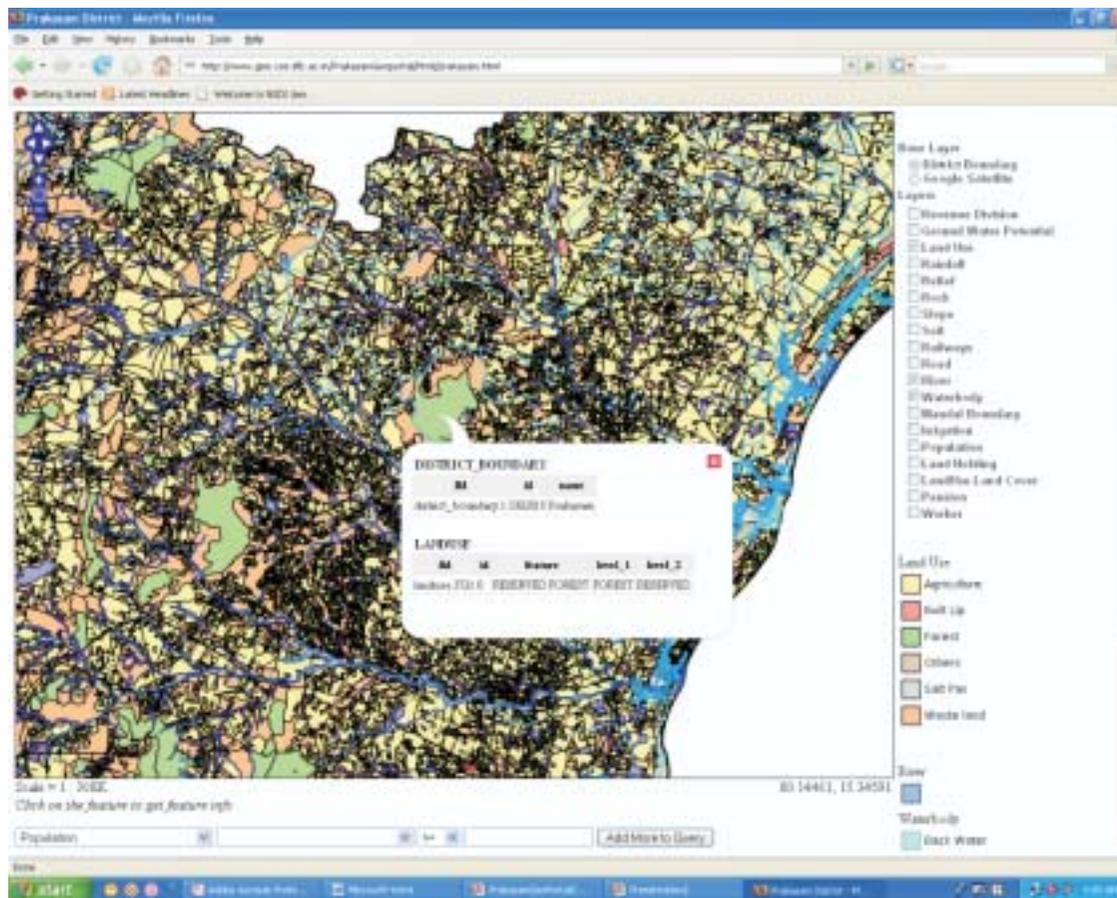


Fig. 5.18: A screenshot of Prakasam Geo Portal Web Map Service showing zoomed-in details of the land use & land cover theme along with its attribute information using the open source RDBMS and Web Service packages

State Geo Portals

Karnataka Geo-portal has been demonstrated to potential stakeholders for different applications. As an outcome, specific applications in the sectors of 'Education' (Fig. 5.19) and 'Bio-fuels' have been developed and presented to officials from Ministry of Human Resources Development (MHRD), Govt. of India and the Dept. of Rural Development & Panchayati Raj, Govt. of Karnataka respectively. The Geo Portal is being upgraded with additional metadata from the Line Departments like Women & Child Development, Transport, and Revenue etc. for provision of Catalogue Service on Web (CSW).

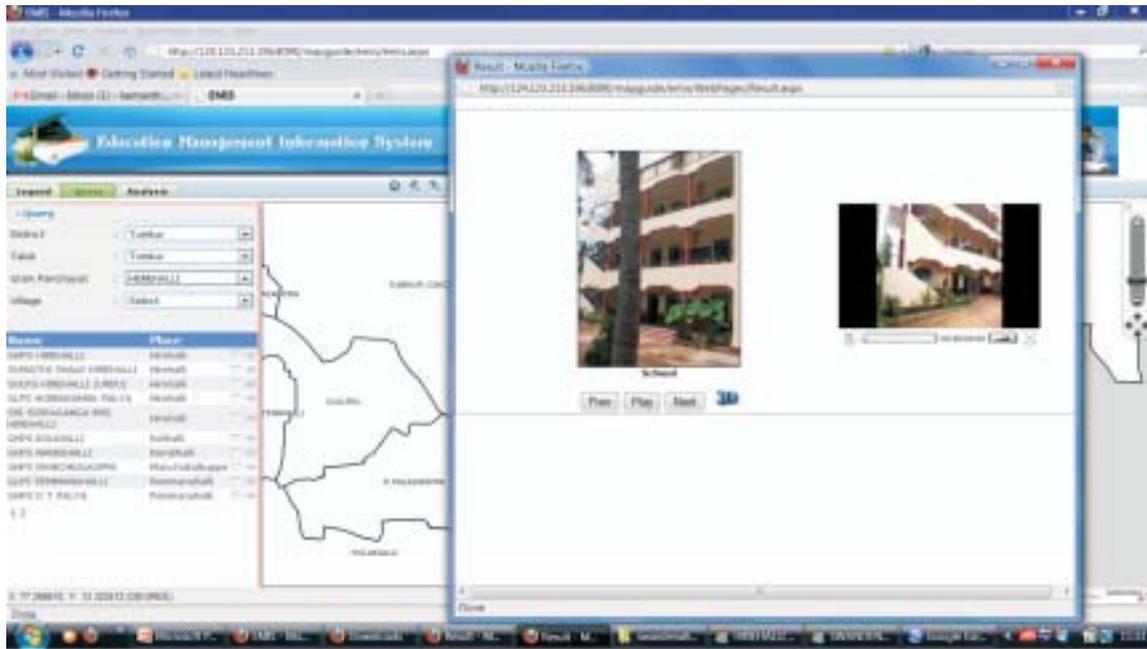


Fig. 5.19: A screenshot of a WMS on school locations and a video display of the school building accessible on the map display for a part of Tumkur Education Block, Karnataka

The State and District Geo Portals developed on open source or commercial-of-the-shelf products have been made accessible through the single window access mechanism of the India Geo Portal of the National Spatial Data Infrastructure (NSDI). Uniform set of standard specifications and compliant tools from ISO/ OGC have been used to ensure Interoperability.

Application of Web Map Service (WMS) in preparation of panchayat level plans

Strengthening Panchayati Raj Institutions (PRIs) and empowering local communities with improved access to up-to-date information is essential to their effective participation in local level planning. In a study conducted in Takula Block, Almora (Uttarakhand), year wise local development plans for a select set of villages have been prepared using up-to-date resource maps and made accessible through OGC-compliant



Fig. 5.20: Village Planning Map of Jharkote prepared with the involvement of Panchayat representatives and local villagers

WMS. The village level plans have been prepared with the involvement of local villagers and panchayats and uploaded to the district data node at Almora with a view to sharing the maps with the concerned stakeholder agencies. The present study aims at sharing the water resources information with the panchayat representatives and villagers for ensuring their participation in recharging the endangered Kosi River basin vital to meeting water requirement in the district. A cluster of 158 revenue villages covered in 8 Nyaya Panchayats, 89 Gram Panchayats, and 1 Kshetra Panchayat (Takula, Almora) and the Almora District Zilla Panchayat have been involved in the preparation of the natural resource inventory and the local level plans. Individual village level plans are proposed to be combined to prepare a block level master plan for Takula block water resources conservation planning.

Validation of the Surface Water Run-off Tool for Hydrological Information System

Access to web-enabled data processing tools for estimating surface water run-off is an essential component in a Hydrological Data Infrastructure. Relevant data needed to evaluate the cause and effect of all the proposed actions (e.g. setting up a water harvesting structure) within a drainage basin are required to be collected, maintained, processed and shared with the stakeholders on a regular basis to provide decision support. A Hydrological Information System (HIS) has been developed and demonstrated to the concerned Line Departments of Government of Himachal Pradesh like Environment, Irrigation & Public Health, Energy, Agriculture, and Horticulture. Capable of providing information on surface run-off, silt yield, biomass yield from a watershed following a rainfall event, the HIS could be accessed by stakeholders for collaborative management of the watersheds. Based on the feedback from the Line Departments and the available gauge/ discharge data, calibration and validation of the underlying Surface Water Run-off Tool for estimating surface run-off have been taken up. An initial validation exercise has been performed on Beas Sub-catchment for monthly results of the Tool with monthly observed values for the period 1995 to 1997. The simulated flows compare well with the observed flows (Fig. 5.21) and a close agreement has been observed between the mean and standard deviation values for both the results. The Nash-Sutcliffe coefficient value has been observed to be 0.7206 indicating a reasonable goodness-of-fit.

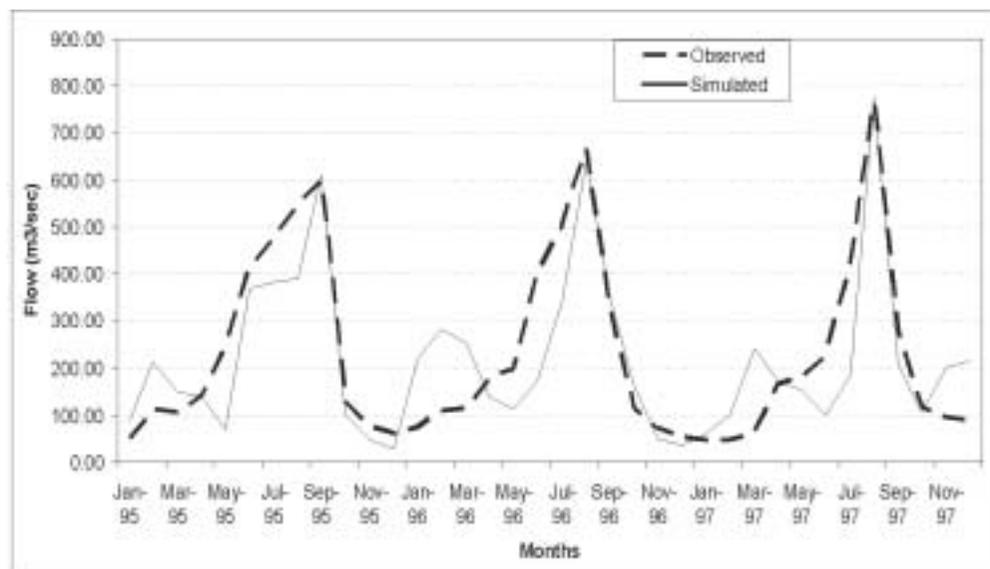


Fig. 5.21: Comparison of SWAT model simulated and observed monthly flow for the duration 1995 to 1997 for the Beas Sub-catchment

A comprehensive validation of the tool is proposed to be taken up with the availability of long-duration flow data sets in the next phase of the work.

Cartographic generalisation

A city map primarily consists of features like buildings and roads. While viewing such a map at a reduced scale, as on a mobile device, the features not only become smaller but tend to overlap as the small area available for visualisation gets smaller. Cartographic generalization plays an important role in overcoming these effects and preserves the required legibility considering the need for communicating (maps) geographical data to mobile device endusers. Various computing operations are performed during generalization of these features.



Fig. 5.22: Contours in the screenshot on the left shown after cartographic generalisation on the right (process of simplification) . For easy visualisation, please compare density of features at A and B on the left with those at A' and B' on the right

One of the important processes - simplification of the features like buildings, roads, contours etc. - involves automatic smoothing and elimination of small but unimportant features (Fig. 5.22).

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

In order to promote R&D in different emerging facets of Geo-information Science and Engineering, an Advanced Laboratory on Geo-information Science & Engineering (www.gise.cse.iitb.ac.in) has been set up at the Department of Computer Science & Engineering, Indian Institute of Technology Bombay. Some of the priorities identified for investigation at the Laboratory include Spatio-temporal Data Analysis, Geo-spatial Statistics, District Geo portal prototypes, General Purpose Wireless Sensor Node Development etc. 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 or outside. Some of the activities pursued during the year include Smart Campus Grid, Wireless Sensor Node, and Spatio-temporal Data Analysis etc.

Smart Campus Grid

The Smart Campus Grid Project (referred simply as IITBGrid) proposes to develop and deploy innovative applications to support managing, planning and optimizing campus resources by making use of

GIS and related technologies. It plans to use IIT Bombay campus as a model to demonstrate the utility of such a concept. The platform is proposed to be made available for supporting R&D in various IIT Bombay Departments/ Schools as it provides detailed spatial context for development and validation of research models (such as studies in energy management, water management, disaster management), including research in mainstream computer science areas such as database techniques, sensor networks, data visualization etc. A set of spatial data layers of IIT Bombay has initially been made accessible to the stakeholders like researchers and other end-users over web using OGC-compliant WMS Services (Fig. 5.23).

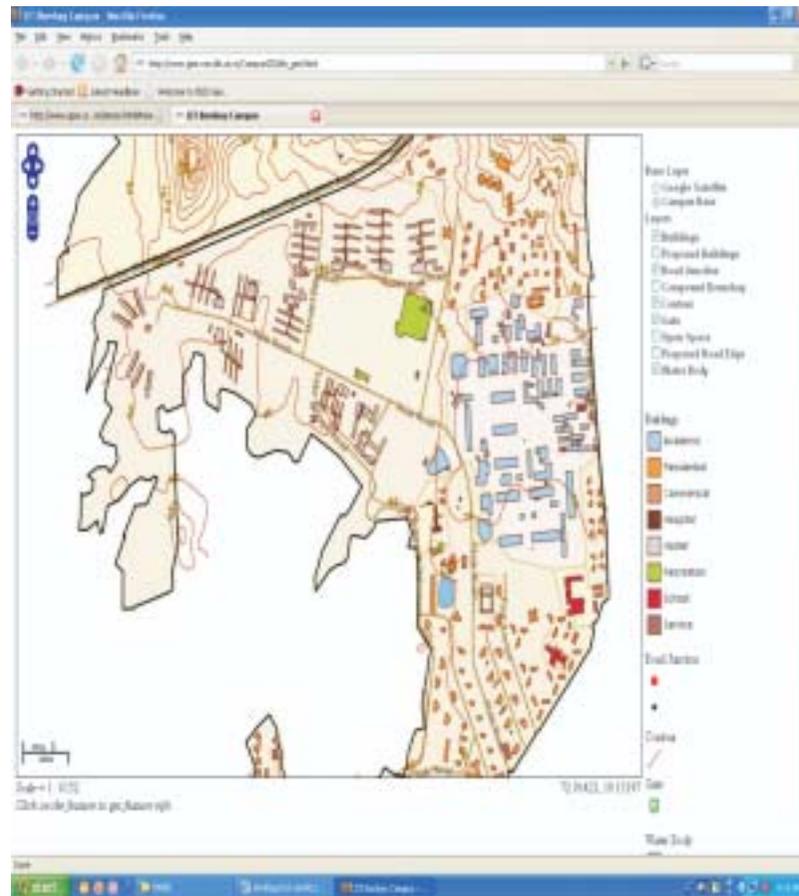


Fig. 5.23: A screenshot of the WMS from the IITBGrid Project showing different data layers relating to the IIT Bombay campus

The Grid is expected to offer a platform to build state-of-the-art geo-spatial technology based applications for managing, planning and monitoring the resources and the environment for better serving the campus community. In addition, the IITBGrid will help support collaborative research activities, technology development, innovation, infrastructure building, modernization, and education within the unit. The Grid is expected to be used as a model for similar applications for larger communities like villages and cities for GIS-based operation management and planning.

General purpose wireless sensor node

The general purpose wireless sensor node has been fabricated with a view to equipping the IITB smart campus grid with sensor nodes for capturing information to support campus resource management. Designed to be a low cost and easily deployable device, the node consists of a Zigbee Module (ZM), GSM/GPRS Module, and a GPS Module.



Fig. 5.24: Low cost general purpose wireless sensor node for deployment in the IITB Smart Campus Grid Project for the management of campus resources

Multiple sensors can be connected to this node via 6 serial ports, 8 ADC channels, one SPI port, and 8 General Purpose I/O lines. The GSM/GPRS module can send data to a Server via SMS or the internet via GPRS for automatic sharing with the end user community (Fig. 5.24).

Spatio-temporal analysis of cyclone data from Bay of Bengal region

Study of movement (trajectory) of cyclones is a pre-requisite to improve early warning and devise better strategies for preparedness. Behavior of tropical cyclone trajectories needs to be better understood in order to isolate potentially predictable aspects of landfall. Cyclone trajectories in a given ocean or sea can be better analyzed using cluster analysis by grouping them into small subgroups with homogeneous spatio-temporal characteristics. A set of 139 tropical cyclone tracks over the Bay of Bengal has been studied and classified into different subcategories using spatio-temporal data sets for the period 1990-2009 and applying K-means clustering algorithm based on the concepts of vector geometry and higher order statistical moments. Using the first two moments of a cyclone track, it has been possible to estimate a measure of its central location, length, orientation, and to an extent, its curvature.



Fig. 5.25: Maps showing mean centroid location and variance ellipse for a cyclone track and similar ellipses (red line) with mean variance ellipse (black bold line) for all the cluster 1 cyclone tracks in Bay of Bengal

A vector of five attributes (two centroids and three variances) per track has been considered for clustering. Fig. 5.25 shows the cluster 1 individual ellipses (red ellipses) and the mean ellipse (represented by the bold boundary in black) for the set of cyclones studied in the work. Cluster 1 is centered close to Tamil Nadu coastline and the mean variance ellipse of this cluster is more elongated in the longitudinal

direction with a negative tilt indicating that the cyclone tracks of this cluster are generally moving in the north easterly direction. Characteristics like landfall location, genesis location, life span, intensity, and seasonality of cyclones for all the clusters are proposed to be analyzed in the near future.

Urban Flood Risk Mapping of Chennai City

About 400 Sq. Km. area of Chennai City has been taken up for flood risk mapping using ALTM technique. The study focusses on (i) selection of flood mitigation techniques to manage flood risk in the study area using Orthomaps, DEM and thematic layers in GIS (ii) site specific mitigation strategies for the 36 flood prone hotspots in Chennai corporation limits and Ambattur Industrial Estate (iii) implementing intensive artificial recharge and rain water harvesting in Chennai (iv) post project activities and follow up projects for Chennai corporation using ALTM data and automatic weather stations (development of DSS and EWS for a pilot area) to make the best use of the high resolution data base (Fig. 5.26).

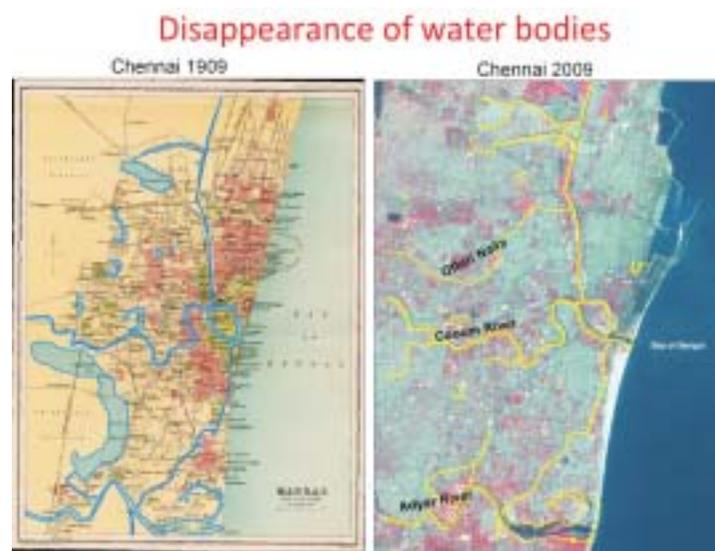


Fig. 5.26: Disappearance of water bodies in Chennai

Landslide Hazard Mitigation

The Kaliasaur landslide on NH-58 between Srinagar to Badrinath has been mapped on 1:500 scale with detailed geological, structural and geo-morphological features. Based on this, a DTM has been prepared to demarcate slope distribution and slip surfaces. Rock mass characterization has been carried out to carry out slope stability analysis and propose suitable remedial measures.

Surbee Landslide near Mussoorie has been investigated in detail with the geological and geotechnical properties. Slope stability analysis for debris material and rock mass have been carried out. Numerical modeling of the slope has been attempted using FLAC2D package. Based on the analysis, causative factors have been identified and accordingly protective measures have been designed.

A regional study in Garhwal Himalaya covering parts of Chamoli and Rudraprayag districts has been carried out for landslide hazard and risk zonation using Advance Pattern Recognition Technique. Remote Sensing and GIS have been used in the Study. The results have been validated and it has been observed that such an approach for studies in a hilly region is more accurate than conventional techniques.

Mapping in 1:10,000 Scale

A Task Force under the Chairmanship of the Secretary, Ministry of Earth Sciences has been constituted for preparation of a detailed methodology to carry out benchmark studies for preparation of topographic maps in 1:10,000 scale using different technologies and resolutions for various land forms. The Task Force Report has been released by the Hon'ble Minister for Science & Technology and Earth Sciences during the inaugural function of NSDI-10. An implementation strategy is being worked out with the concerned partner agencies.

Bio-Geo Data Base and Ecological modeling for Himalayas

The coordinated programme on 'Bio-Geo Database and Ecological Modelling for Himalayas' is being implemented for the identified study transects in the North-western (NW) & North-eastern (NE) Himalayan ranges. Under the programme, specific R& D studies at the micro-watershed level have been taken up primarily to enhance scientific knowledge on the mountain environment to support local level decision-making.

(A) Uttarakhand Study Transects in the NW Himalaya

(i) Development of Socio-Economic Profile of Selected Micro Watersheds in Uttarakhand

A database has been developed for two micro watersheds - Dabka and Khulgad - located in the Kumaon region. The study identifies important locally relevant developmental indicators and indices to prioritize villages for developmental intervention. Both primary, through questionnaire survey, and secondary data have been used. A framework has been developed to collate household information at village level that in turn could be used for developing a socio-economic database. The demographic, social, economic and infrastructural indices have been developed along with a composite index to understand the disparities in development among the villages in the watersheds. Under the study, a geospatial information system at village level consisting of demographic, social, economic and infrastructural variables has been developed.

(ii) Database on forest and agricultural ecosystem dynamics along an altitudinal transect in Garhwal Himalaya

Agro biodiversity comprises the whole plant resource diversity that human societies use and manage for agriculture, food, healthcare, and livelihood. It includes the enormous diversity of crops and crop varieties that small-scale farmers conserve and cultivate, representing both the basis for their subsistence and a source of income. Agricultural diversification and low-input agriculture with indigenous agro-ecological knowledge and practices have been the major focus for development of societies. A watershed based development approach leading to a concrete set of suggestions for enhancing productivity and sustainable development of the study area has been evolved under the study. Monitoring at the level of watersheds or sub-watersheds in the basin helps in analyzing impacts of current and future activities and accordingly plan area specific management alternatives based on the local priorities. A five second grid of the land use map was taken and the agricultural area was covered for field sampling where the agro diversity was computed and analysed to help preserve the local ecology. Techniques for agro biodiversity and sustainable livelihood assessment at the local level based on an extensive set of data like land use/land cover, drainage, settlements etc. using a GIS could be upscaled to cover a region or a state for framing suitable policies.

(B) Arunachal Pradesh Study Transect in the NE Himalaya

The coordinated programme on 'Bio Geo database and Ecological modeling' for the North East is being implemented for the state of Arunachal Pradesh occupying a major part of the north-eastern Himalayan region. The West Kameng and East Siang Districts of Arunachal Pradesh have been identified for a detailed study of the biodiversity. Inventorization and mapping of natural resources including exploration of floral and faunal diversity, monitoring of water quality, socio-ecological assessment of existing land use systems in Jhum areas of North-Eastern Himalayas, namely (1) Remi (East Siang), (2) Kalaktang (West Kameng) and (3) Tenga of West Kameng District in Eastern Himalayas of Arunachal Pradesh are proposed to be undertaken. Agencies located in the North East are involved in the Programme's activity.

Modelling Tool for Assessment of Non Point Source Pollution in a Watershed

A GIS- Based Modelling Tool for Assessment of Non Point Source Pollution in a Watershed - NutriL - GIS has been developed. Comprising of three modules - RunEstim, ADAM and NutriLEM to evaluate the effects of management decisions in a watershed in terms of run-off augmentation, fertilizer application and nutrient pollution control, NutriL-GIS is a user-friendly, stand-alone package tool for assessment of nutrient pollution load e.g. nitrogen (N) and phosphorus (P) generated from an agricultural watershed (Fig. 5.27). The software integrates Application Programming Interfaces (APIs) in a GIS environment. Data sets like land use, soil cover, topography in a watershed in addition to secondary data on rainfall and agriculture are used in the analysis. NutriL-GIS incorporates GIS features and functionalities for database management and data processing.



Fig. 5.27: A screenshot of the home page of the NutriL-GIS package

End user/ stakeholder sensitisation and training workshops

Advanced Lab on Geo-Information Science & Engineering organised a two day workshop on “Standards and Technologies for Spatial Data Infrastructures” at IIT Bombay on 24-25 January 2011 for the nodal officers of NSDI and the scientists / officials from the agencies implementing the State SDIs. Experts in the field from Canada, United States, and Germany delivered lectures on the next generation SDIs, and related standards & technologies.

In order to assess the geo-spatial data sets available for setting up the North Eastern Geo Portal and sensitize the participating State Governments on spatial data sharing, a workshop on ‘North Eastern Spatial Data Infrastructure (NESDI)’ was held at Shillong and Guwahati on 19 – 20 August 2010.

Brainstorming sessions on ‘National Geo-technical Facility (NGF)’ and ‘Application of Geo-Statistics & Soft-computing Techniques in Geo-spatial Data Analysis’ were held at Dehradun on 17 September 2010 and at Tirupati on 22-24 November 2010 to prepare a road map for operationalising the NGF and work out areas of research in Geo-statistics & Soft-computing respectively.

User sensitization workshops on ‘Urban flood management’ and ‘Landslides’ were held at Chennai on 21 November 2010 and at Ooty on 17-19 September 2010 respectively. A workshop on ‘Capacity building’ was organised at Hyderabad on 27-28 October 2010 to draw up a strategy for building the required human resource base in Geo-spatial Technologies.

A special session on “Hyper spectral remote sensing” was organised with the Indian Society for Remote Sensing (ISRS) Conference held at Lonavala, Bombay on 29 November 2010 to present the research outputs from various projects in this emerging field.

Centre for Geo-information Science & Technology, Kerala University, Thiruvananthapuram organised day-long user awareness workshops on ‘Application of Spatial Data Modelling in Urban Health’ and ‘Human-Wild life conflict: application of Spatial Technologies in Database Development and Management’ on 27 May 2010 and 20 December 2010 respectively for the end users. The former was organised to discuss and improve the health data model through the feed back and requirement analysis of the end user like Councilors of the local City Corporation, health officials, representatives from the State Health Department, National Rural Health Mission (NRHM), the local Medical College, and NGOs. The latter was attended by officials from the State Forest Department as well as scientists and researchers from the Kerala Forest Research Institute (KFRI), World Wildlife Fund, University Zoology Department and a select group of NGO’s for finalizing the forest data model towards improving management of forest data in the State.

NATIONAL COUNCIL FOR SCIENCE & TECHNOLOGY COMMUNICATION (NCSTC)

The National Council for Science & Technology Communication (NCSTC) is mandated to communicate science & technology to masses, stimulate scientific and technological temper and coordinate and orchestrate such efforts throughout the country. The programmes of the Council aim at building capacity for informed decision making in the community and promote rational thinking. The Council is devoted towards societal upliftment through dissemination of scientific knowledge in an informal manner and builds programmes with the help of different media which percolate down to every nook and corner of the society.

NCSTC encourages research in S&T communication and impact assessment of various programmes, for diverse target groups. It also supports programmes aimed at School and college level popular science, Community level general S&T and others. Books, manuals, posters, exhibitions, films, radio programmes and television programmes are regularly produced to reinforce these efforts. NCSTC recognizes outstanding efforts through awards and incentives all over the country.

Major Programmes

Science Express: ‘Science Express’ is a unique 16 coach custom-built AC train owned by DST, which showcases a state-of-the-art Indo-German science exhibition. The exhibits have primarily been developed by several Noble laureates from Max Planck Society, Germany. This project, which was flagged off on 30 October 2007 by Hon’ble Prime Minister of India and German Chancellor, received unprecedented response during its over 600 days of journey across India, in three phases. This flagship programme of DST has also been able to effectively engage & motivate students to pursue higher studies as well as careers in science besides inculcating scientific temper among masses.



Fig. 5.28: Young students enjoying experiments at Joys of Science Lab

On completion of the Phase-III on 27 April 2010, this iconic mobile classroom has covered more than 160 destinations and enthralled a whopping 51 lakhs people including about 10 lakhs students and 50,000 teachers from 10000 schools. About 500 visiting dignitaries too have hailed this initiative while media has consistently covered this unique science-on-wheels venture with over 1000 news items/ stories in national & regional newspapers, magazines & journals and also on the web. Doordarshan & AIR as well as many private TV channels & FM Radios have featured it prominently. There is thus wide appreciation of this record breaking effort to popularize science.

Exhibits on Indian scientists have been added to inform people, in general and youth, in particular about their immense contribution. In addition, a campaign to celebrate Year of Chemistry-2011 was put up on board Science Express to excite students about some aspects of Chemistry. Content of some of the important exhibits was made bilingual by translating in Hindi.

Once again, several corporate and non government organizations & agencies like Hong Kong & Shanghai Banking Corp.(HSBC), Nestle, **Petroleum Conservation Research Association (PCRA)**,

GKSF, FPRA, etc. joined hands to use this informative, interesting and interactive medium to reach out to the target audiences for their respective campaigns on Climate Change, Water, Energy Conservation, Health, Road Safety, and so on. Phase IV was inaugurated in December 2010 from Gandhinagar which will continue till mid June 2011.

National Science Day: NCSTC acts as a nodal agency to support catalyze and coordinate celebration of the National Science Day throughout the country in scientific institutions, research laboratories and autonomous scientific institutions associated with the Department of Science and Technology. Celebrations of important scientific days & events bring scientific awareness in the community. Many institutions organize Open House for their laboratories and appraise students about career opportunities available in a particular research laboratory/institution. The year 2011 is being celebrated as “International Year of Chemistry-IYC”. The theme was proposed by the International Union of Pure and Applied Chemistry (IUPAC) and was adopted in UN General Assembly in 2008. Accordingly, the theme for the year 2011 is “**Chemistry in our Lives**”.

Last year the theme was “Gender Equity for Prosperity with Peace”. Based on the theme, consolidated proposals were invited from State S&T Councils and partial funding was done in many States like Orissa, Kerala, Karnataka, Mizoram, Arunachal Pradesh and on Exhibitions, Popular Lectures, Debates, Quiz and Essay Competitions, Seminars, Symposia’s and other such activities were organized in various States. The NSD theme helped in increasing public appreciation of Chemistry in meeting world needs, increase interest amongst students about Chemistry as Career choice and celebrate the 100th anniversary of the Madam Curie winning the Nobel Prize.

Communicating S&T for Water, Sanitation & Hygiene (WASH): NCSTC has an ongoing programme on S&T Communication for Eco-WASH (Water, Sanitation & Hygiene) Literacy aimed *to raise awareness, promote scientific literacy and build capacity for informed decision making on issues concerning water, sanitation & hygiene and related ecological sciences*. Innovative S&T communication methodologies/techniques and principles for communicating the critical knowledge through different media (*folk, print, electronic, mixed media, alternate media*) are used to spread the message. The range of activities include promoting professional S&T Communication trainings, developing communication material, catalyzing field projects, and engaging select target groups for enhancing the actionable learning of stakeholders.

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. Notable examples are-

- Community assessing its watersheds, soil and land degradation, and sharing solutions for conserving water.
- Community initiatives in mapping water sources, water audit & *paani panchayats*.
- Water quality monitoring & surveillance with technical skilling.
- Understanding nexus between waste water & poor sanitation, hygiene & long term health effects of contaminated water, and adopting rational behavior.
- Adoption of conventional & un-conventional methodologies (including resource centers, demonstrative communication with new S&T solutions & kits for monitoring water quality, and people’s GIS for

mapping water sources, etc.) for delivering appropriate messages to people and building capacity for informed decision making.

A multi-faceted approach has been adopted towards bringing about a behavior change through varied activities, like door to door contact, focus group discussions, public meetings, kala jatha-sociodrama jatha (a journey to promote a dialogue on water), rainwater harvesting (RWH) demonstration, Jal Jeevan kendras, Jal Chaupals, building association with people, especially women (as they are the household managers when most of the male members migrate in search of livelihoods) and enhancing capacities of field workers regarding the complexity of water related problems. RWH demonstrations have been situated at the hamlet level in –

- Prominent public space – temple/mosque/village market
- Panchayat bhawan (office of the decentralized governance unit)
- Primary and secondary schools
- Private areas selected by the community on the basis of their accessibility by a larger section of the population

There has been steady growth of **Water Literacy Toolkit**, with development of Comparative evaluation based development of decision support software & communicative guidance in use of a wide variety of water testing kits, a Training Manual of Teachers on Water Test Kits and Water Audit Templates, apart from several brochures, posters, flyers, etc.

National Children's Science Congress: The 18th National Children's Science Congress-2010 was held at Chennai during 27-31 December 2010. About 600 projects were presented by child scientists who assembled from different States of the country belonging to both urban and rural areas. Activity corner cum exhibition, daily workshops for guide teachers, face to face interaction with eminent scientists and cultural shows at every evening were the additional attractions of the event. Each year an Activity Guide is designed & developed for the selected theme and it is distributed across the country to enable the organizers to attract wide spread participation. The focal theme for 2010 & 2011 was **Land Resources: Use for Prosperity & Save for Posterity**. In a programme of Pan IITians conclave 2010 held during 28th – 31st October at India Expo Centre, Greater NOIDA, 25 team leader, identified in national event of NCSC 2009 held at Ahmedabad were given awards. Participants of ASEAN countries also participated in NCSC 2010.

Rashtriya Kishore Vaigyanik Sammelan (RKVS) 2011: Every year along with the Indian Science Congress, RKVS involving selected child scientists from State level Children's Science Congress (CSC) is conducted. The objective of this activity is to stimulate creativity and inventiveness in science in the young minds. RKVS 2010 was organized during 4-6th January 2011.

About 3500 delegates including children in the age group of 10-17 years along with their science teachers participated in RKVS 2011. Among them about 500 were permanent delegates and 3000 floating delegates. These permanent delegates were given opportunity to be part of the inaugural and valedictory functions and the lectures of Indian Science Congress.

Understanding of Weather & Climate Change: Climate Change and global warming is a burning issue nationally as well as internationally. Understanding of weather, climate change, conservation of resources

and related issues is crucial for sustainable development. A programme was formulated and communicated to the stake holders. The programme has the following objectives:

- To create better understanding and awareness amongst various target groups about weather, climate change, resources conservation and sustainable development;
- To inculcate a spirit of enquiry, questioning, observation, analysis and interpretation of data by understanding weather patterns through low-cost weather observation kits and models; learning and taking scientifically valid measurements;
- To learn about interdependence in food web, study of food web specific to climate zones, threats to environment due to extinction of certain plant and animal species; &
- To stimulate student's interest in pursuing careers in S&T especially in areas of climate, meteorology, hazard management, etc.

Besides this training and awareness programmes on the subject were organized. A kit and manual for the target group of school students was conceptualized and finalized with the help of subject area experts and under a project to a field agency. Programme is making good progress and is in full swing. Teachers' Training workshops & Resource Persons training was completed in Madhya Pradesh, Manipur and Andhra Pradesh. Workshops are going to be organized in Chhatisgarh and Sikkim.

Countrywide Programme on Genesis & Development of Science & Technology Communication in Indian Languages: The programme has helped in developing contents for science communication students and researchers. The trends emerging out of the studies are interesting and motivating to young science communication enthusiasts to take up science communication as a career and hobby too. It also helps develop future plans and studies for effective science and technology communication in the country.

Enrichment of Resource Material to Promote Popularization of Science and Technology: This was inter-institutional collaborative project. The Partner Institutions in the Project were NCSTC, United Nations Educational, Scientific and Cultural Organization (UNESCO), New Delhi, Central Institute of Education (CIE), University of Delhi and Society for Education and Social Development (SESD), Delhi. The project focused on the popularization of Science through enrichment of Science Kits as resource material for their pedagogical effectiveness and usage in school as well as community. Following activities were carried out:

- A series of two-day workshops were held at CIE, Delhi University during the months of November and December, 2010 to assess and enrich the Science Kits and their support material.
- The enriched resource materials (Science Kits) were put to field trials from January to September 2010 in the teacher education institutions, schools and community centers of Delhi, Rajasthan and Madhya Pradesh. The Regional Institutes of Education (RIEs) in Northern and Western Regions of the country were visited and identified as the nodal institutions.
- An international symposium on the theme, 'Popularization of Science: Towards Capacity Building of Teachers' was held in January 2011 to showcase the enriched resource material and strategies its dissemination within the country as well in the cluster countries (Bhutan, Maldives, Nepal and Sri Lanka). The Project was coordinated and conducted by the Society for Education and Social Development (SESD).

Empowering the Next Generation of Innovators – IRIS: The ‘Initiative for Research & Innovation in Science – IRIS’ is a research based science fair initiative for students, with an objective to inspire budding scientists in India. IRIS is an excellent example of a public – private partnership heralded by Confederation of Indian Industry (CII) and Intel for empowering the next generation of innovators.

IRIS promotes and nurtures science and scientific research amongst young Indian innovators, recognizes and rewards outstanding projects and provides a platform for these geniuses to represent India at global science competitions like the Intel International Science & Engineering Fair (Intel ISEF) and International Exhibition for Young Inventors (IEYI) and Stockholm International Youth Science Seminar (SIYSS).

In today’s global environment, it is essential to encourage originality of thought to enrich the quality of human capital and build a pipeline of world class talent in the country. In its fifth year now, the fair receives innovative project entries from school students across the country. The students participate by sending synopsis across 10 categories: Behavioural Sciences, Bio-Chemistry, Botany, Chemistry, Computer Science, Engineering, Environmental Science, Mathematics, Physics, and Zoology.

IRIS is different from most State/school Board science fairs as it seeks to nurture innovative problem solving and a systematic approach to experimental science. The scientific direction to this fair is provided by a team of volunteer scientists from various national labs and universities as TIFR, NPL, IISC, HBCSE etc.



Fig. 5.29: IRIS Team India at Intel Science and Engineering Fair, USA 2010. Team India interacted with the Nobel laureates at ISEF.

IRIS Super Stars

India Innovation initiative – i3: To promote and inculcate a spirit of innovation in India, numerous initiatives have been taken by the Indian government as well as by Industry/academic leaders to encourage and harness breakthrough technology ideas in the society. One of the significant steps is “**India Innovation Initiative**” or “**i3**” - a Public-Private partnership initiative of Agilent Technologies Ltd, DST & CII, which aims at promoting innovators and facilitates the commercialization of the innovations and creating an innovation eco-system in the country by sensitizing, encouraging the innovators / innovations. This initiative



Fig. 5.30: Shri. Kapil Sibal, Hon. Minister, Govt of India and Shri, R Sivakumar MD Intel South Asia felicitating Mr. Kaushik Srivatsan, JNV Mandya and IRIS 2010 winner and his Biology teacher Ramani on 10 August 2010.

This has been a dream come true for me. I was very excited to meet students of my age from different states who had worked on different aspects of science.

- Kaushik Srivatsan, Winner IRIS 2009 and Intel ISEF 2010.

is for all innovators in India, above 18 years of age and irrespective of their profession or background (students, professors, industry professionals, individuals or grassroots innovators).

Indian Institute of Management, Ahmedabad (IIM-A) & Young Indians (Yi) were partners for this initiative. While IIM-A offered to provide incubation support for business proposal development and commercialization of some of the best innovations, Yi supported a wider outreach of this significant initiative, confer a Special Yi Next Practices Award and also support in commercialization of select innovations. SINE, IIT Mumbai also extended its support this year for providing mentoring services to the potential projects of i3 2010. Interaction with various support organizations involved in the process of commercialization was facilitated through CII-Raunaq Singh Innovation Grid (www.innovationgrid.org).

The i3 website recorded more than 10000 hits. A total of 890 entries were received from across the country from students, industry professionals, individuals & grassroots innovators in various fields such as Life Sciences, Electronics & Communications, IT, Energy and Engineering Technologies. “Novelty Search” of the entries received was conducted by CII’s APTDC & TNTDPC; our partners for patent search. After the “Novelty Search, a total of 186 projects were short listed for second level screening at the Regional level. After the screening by an expert panel comprising of eminent scientists and industrialists, the top 52 innovations were selected for participation at the i3 National Fair.

The i3 National Fair was organized at IIT Delhi during November 2010. A panel of Jurists selected top 5 innovations based on the technical feasibility, market potential of the innovation and its impact on the Industry, society and environment for the i3 Awards.

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) throughout the country for the purpose of fostering children's dreams and passions for S&T of young minds. Talented students are encouraged to pursue ideas which have potential over a 3 week internship in one of the centers identified by the department. The period of internship can be extended or utilized in different time intervals, if the mentors so recommend interesting projects made by school children are exhibited to other students and general public to stimulate their creativity.

For the sake of effectiveness, the hubs were located in different host organizations like: Schools; Universities with centre for science education; Science centers; Science cities; Science based voluntary organizations; Societies/foundations promoting science talent; and Bal Bhawans. The core faculty in each RISHI caters to the needs of class XII level Physics, Chemistry, Mathematics, Botany, Zoology and Computer Science. The hub has a choice to select any one or more of the disciplines like: Robotics; Biotechnology; Ocean Sciences; Bio-medical Engg.; Agriculture and rural development; Science and mass communication; and Renewal energy sources and applications.

Countrywide Programme on Technology Communication for Developing the Spirit of Innovation and Technology and Awareness among Artisans and Masses: The programme was able to attract a number of young innovators from across the country and demonstrate their innovative skills in five workshops organized in different parts of the country in this connection. The programme is likely to pick up momentum and should be able to generate innovative ideas and practices towards fulfilling the aspirations embodied in the India Innovation Decade (2010-2020).

“Networking for WASH” Campaign on World Water Day: NCSTC supported month long Eco-water Literacy campaign for implementation by State S&T Councils/Departments starting on the occasion of World Water Day i.e. 22nd March every year. This involves a clear role for each Council/Department for networking at institutional and community level and developing a series of project/activities for implementation.

Now the initiative has been scaled up for six month duration for Modular Proposals for Capacity Building, Knowledge Intensive & Awareness based communicative action are being guided and considered from State S&T Councils. There are three modules, namely

Module A - Capacity Building & Knowledge Sharing

Module B - Capacity & Awareness Building

Module C - Awareness Building (“Science for Sanitation Month”)

The 11th International Conference on Public Communication on Science & Technology (PCST-2010): The conference was organized at the National Agricultural Science Centre (NASC) Complex, New Delhi during December 06-10, 2010 attracting over 600 national and international delegates from across the world offering a dynamic forum for researchers and practitioners of science, communication, and science communication. The theme for the conference was **“Science Communication without Frontiers”**. A proceeding containing over 400 papers is being published, which can be considered a huge treasure of contemporary ideas, concepts, practices, activities, processes and strategies in the area of science and technology communication across the world.



Fig. 5.31: Attracting Youth to Careers in Science: Students attending Motivational Programme in Orissa

Motivational Programme for Talented School Students: To encourage bright students to select careers in science, NCSTC has developed field level awareness programmes where talented brilliant students of secondary and senior secondary level spend quality time in research laboratories with leading scientists. The programme aims at sensitizing students about research in frontier areas of science; spending time with charismatic scientific personalities; giving them an exposure of various sophisticated instruments, hands-on experience on small scientific projects, visits to scientific institutions and laboratories. A number of such programmes were organized during the year in Orissa, Saurashtra, Manipur, Jorhat, and Punjab. These programmes will go a long way in motivating students towards scientific careers and pursuing studies in basic sciences. A Review of the Motivational Programmes was also organized by the Tamil Nadu Science & Technology Council, Chennai and valuable suggestions like involvement of parents and teachers in motivational programmes increase in duration of the programmes in difficult geographical zones, discussion on emerging S&T careers for youth, etc. were discussed for implementation.

Detection and Prevention of Adulterants in Food Stuffs: Adulteration in edible stuffs like milk, Khoya, spices, oil, etc. is a serious problem which manifests in the form of health hazards in the society. To create awareness and sensitize masses about adulterated foodstuffs, number of training programmes and lectures demonstrations are catalyzed and supported. Society benefited to a large extent through organization of field programmes, lectures-demonstrations and training of resource persons for detection and identification of adulterants in the foodstuffs. SPECS, Dehradun organized more than 100 lectures-demonstrations in Uttarakhand on the subject, a training programme was organized by the Al-Falah Institute of Engineering & Technology (AFSET), Village Dhauj, Faridabad wherein more than 50 students participated and received training. Besides this many State S&T Councils also organized such programmes.

Appreciating the Work of Darwin: In continuation of Bi Centenary Celebration of Charles Darwin's birthday and 150 years of his famous publication 'Origin of Species' a Year long programme has been developed. In first phase around 50 colleges of the country were identified for 2 days programme highlighting the importance of Darwin's contribution to biological science & its relevance to development of biological sciences. Students of M.Sc were invited to make presentation on evolution of species relating to its relevance to present day research in various fields of biological sciences.

Science behind Miracles: NCSTC continued to support short duration projects on Explaining Science behind Miracles during which the participants get trained in demonstrations of so-called miracles

followed by their explanations including over 115 tricks, generally shown by self styled God-men.

Perfect Health Mela: In order to communicate science and technology achievements among the public-urban and rural population, NCSTC conducted a series of science exhibitions in different parts of country. The Council also participated in the popular Perfect Health Mela organized by Heart Care Foundation of India during 22 – 31 October 2010 in New Delhi and put up its activity corners that attracted thousands of visitors.

Mobile Planetarium: NCSTC acquired mobile planetariums to popularize astronomy and its related activities in rural schools of Uttarakhand, Assam, Uttar Pradesh, Orissa, Maharashtra, Rajasthan, Jammu & Kashmir, Madhya Pradesh, after enquiring mobile planetarium from NCSM, Kolkata, for such demonstrations across the country.

Training Modules for Resource Teachers

Microorganism: Let us Observe & Learn: A low cost and easy to handle microorganism kit was developed jointly in collaboration with ASTEC, Guwahati and Botanical Hobby Centre, Cotton College, Guwahati to empower Science Communicators and Resource Teachers to create excitement among the young children to understand about microorganism and its related discipline. This module comprises a small microscope, tools and materials, posters, audio video CD along with activity manual. A national orientation workshop was organized and around 35 resource teachers were trained. Now similar workshops are being organized at regional as well as at State level to generate resource teachers to pursue the concept and related activities to the children. So far, 200 resource teachers have been trained. The kit & resource material is being replicated to meet the growing demands of various government & Non-governmental agencies.

Vermi Composting: Training workshops on open-ended experiments on life sciences using vermi-composting as a base were organized to train the resource teachers so that they can pursue the activity with children as science and eco-club activities. Such workshops were organized across the country.

World of Social Insects: Modules on World of Social Insects have been developed for introducing the spirit of scientific enquiry among the children. Some highly involved social insects are taken in this module which create interest in children about architecture, their habitat and communication skill among inmates, division of labour, defence mechanism and reproduction, etc. A national orientation training workshop was organized during first week of February 2011 at Wardha, Maharashtra. An S&T based Voluntary group Dharamitra organized a 4 day training workshop to train the resource teachers who further organize similar training workshops in different part of the country.

Simple Tasks, Great Concepts: Life Science is one such intriguing subject that the teacher is often excited to show students some experiments which would be captivating, stimulating, observing and interesting. Most experiments suggested in the text books follow the syllabus, and are designed to be done in a laboratory. Several schools due to some reason or other do not have access to science laboratories. So, majority of the experiments in this publication have been carved in a way that they can be done anywhere, anytime having fun meddling with commonly available resources such as waste material, water bottles, etc. and also reading and learning from several sources, aimed at evolving a concept to bring out simple experiments.

A module titled 'Simple Tasks, Great Concepts' was designed and developed in a simple and presentable form where nearly 100 experiments were tried, experimented and documented with possible illustrations

targeting students of high school level. This module consists of a well illustrated manual supported by CD and a good number of posters. To implement this programme, a national orientation training workshop was organized during 19 - 22 January, 2011 at Chennai with the active support of Eco Science Research Foundation, Chennai.

Animal Life Issues with Special Reference to Animal and Human Health: To create awareness and build capacity among people about animal life issues with special reference to Animal & Human Health, proposals were invited 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 considered.



Fig. 5.32: Science Exhibition



Fig. 5.33: Resource Person demonstrating science behind miracles in a science exhibition at Ghatakpukur, West Bengal

NCSTC is organizing various activities in the field of science popularization. Science exhibition is one of the most important activities to enhance scientific knowledge of students, teachers, parents, common man and people's representative. It also brings change in their attitude. It is participatory in nature. Activities displayed in majority of exhibitions are results of training modules developed by the NCSTC.

Resource Persons Training Workshop on Model Rocketry: Model Rocketry is an important awareness generation activity which creates an understanding about important scientific principles amongst student community like gravitation laws, Bernoulli's principle, escape velocity, etc. The objectives of the programme are to create basic understanding about associated scientific principles amongst target groups, to develop a resource base of teachers and voluntary activists who can impart actual training on the subject. Training workshops were held in Agra, Shikohabad and some other districts of Uttar Pradesh.

Human Resource Development in Science Communication: A number of programmes, activities and courses were organized to develop trained manpower in the area of science communication and journalism. The Training Programmes on Science Communication using different mass media, i.e. print, broadcast, digital, folk and interactive media at grassroots level in different parts of the country including remote, troubled and difficult areas of the country have helped in the growth of trained manpower in the country to fulfill the present and future requirements in this area. These training programmes in different parts of the country have been able to arouse millions of science enthusiasts to bridge science-public gap. A single programme attracts about 50 participants on an average who are exposed to various popular science writing and journalism techniques. They also develop scripts during the workshops with the help of resource persons which are eventually appearing in the mass media through which we are able to directly expose the current science issues to millions of the people. This is the impact of a single workshop and it is hoped that a chain reaction starts, which is fueled further by continuing with advanced level training programmes from time to time and the impact is manifold.

13 Part Teleserial "Utthan": A 13 part tele-serial "Utthan" for communicating rural technologies was supported with CSIR on matching cost sharing for production and telecast. The telecast had overwhelming response from public with large participation in quiz programmes with awards to winners. It has been decided to dub the programme in five languages for telecast on regional channels of Doordarshan.

5.2 GENDER INITIATIVES

The Department of Science and Technology has over the years pioneered several unique gender initiatives. These initiatives include scheme for empowerment of rural women by enhancing livelihood through input of S&T and also schemes for providing opportunities to women scientists to return to careers in science after a break. All these initiatives are planned keeping in view a gender perspective and providing a variety of options to suit individual aptitude and capabilities. The gender initiatives are supported within the budget head of the women component plan.

Science & Technology for Women: The Science and Technology for Women, is one of the first gender enabling schemes of the Department of Science and Technology implemented during the 6th plan period with a vision to promote research, development and adaptation of technologies to enhance the overall social status of the women and augment their incomes through to science and technology, especially in rural areas. The main objective of the program is to involve/network/support R&D Institutions, Scientific Institutions, Universities, Colleges and S&T based field groups (NGOs) in developing appropriate technology packages for women.

Priority areas, with women as specific target groups, have been identified for proper scientific/technical interventions in the existing sustainable livelihood. Besides individual projects for technology development, up gradation, modulation and replication, the scheme also focuses on All India Coordinated Programmes (AICP), Women Technology Parks (WTP), Scholarship Schemes (WOS – B) and National Awards for Women’s Development through application of Science and Technology.

“Coordinated Programmes (AICP’s)” have been launched for a wider spread of successful technology packages in various aspects relating to fodder and feed, biomass dryers and, phycology for sustainable livelihood and income generation to the beneficiaries. Coordinated programmes aimed at addressing health issues related to women on production of low cost sanitary napkins and prevention of anemia through green leafy vegetables were also taken up under this component.

Specific Achievements:

1. Coordinated Programmes:

1.1. Large Scale Employment Generation in Coastal India through Sustainable Utilization of Marine Bio-resources: Seaweeds are one of the major sources of raw material for the food and phycollid industry. The demand for seaweeds as raw materials is growing @ 10% annually. Large scale Seaweed cultivation has been in practice in many oriental countries like China, Japan, India, Philippines etc. However in India seaweeds are being indiscriminately harvested from the natural habitat for the last several years. This unscientific exploitation of natural recourses has not only caused extensive damage to the marine habitat but also is one of the major factors for declining fish productivity. Thus large scale seaweed cultivation has been proposed not only as an alternate source of livelihood but also as an environmentally friendly technology for biomass supply to the seaweed industry.

Under a project “Study of the environmental impact of large scale seaweed cultivation at different parts of the Indian coast”, it has been observed that different study sites showed substantial difference in their environmental parameters as shown in Fig. 5.34.

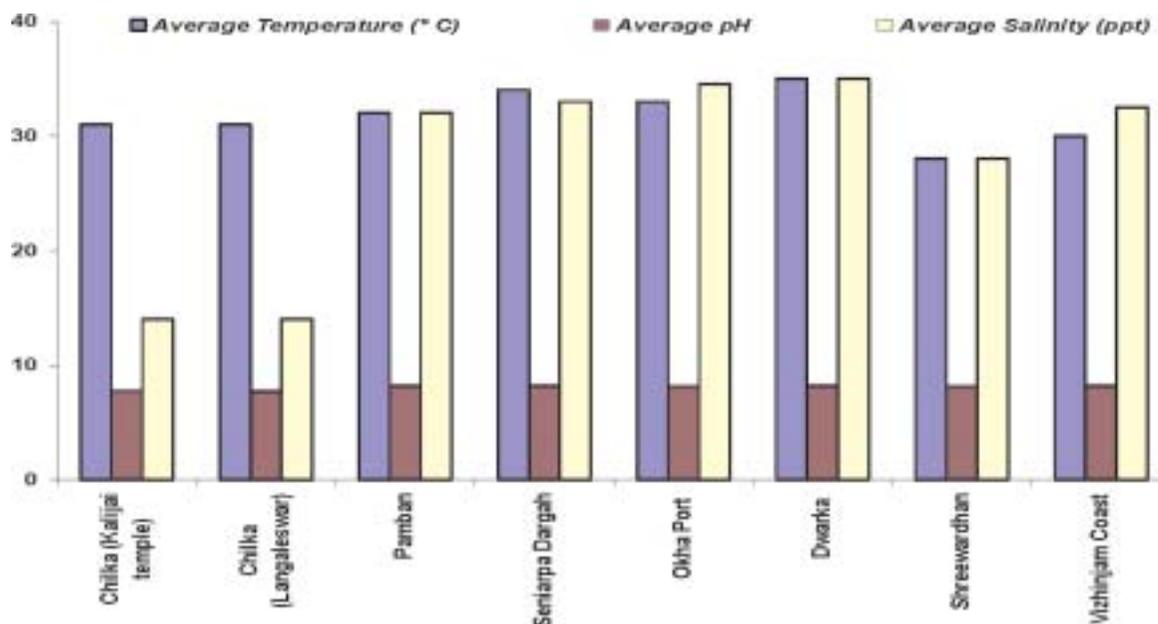


Fig. 5.34 : Various physical parameters of the different cultivation sites

In Chilka Lake, the salinity and pH ranges from 12-16 ppt and 7.3-8.2 respectively, making this suitable for the cultivation of *Gracilaria Verrucosa*. Several other seaweed species were also observed in Chilka Lake such as *Enteromorpha*, *Ulva*, *Chaetomorpha* etc. along with *Gracilaria* sp. At Mandapam, common seaweed species were *Hypnea*, *Dictyota*, *Caulerpa*, *Sargassum*, *Kappaphycus* etc. The coast is sandy and rocky and its salinity and pH ranges between 30-33 ppt and 8.0-8.2 respectively. Okha Coast is highly rocky due to dead corals. The salinity and pH ranges between 34-36 ppt and 8.0-8.2 respectively. Okha coast is the most diverse coast of India with a large number of seaweeds species like *Gracilaria*, *Caulerpa*, *Sargassum*, *Ceramium*, *Hypnea*, *Dictyota*, *Halymenia*, *Lygora* and *Acanthophora* etc.

During adverse conditions seedlings of *Gracilaria* was protected from destruction by basket method. The healthy thalli of *Gracilaria verrucosa* was also cultured in different liquid medium such as PES, ESW and Artificial seawater in laboratory. After every 15 days the culture medium was changed to maintain nutrient level. The maximum growth was observed in ESW medium as compared to PES medium and Artificial Seawater. When agar was extracted from *Gracilaria verrucosa* with alkali treatment all the parameters such as yield, gel strength, viscosity and gelling temperature was higher as compared to without alkali treatments.

A Seed Bank Facility of *Kappaphycus* at Thottappally, Aleppey district, Kerala has been developed for scaling up programs and specimen samples to other academic and research institutions in and outside Kerala besides conducting growth studies and feed experiments with seaweed diets for aquaculture practices for cultivable carps (*Catla catla* and *Labeo rohita*) under a project "Development of a Facilitator Mechanism & Seed Bank Facility for Seaweed Farming through Empowerment of Self Help Groups from Coastal Communities in Kerala".



Fig. 5.35: Kappaphycus Seed Bank at Thottappally, Aleppey

The project aims in developing seaweed biofertilizer for vegetable crops using indigenous (*ulva*, *sargassum*, *spyridia*) and farmed seaweed (*Kappaphycus*). A detailed survey to identify the potential sites for seaweed cultivation on the entire coastline of Kerala was carried out from Trivandrum to Kasargod. The areas identified for the potential expansion of cultivation program are Vizhinjam (Kovalam), Valiazheekkal (Thirumullavaram), Anandeswaram (Thottappally), Chandiroor (Njarakkal), Mappila Bay, Chaliyam (Thikkodi) and Kottikkulam (Kanjangad).

1.2. Development and Production of Low Cost Sanitary Napkins with knitwear waste: In India, research and development efforts in the area of menstrual hygiene management have been limited to commercial ventures that are unable to market products that are affordable by the poor. Women's menstrual hygiene needs have been gravely overlooked in development programs and training modules

for health and sanitary workers. The initiative of this research work was towards improving the Menstrual Hygiene status of women belonging to the lower income strata by the development of improvised low cost sanitary napkins. Besides the objective of developing low cost sanitary napkins, these efforts have been designed to train poor women to make napkins and adopt it as a self sustaining activity. The technology developed for the manufacturing of sanitary napkins is simple and women can be trained to operate this technology to manufacture sanitary napkins under a DST project by Lady Irwin College, Delhi Social marketing and door-to-door selling can be extended for the distribution of affordable, user-friendly sanitary products for menstrual management. The project is in the process of setting up these manufacturing units for sanitary napkins made from cotton knitwear waste in coordination with different Government Organizations/Institutes/NGO's at various geographical locations under the first phase.

1.3. Biomass Dryers: This initiative was conceived by seed division for economic upliftment and empowerment of livelihoods of women through food processing involving biomass based tray dryers in North and Northeast India. The project is being implemented at Himachal Pradesh, Uttarakhand, Assam etc.

Other Individual Projects: Numerous sustainable technology models have been developed/are being developed in the fields of agro – processing, aquaculture, sericulture, horticulture, medicinal/aromatic plants, animal husbandry, occupational hazards, health, construction, energy, management of natural resources, rural development, rural industry, rural engineering, micro enterprise, sustainable agriculture, etc. in coordination with reputed institutes/organizations/NGO's to empower women for sustainable livelihood through science and technological interventions.

Sustainable agriculture envisages use of less chemicals and more of organic inputs. Composting is one of the oldest methods of preparation of organic manure. Vermicomposting is the use of earthworm for composting of organic wastes. The beneficial role of vermicompost in crop production is well documented. But the information on enriching vermicompost with biofertilizers is meager, which was contemplated under a project “Value Addition to Vermicompost through Microbial Inoculants”. Vermicompost was enriched with nitrogen fixing bacterium *Azotobacter chroococcum*; the P solubilizing organisms *Serratia marcescens* and *Aspergillus awamori* separately; and the Zn solubilizing fungus *Aspergillus* sp. at 20% and 25% moisture levels and stored at room temperature. The variation of population for different species in the vermicompost at 20% and 25% moisture levels at different days of incubation is shown in the following graphs.

The results showed that the population of *Azotobacter chroococcum* was 3.3×10^5 /g at both moisture levels. The population increased steadily up to 45 days to reach 58.6 and 47.3×10^5 /g at both the moisture levels and declined later to reach 0.3 and 1.0×10^5 /g at 20 and 25 % moisture (Fig. 5.36a). The initial population of *Serratia marcescens* was 2.0 and 6.3×10^5 /g at 20 and 25 % moisture levels. It increased steadily to reach 62.6 and 85.3×10^7 /g on 120 days of storage. Thereafter a slow decline is being observed. The population was 57.0 and 72.0×10^5 /g on 180 days (Fig. 5.36b).

For the Zn solubilizing fungus *Aspergillus* sp. the initial population was 9.0 and 11.0×10^7 /g at 20% and 25% moisture of the substrate. The population steadily increased to reach the highest value of 56.6 and 68.0×10^7 /g on 90 days and the population decreased slowly thereafter. The population on 180 days was 20.6 and 52.0×10^7 /g respectively at 20% and 25% moisture level (Fig. 5.37a). The initial population of the phosphate solubilizing fungus *Aspergillus awamori* was 8.6 and 12.3×10^7 /g at 20% and 25%

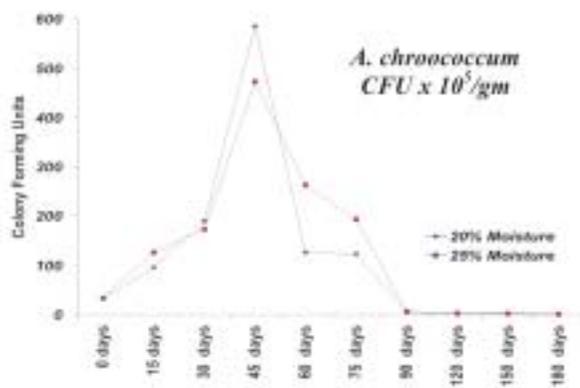


Fig. 5.36a

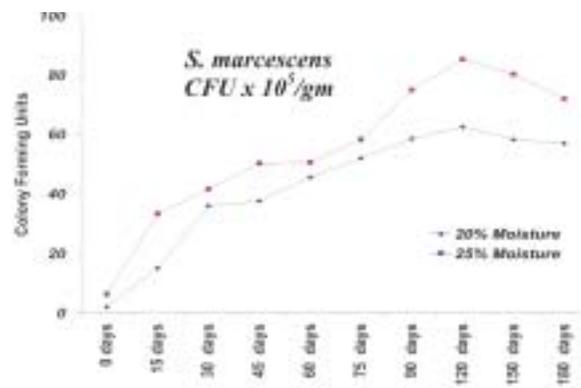


Fig. 5.36b

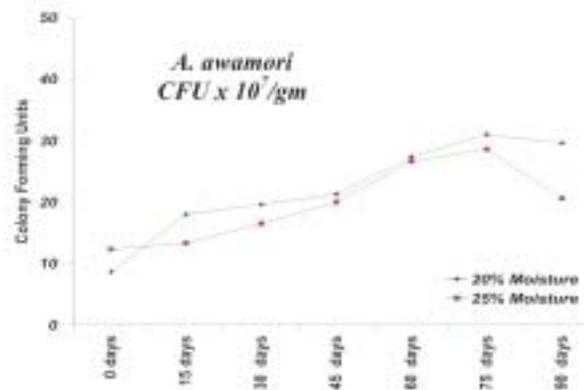
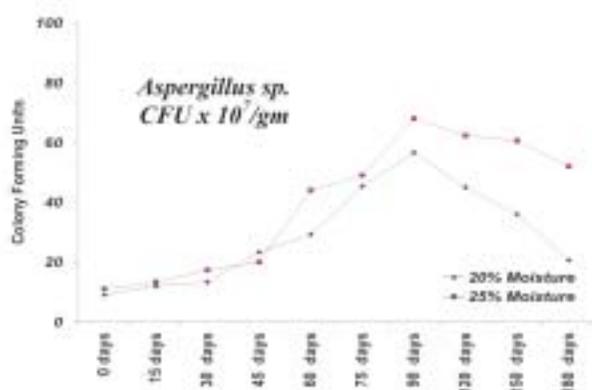


Fig. 5.37a & 5.37b. Variation of population for in *Aspergillus sp.* & *Aspergillus awamori* in the vermicompost at 20% and 25% moisture levels

moisture levels. The population steadily increased up to 75 days and then showed a slight decline. The population was 29.6 and 20.6×10^7 /g at 90 days of storage (Fig. 5.37b).

Azotobacter chroococcum showed a growth rate of 2-3 folds for a period of 45 days, which indicates the suitability of the substratum for nutrients and space. Beyond 45 days the “environmental conditioning” caused by saturation of the population has shown a negative effect on population. This indicates the requirement of more substrate or use of alternative carbon rich resource like coir pith along with vermicompost to maintain steady state of the population and shelf life for extended period of 180 days. The present results suggest that unamended vermicompost as such can be used for enriching biofertilizer organisms like *Serratia marcescens*, *Aspergillus sp.* and *Aspergillus awamori*. Results also clearly bring out that 25% moisture supports biofertilizer organisms, except *A. awamori*, at 20% moisture.

Besides above, projects were taken up in the field of aquaculture including ornamental fish for transfer of technologies, technology demonstration and specific interventions for enhancing the livelihood of women in the coastal areas. Under a project “**Backyard hatchery for marine ornamental fish breeding: An alternative livelihood option for rural women development**” executed at Centre of Advanced Studies in Marine Biology, Anna University, The project team successfully developed brood stock for twelve species of damsel fishes, out of which spawning and juvenile production was achieved for eight species using estuarine water. This was the first attempt made in the country. The technology can be extended to regions, other than coastal areas like backwater, mangrove and estuarine areas also. Different hatchery

technology packages according to the takers, interest were developed in addition to a low cost, under water filtration set up which will help the entrepreneurs to maintain water quality in the tanks with least expenses.



Fig. 5.38: View of the Demonstration Tank and Filtration Set Up at Annamalai University

An artificial feed using locally available raw materials and methodology for treating the infected fishes with coastal herbal extracts has also been developed which will be very much useful to maintain the aquariums without antibiotics.

Apart from developing various technologies, around 150 coastal rural women were trained on backyard hatchery production of damselfishes which enabled them to enjoy the benefits of eco-friendly aquaculture. The beneficiaries were also helped to establish a small scale backyard hatchery with the financial support of subsidized loans for their regular income.



Fig. 5.39: View of the training, demonstration to women and larval rearing systems

- 2. Women Technology Parks:** The Women Technology Parks are envisaged to act as a resource centre where all necessary support is made available to women from a single platform for technology sourcing thereby improving the socio-economic quality of life. Women Technology Parks act as a window for providing information, creating awareness, giving training for appropriate technologies leading to skill up gradation and also possibly to help establish the all 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. Twenty Women Technology parks have been facilitated in the States like Andhra Pradesh, Arunachal Pradesh, Assam, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Pondicherry, Rajasthan, Tamil Nadu, Uttaranchal, West Bengal etc. These parks showcase technology options, backward and forward linkages to rural women for income generation activities based on local resources. Technology areas, addressed are post harvest processing, soil fertility management, medicinal plant

cultivation and semi processing, nursery techniques, aquaculture, energy, occupational health etc. A women technology park has been initiated at TIDE Bangalore during the year 2010 – 2011.

3. National Award for Women’s Development through Application of Science & Technology:

This award has been instituted to recognize the contributions of individuals/institutions who have worked at the grass root level for women’s development through application of science and technology. This prestigious award is announced every year which comprises of a memento, a cash prize of Rs.1.00 Lakh for individual and Rs. 10.00 Lakhs for institution with citation. The recipients of this award for the year 2009 are Dr. Seema Bhadauria, RBS College, Agra in individual category and Society for Rural Industrialization, Ranchi in Institutional Category. This award has been given to them for their outstanding contribution in the field of economic and social empowerment of women in rural areas through gender specific S & T interventions respectively.

4. Scholarship Scheme for Women Scientists (WOS)

WOS – A : For Research in Basic & Applied Sciences: In 2002, Department of Science and Technology has started ‘Women Scientist Scheme- A (WOS-A)’ with aim to provide opportunities to women scientists and technologists who had break in their careers for pursuing research in frontier areas of Science and Engineering.

Since its inception, the Department has received 4974 proposals against which 1045 projects have been supported in different disciplines - Life Sciences: 584, Chemical Sciences: 156, Physical and Mathematical Sciences: 142, Engineering Sciences: 106, Earth and Atmospheric Sciences: 57. The 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 the aim of the scheme.

This year the Department received a total of **553** new proposals (Life Sciences – 355, Chemical Sciences – 72, Physical and Mathematical Sciences – 61, Earth and Atmospheric Sciences – 14, and Engineering Sciences – 51) against which a total of **191** projects have been sanctioned this year. The subject-wise distribution of sanctioned projects was: Life Sciences – 118; Chemical Sciences – 21, Physical and Mathematical Sciences – 31; Earth and Atmospheric Sciences – 3; and Engineering Sciences – 18. The last year trend indicates approx. 35% approval rate.

Proposals Received during 2010-11

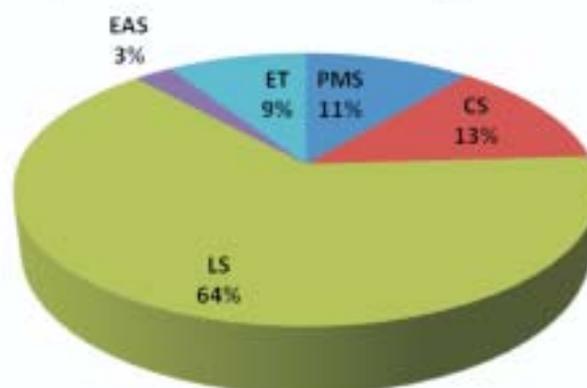


Fig. 5.40

Projects Sanctioned during 2010-11

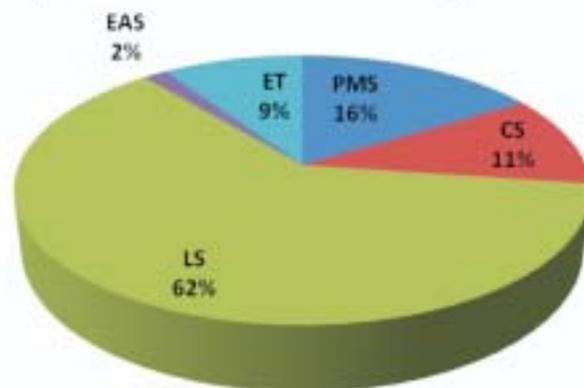


Fig. 5.41

During the year, the Department has also monitored 112 ongoing projects funded under this Scheme. Out of these, 10 were graded very good, 28 – good and 40 were graded as satisfactory.



Fig. 5.42

Sensitization Workshops became very good practice in WOS-A scheme to encourage and mentor the women with break in career for pursuing research. This has proved to be a very effective tool in generating research proposals from such women scientists. This year Department has organized Sensitization Workshops at various places viz.- (i) Jawaharlal Nehru Technological University, Kakinada, (ii) CEPT University, Ahmedabad, and (iii) CR Rao Advanced Institute of Mathematics, Statistics and Computer Science, Hyderabad.

Analysis of overall performance indicates that these women scientists have contributed more than 500 research papers in the kitty of country's total research publications. Not only this, approximately 30% of the awardees have got employment in universities and national labs – a significant addition to the scientific workforce of the country.

WOS-B for Societal Programmes: This scholarship is specially intended to motivate women scientists to contribute to the development of the country through (i) research, development and adaptation of technology for improving the quality of life and provide additional opportunities for income generation in urban slums or rural areas. (ii) Adaptation and transfer of an innovative technology

form laboratory to field in rural areas. Under the scheme, projects will be considered from the scientist in areas of science, engineering or medicine.

The minimum essential qualifications are PG degree equivalent to M.Sc in basic or Applied Science, B. Tech in Engineering Science and MBBS or other equivalent professional qualifications. The desirable qualifications are PhD in Basic or Applied Science, M.Tech in Engineering Science and MD/MS, DM/MCH in Medical Science from recognized Universities. Cut off age for the candidate is 50 years. The candidates should also have working experience and linkages with the relevant organization to carry out research on R&D projects of societal relevance.

Under this scheme, 32 projects have been supported in the year 2009-10. In one of the project, study was undertaken on *Incidence and Aetiology of Neonatal Sepsis in Rural Institution* at Institute of Post Graduate Medical Education & Research, Kolkata to assess the incidence and aetiology of neonatal sepsis in rural institution setting.

The specific objectives of the project were:

- a. Determination of incidence & causative organisms of neonatal sepsis in a rural institutional setting.
- b. Study of feasibility of centralized Microbiology lab for processing critical samples from periphery.
- c. Development & testing of a transport system for the same.
- d. To convey results in a timely and efficient manner in order to ensure early & appropriate treatment.
- e. Framing a rational antibiotic policy for rural centre.

Under this project, feasibility of developing a system of transport of critical culture samples from peripheral unit to central lab is studied. Experiments have been carried out with several prototypes for transport systems.

WOS-C Scholarship Scheme in the area of IPR: The WOS-C scheme of DST is being coordinated and implemented by the Patent Facilitating Centre (PFC) of TIFAC on behalf of DST since its inception in the year 2002. Under this scheme the selected candidates are trained for one year in the area of IPR, mainly patents. The scheme is being carried out at four different centres, namely Patent Facilitating Centre (PFC) of TIFAC, New Delhi, Centre for International Cooperation in Science (CICS- former CCSTDS), Chennai, Indian Institute of Technology, Kharagpur and Unit for Research & Development of Information Products (URDIP), CSIR, Pune.

About 230 women scientists have been trained in five batches. Out of these 230 candidates, 98 candidates have successfully cleared the Patent Agent Examination conducted by the Patent Office of India. For clearing this exam, these candidates have received a cash incentive of Rs. 10,000/- also. 80% of the women scientists who have received training under this scheme are now well placed and are pursuing their career in the area of IPR. PFC helps the scientists in tracking and establishing gainful engagements in the area of IPR after they complete their one year training.

The selected candidates are given a monthly scholarship based on their qualification during the one year period. There has been a revision in the amount of the scholarship received by the candidates. The scholarship for the candidates having post graduation degree (M.Sc.) or equivalent has been revised from earlier Rs. 10,000/- to Rs. 12,500/- per month. Similarly the scholarship for the candidates having doctorate degree (Ph.D.) or equivalent has been revised from earlier Rs. 15,000/- to Rs. 17,500/- per month.

The training for the 84 candidates of the fifth batch completed in May 2010. The training for the sixth batch started from May 10, 2010 and is still going on. Seventy three (73) candidates were selected under the sixth batch in all the four centres. A common five week orientation programme for the candidates of all the centres was organized by PFC at New Delhi from May 10 to June 11, 2010. The orientation programme was a very exhaustive programme on IPR. Lectures on different aspects of IPR were delivered by eminent people in the area of IPR. During this one month, the candidates were exposed to various facets of IPR like patents, copyright, trademarks, designs, plant variety and geographical indications. They were also made aware about the subjects like IP management, preparing technology scan reports, international treaties on IPR, filing procedures, drafting of various IP applications, procedures of the IP offices of India and other countries. Many sessions in this programme were dedicated to provide hands on training to the candidates on patent searches. The candidates were introduced to different databases on patents like USPTO, ESPACE, EKASWA, STN, MICROPATENT, IPSCORE and many others. Some new features were introduced in this programme which included lectures on Indian legal system, basics of computers, technical writing and communication, surprise tests and an IPR quiz. There were many interactive sessions as well where candidates were asked give presentation on various topics.

After the programme, the candidates were placed as interns with patent attorney firms, IP departments of government agencies, MNCs and Patent Information Centres (PICs). Some candidates left the programme in between due to their personal reasons. Their training will conclude on May 19, 2011.

After few months of their internship were over, the candidates were exposed to another two-day workshop on patent drafting. This workshop was held at on September 13-14, 2010 at Chennai centre, at Kharagpur centre on October 30-31, 2010 and at Delhi centre on December 11-12, 2010. In this workshop, the candidates were exclusively trained in practical nuances involved in patent drafting.

The preparations for the selection of the seventh batch have already started. The advertisement for inviting applications was brought out on November 20, 2010 in the Employment News, the Times of India, the Sakal, the Hindu and the Anand Bazaar Patrika. We have received around 3900 applications in all the four centres. The written examination will be conducted simultaneously at the four centres on February 20, 2011. The training for the seventh batch is expected to start in May 2011.

SCIENTIFIC SERVICES

The Department of Science and Technology offers a diversity of scientific services through Survey of India (SOI), National Atlas and thematic Mapping Organization (NATMO), Technology Information Forecasting and Assessment Council (TIFAC), Vigyan Prasar (VP), National Science and Technology Management Information System (NSTMIS), National Accreditation Board for Laboratories (NABL) and Good Laboratory Practice (GLP).

While the Survey of India provides base maps for integrated development of our country, NATMO is a premier organization in the field of preparation of thematic maps, educating people of India about the changing scenario of the political, social, economical & cultural set up of the country and helping the planners to use the maps as development tools for resource mobilization at grass root level.

TIFAC, an autonomous institution of DST supports programmes such as Technology Refinement & Marketing, Collaborative Automotive R & D and National missions (eg. Geospatial Applications, Bamboo Applications etc.) and also supports a Patent Facilitating Centre, thus creating awareness about intellectual property rights (IPR) in the country. VP handles activities pertaining to communication of science and technology, while NSTMIS is involved in collection of data on resources devoted to research and development in the country.

NABL and GLP are linkages of laboratories and test facilities in the country with regulatory authorities. On one hand, NABL implements and maintains an accreditation system for laboratories in accordance with the relevant national and international standards such as International Laboratory Accreditation Cooperation (ILAC), Asia Pacific Laboratory Accreditation Cooperation (APLAC), while the National GLP Compliance Monitoring Authority is responsible for compliance monitoring of GLP test facilities in the country in accordance with the OECD Principles of GLP, so that the safety data generated by Indian test facilities on chemicals is accepted world-wide.

SoI as well as National Resource Data Management System (NRDMS) have offered valuable Geospatial technology services. New Data policy for improving access and sharing has been developed and the revision of map policy has been undertaken. NABL has expanded its service potentials. There is 14% annual growth of services rendered and revenue gained. NABL has gained self-sustainability with respect to revenue expenditure. Indian entry into Good Laboratory Practice (GLP) is now made tangible.

TIFAC has mounted an initiative to establish a revolving fund for supporting Home Grown Technologies and prepare a Technology Vision 2035 for the country through participative and consensus based approach.

SURVEY OF INDIA

Survey of India, under the Department of Science & Technology bears a special responsibility to ensure that the country's domain is explored and mapped suitably to provide base maps for expeditious and integrated development and ensure that all resources contribute their full measure to the progress, prosperity and security of our country now and for generations to come.

In the emerging information marketplace, geographic or geo-spatial information occupies pre-eminent position. In fact, the use of high quality, reliable, geo-spatial information is critical to virtually every sphere of socio-economic activity – disaster management, forestry, urban planning, land management, agriculture and infrastructure development etc. Survey of India is providing base maps, geographic and geo-spatial information to user community.

SCIENTIFIC RESEARCH

Antarctica Expedition

Initiative

A network of well distributed precise control points is essential for carrying out mapping or location based research activities, Survey of India started participation in Indian Antarctica Research Programme from 10th **Expedition, 1990-91** and started providing a network of Ground Control Points, mapping for scientific studies in Schirmacher Oasis, Antarctica. Geodetic and Geophysical observations were made using theodolites, EDM instruments, GPS and other Surveying equipments for providing a network of **Ground Control Points**.

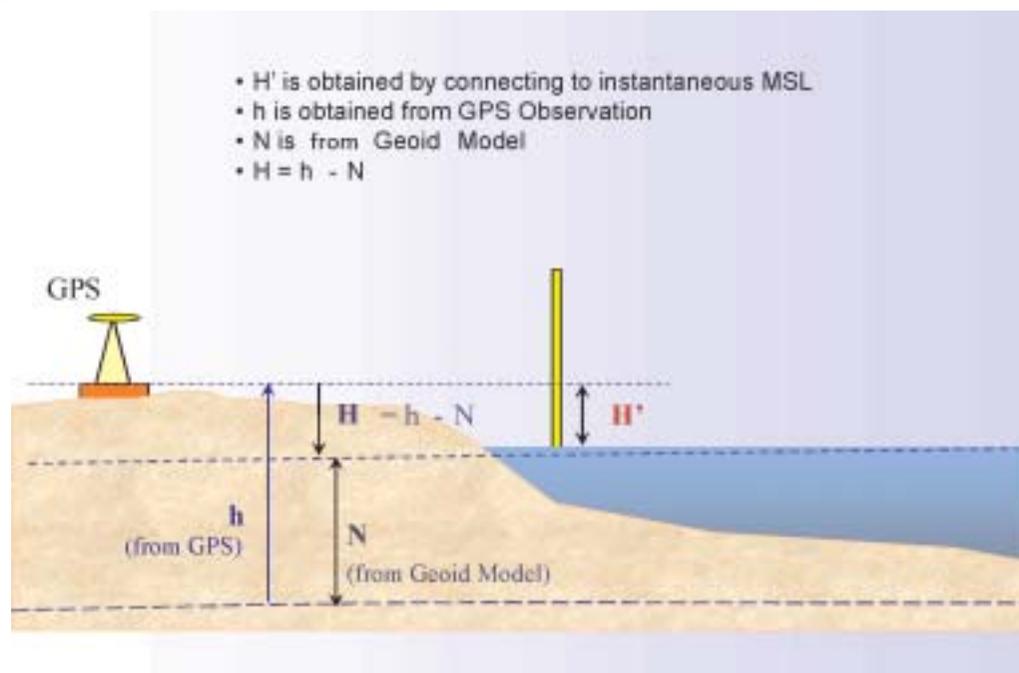
Achievements

18 Planimetric control points in WGS84 datum were established in Schirmacher Oasis and surrounding area using Ashtech dual frequency GPS Receiver.

Heights of the stations were provided in two different ways:

- (a) Connecting to Instantaneous Mean Sea level.
- (b) Computing ellipsoidal height from GPS and then subtracting the Geoidal Undulation from OSU86D Global Geopotential

In addition, gravity measurements were also made on all control points established through GPS techniques.



All these activities were carried out in view of providing basic control as well as further studies for Crustal Movement or Glacier Movement.

During the 29th Indian Scientific Expedition to Antarctica 2009-10, mapping of 3.5 square km and total up to date more than 20 square km on scale 1:5,000 with 5 metre counter interval at Schirmacher Oasis, has been completed. The area around Maitri has also been mapped on 1:1,000 scale.

HUMAN RESOURCES FOR INDIAN S&T ADVANCEMENT

Various training programmes round the year are conducted by the Indian Institute of Surveying & Mapping (IISM), the capacity building arm of SOI to train the officers and staff of the Department, other Central and State Government Departments, and trainees from foreign countries sponsored by the Government of India.

35 Basic/Scheduled courses including 04 Advance courses on various training programmes during the year were conducted during the year and 511 trainees underwent such courses. 371 officers nominated by various Scientific/professional organizations and 27 Engineering students participated in 22 special courses designed specifically by IISM. Special efforts were made to conduct short term courses for dissemination of new technologies and creation of map awareness amongst public in general and scientific community.

18 foreign nationals sponsored by the Royal Government of Bhutan and 03 foreign nationals sponsored by Oman were among those attended the scheduled courses during the year.

TECHNOLOGY DEVELOPMENT PROGRAMMES

Dual Map Series

Initiative

Over the years, Survey of India has produced a rich “base” of map information through systematic topographical surveys and the use of remote sensing images. Further, the availability of high resolution satellite images for updation of old data base, Global Positioning System (GPS) for providing control and integrable data from other sources in GIS environment enhances the utility of these data sets.

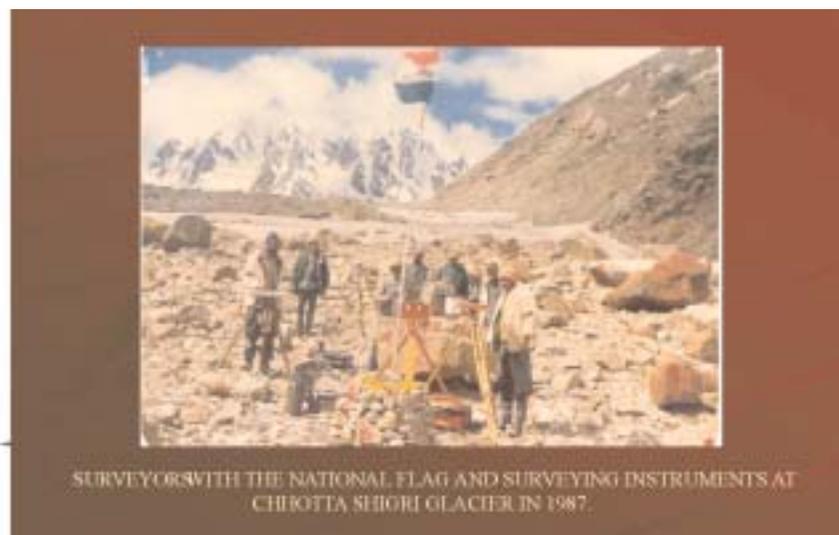


Fig. 6.1

In order to meet the demand from the users' community not only for free access to map data but also for the latest updated and higher resolutions data sets, Survey of India has generated two series of maps –

1. Defence Series Maps (DSMs), which will mainly cater for defence and national security requirement. These series of maps (in analogue or digital forms) for the entire country will be classified.
2. Open Series Maps (OSMs), which will be brought out exclusively by Survey of India, primarily for supporting development activities in the country. Each of these OSMs (in both hard copy and digital form) will become unrestricted after obtaining a one-time clearance from the Ministry of Defence.

Achievements

1. 1:50,000 scale topographic data.
 - a) Survey of India has completed updation of digital data base pertaining to 4,498 sheets from field verified data. Field updation of map data has been completed for 4507 sheets.
 - b) Transformation of 4409 sheets, Patterning of 3256 sheets and printing of 1079 sheets from updated digital data base on 1:50,000 scale pertaining to OSM have been completed.
 - c) Transformation of 3293 sheets, Patterning of 2102 sheets and printing of 300 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	= 12,223
Sheets published in hard copy form	= 7,987
Sheets digitised so far (in soft copy form)	= 6004

Tidal Data

Initiative

Survey of India (SOI) is the only agency having the mandate for monitoring and analysis of sea level changes and its associated impact along Indian coastline and islands since 1877. SOI took leadership in the contribution for determination of MSL and providing accurate tidal predictions for safe commercial navigation, sea level development work and for strategic planning with our traditional Indian tidal network.

Now SOI has equipped the maximum tide gauge stations with digital tide gauges co-located with GPS receiver to monitor sea level variation and crustal movement. Real time data communication facilities have been established at National Tidal Data Centre, Dehradun as well as at several remote locations along Indian coastline and Islands.

Achievements

Tidal data received from the remote locations is being analysed in real time at National Tidal Data Centre, Dehradun. This data is also being mirrored to National Tsunami Warning Center, INCOIS, Hyderabad on real time for further analysis and issuance of alert/ warning in case of extreme events like tsunami and storm surges taking place in the region. This will facilitate timely evacuation of public from tsunami and storm surge hit areas. Data is also being provided to BARC, Mumbai on real time for safety

of their vital installations. The above data is also being utilized for determination of Mean Sea Level and Tidal analysis for improved tidal predictions.

Tidal data and GPS data will provide a basic tool for various scientific studies related to sea level variations and crustal movements.

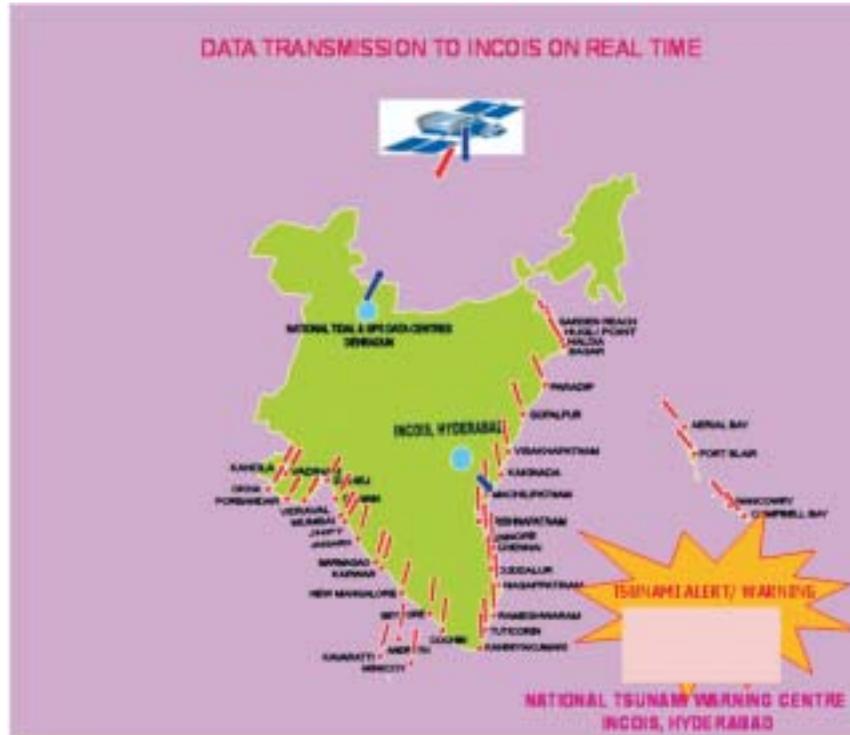


Fig. 6.2

Gravimetric and geomagnetic control network

Initiative

Survey of India also has the responsibility to provide and maintain the Gravimetric and Geomagnetic control network of country.

GRAVITY: The Gravity observation is carried out by Survey of India for execution of departmental programme of 15 km gravity mesh, Gravity observations along selected profiles as and when required, Gravity observations along levelling lines and for Computation and study of various gravity anomalies .

Achievements

At present, there are 56 standard gravity stations in the country which are being used for densification work. Gravity observations are used for measurements of height above vertical datum (i.e. geopotential number), Geodynamic studies & Development of Geoid Model for India.

High Resolution Gravimetric Geoid Model has been developed for Delhi area and is under testing. However it is under development for the other areas.

Survey of India also provides Gravity values and true North at Satellite / Missiles launching sites and Airforce stations etc.

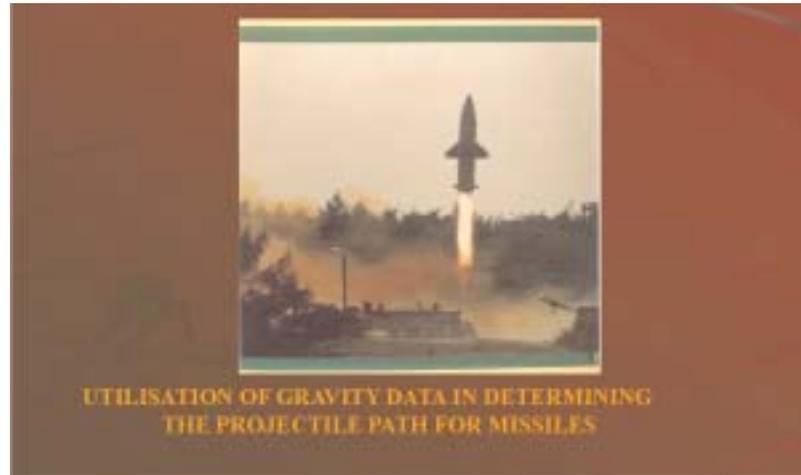
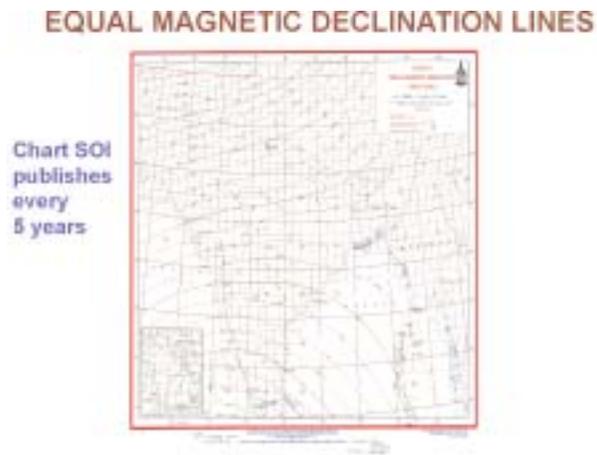


Fig. 6.3

Geomagnetic: The Geomagnetic Observations all over the country are being performed for development of Geomagnetic Model of Earth, preparation of Geomagnetic Anomaly Maps, Geomagnetic Observations of Horizontal Force (HF), Vertical Force (VF) and Declination (D) at Magnetic observatory, Sabhawala to determine total force.



Geomagnetic Observatory, Sabhawala



Ervimag PPM Magnetometer



Digital Fluxgate Magnetometer

Fig. 6.4

Achievements

Survey of India carried out observations at 183 repeat geomagnetic stations for secular variations, preparation of declination chart once in 5 years and Chart for Horizontal force & Vertical force is published every 10 years. The major users are Defence Forces, Airport authority and topographical units of the department.

The data is collected at magnetic observatory, Sabhawala throughout the year for publishing Magnetic Bulletins and data is also supplied to IIG, Mumbai etc.

Sabhawala Magnetic Observatory has been upgraded to Digital Geomagnetic Observatory. Fluxgate Digital Magnetometer has been procured and installed in it.

National standardized control framework

Initiative

Survey of India is establishing a net-work of standard ground control points spread 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 well spread 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. In the third phase, it will be further densified to 65,000 GCPs connecting all the tri-junction village boundary pillars available on the ground.

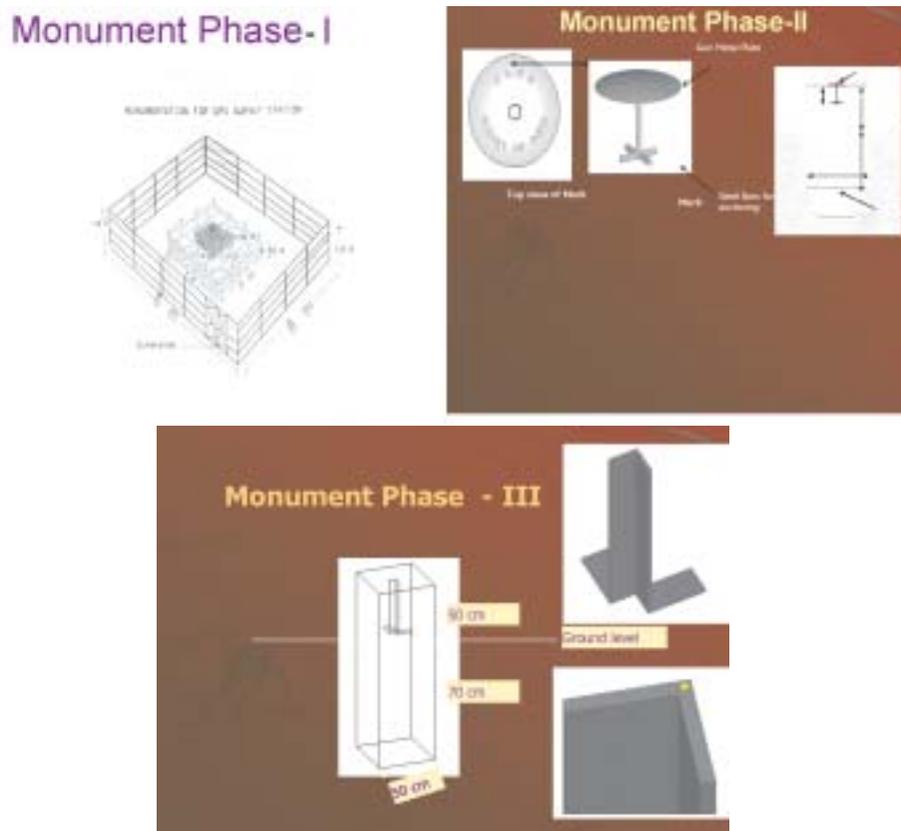


Fig. 6.5

Achievements

Survey of India has already completed the observation at 300 Ground Control Points (GCPs) covering the entire country in 1st phase. Densification of first order network at a spacing of 30 to 40 km. apart is under progress.

Reece/ Site selection of 2149 points, construction of 2124 pillars and GPS observation at 882 stations have been completed so far. Processing & adjustment of GPS data for GCP Library Phase-II in M.P., U.P., Bihar, Maharashtra and Gujarat state is completed.

International science and technology cooperation

Survey of India represents at various International conferences/Seminars to promote the growth of Surveying and Cartography and to introduce the latest technology for optimum results. 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 vide DST 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 (NSTTMIS)

Mapping and Delineation of Hazard Line

Initiative

To ensure effective protection of shore lines, coastal infrastructure, livelihoods and lives through improved coastal management a Coastal Management Program undertaken by Ministry of Environment & Forest (MoEF) and entrusting the work of supplying a requisite coastal data and vulnerability mapping,(involving hazard line demarcation of coastal areas) to Survey of India through its Integrated Coastal Zone Management (ICZM) Project.

Hazard line will be based on two sub-components, one is the rate of coastal displacement (**Erosion line**) and other is Coastal inundation level due to natural factors like tides, storms, surges and cyclones (**Flood line**).

Achievement

By it's more than 240 year of experience in national surveying and mapping, Survey of India, the national mapping agency of India possesses the necessary expertise, infrastructure to carry out such massive project.

Methodology: to draw hazard line - erosion line

The coastal line is drawn from the oldest data available with SOI. For this purpose, the maps of 1:50K scale will be used. New coastal line is drawn from the latest geocoded satellite imagery and difference of both is found out. The difference is extrapolated to say for next 100 years and extrapolated line is Erosion line

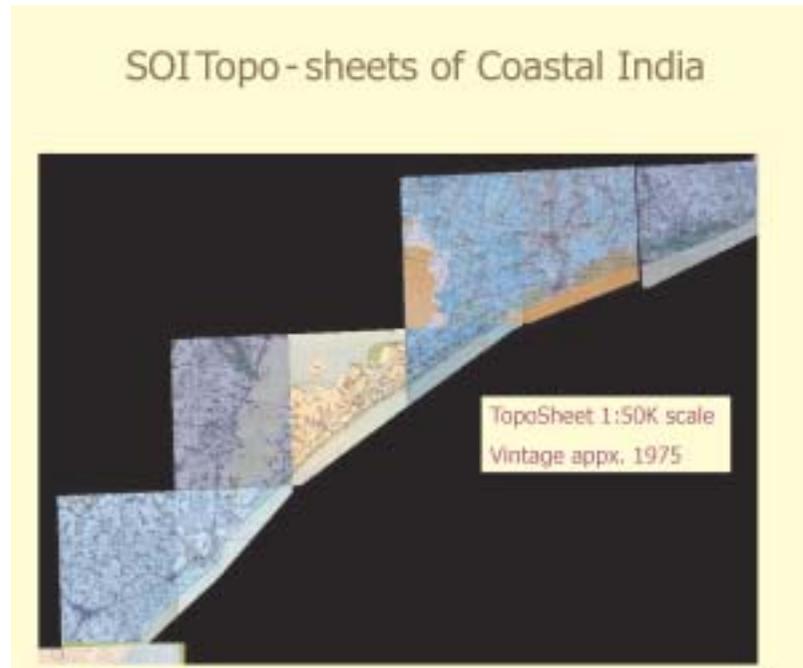


Fig. 6.6

Methodology: to draw hazard line - erosion line- inundation level:

Survey of India observes tidal data for more than 100 years at various tidal stations at each hour. Max water level from each tidal station will be taken (as agreed to for last 30 yrs). The max water level from each tidal station will be taken. This value of max water level will be superimposed to the DEM of the coastal area. This will give the Flood line and it will give the max coastal flood level line

Hazard Line



Fig. 6.7

The work is under progress to demarcate the coastal hazard line all along the mainland coast of India. Tidal data pertaining to 40 years (as available with G&RB) for extraction of maximum annual elevation and extra-pullation for 100 years pertaining to 20 various ports (converted to MSL heights as compiled by G&RB) has been supplied to MoEF. DT Levelling and GPS observation for provision of control framework is under progress.

Coal Mine Project

Initiative

Survey of India is going to generate up-to-date digital topographical maps of Major Indian Coal fields covering an area of 26,400 sq.km. in five years time in collaboration with Central Mine Planning & Design Institute, a subsidiary of Coal India Limited using aerial photographs and adequate ground checks.

To generate the Topographical maps of the major coalfields on 1:5000 scale with 2 meter contour interval in Plains (in case of hilly terrain contour interval may be 3-5 meter as practical) in GIS digital format based on Digital Photogrammetric Techniques using high resolution aerial photographs and adequate ground verification.

Survey of India also impart on-job training on data processing and interpretation to 4 scientists of Central Mine Planning & Design Institute for three months at the initial stage on preparation of Topographical maps based on aerial photographs using digital photogrammetric technique.

Achievement

The Vector Shape Files in .dgn format in respect of 10 Coal Fields (Priority – 1 area) (Bisrampur, Lakhanpur, Korba, Chirimiri, Sonhat, Sohagpur, Talcher, Hasda, Arand,, I.B. Valley & Mand–Raigarh) has been completed and send to NRSC for aerial Photography.

Field for providing control point (Plan & Height) is under progress.

Urban Mapping for NUIS

Initiative

The Ministry of Urban Development (MOUD), hosts the National Natural Resources Management System (NNRMS) Standing Committee on Urban Management (SC-U) and the proposal to develop holistic National Urban Information System (NUIS) Scheme was mooted by the SC-U to be taken up in a National Mission Mode. 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 1:1,000 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 Allahabad City for Thematic Mapping

MERGE PRODUCT (2.5 RESOLUTION) OF P5 (2.5 RESOLUTION) & P6 (5.8 RESOLUTION)



Fig. 6.8

Achievement

Databases on 1:10,000 scale – Survey of India has supplied Geo-referenced Satellite Imagery of 148 towns to National Remote Sensing Center (NRSC) for Thematic mapping and 140 has been accepted by them. Thematic mapping of 97 towns have been completed and final product of 85 towns has been sent to state nodal agency.

Databases on 1:2,000 scale - Aerial photography of 103 towns have been received and scanning of 101 towns have been completed. Control points of 85 towns have been completed and for 16 towns are under progress. 2D Feature extraction of 60 towns has been completed so far.

Ground Survey of 6 towns, using Total Station has been completed while Ground Survey of 1 town is under progress.

Security clearance of 43 towns has been obtained from GSGS and data has been sent to State Nodal Agency.

Databases on 1:1,000 scale (GPR Survey) - Job awarded to M/S Eaga energy Pvt. Ltd. and work is under progress.

Delhi State Spatial Data Infrastructure (DSSDI) Project

Initiative

Survey of India has to create Land Information System and central data base for all Govt. Department of Govt. of National Capital Territory of Delhi (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.

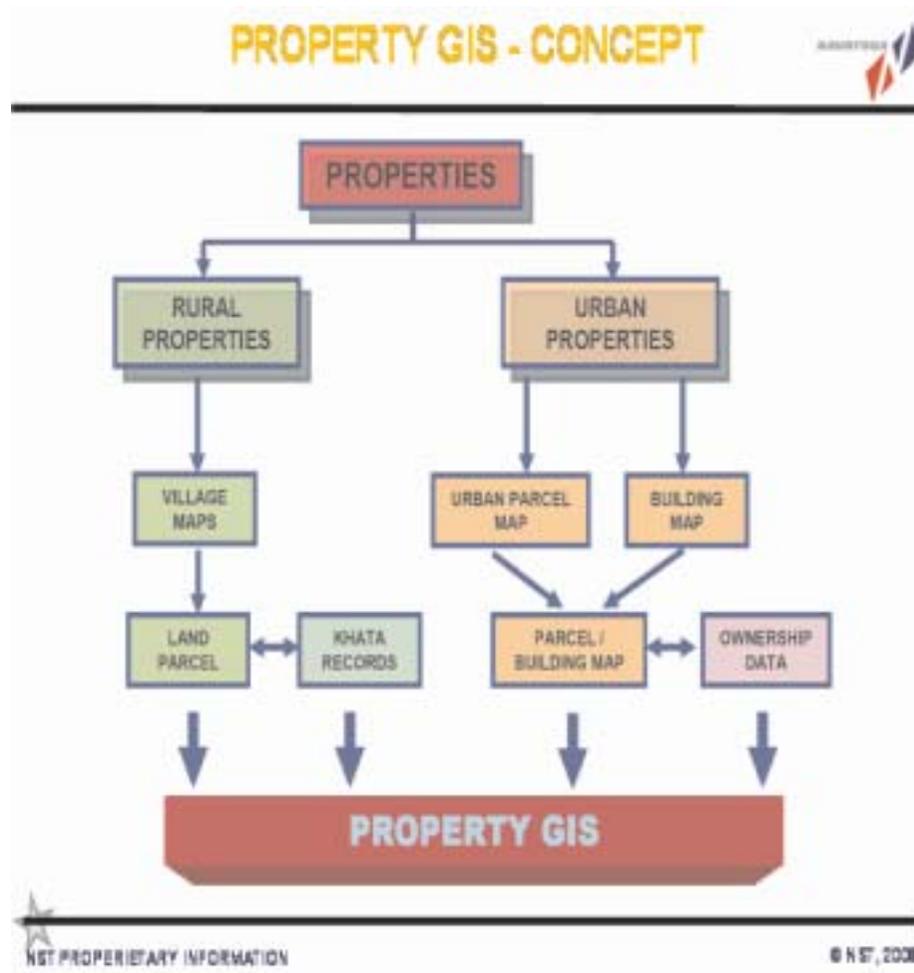


Fig. 6.9

Achievement

Extension of framework control, Aerial Triangulation, DEM generation and preparation of Ortho-photo had been completed. Installation, Testing, Integration and operationalisation of main control centres, monitoring centres are completed. Delhi Geo Portal for DSSDI project has been installed.

3D Feature extraction, Ground validation over ground utility survey & creation of topographical database had been completed. Property survey for property GIS, linking of property data with the buildings and Utility Mapping (Underground) are under progress and likely to be completed soon. 3D Topology generation completed for all 9 districts (1424 sq.km.) except restricted area.

GIS BASED MAPPING OF CITIES/TOWNS

Initiative

Survey of India has taken up a job for Registrar General of India to supply the digitized ward Maps with attached attributes. Initially 22 towns have been taken for the project. Each town is divided into Wards and further sub divided into Enumeration block (E.B.).

Ward map will be prepared on large scale (1:2000) and will be verified on the ground to collect the house number along with the other information in tabular form. When the maps are digitized (with attribute house number map), the digital ward is joined with the tabular information to give the digital data of ward with complete information.

Sample Ward Map of Itanagar Town

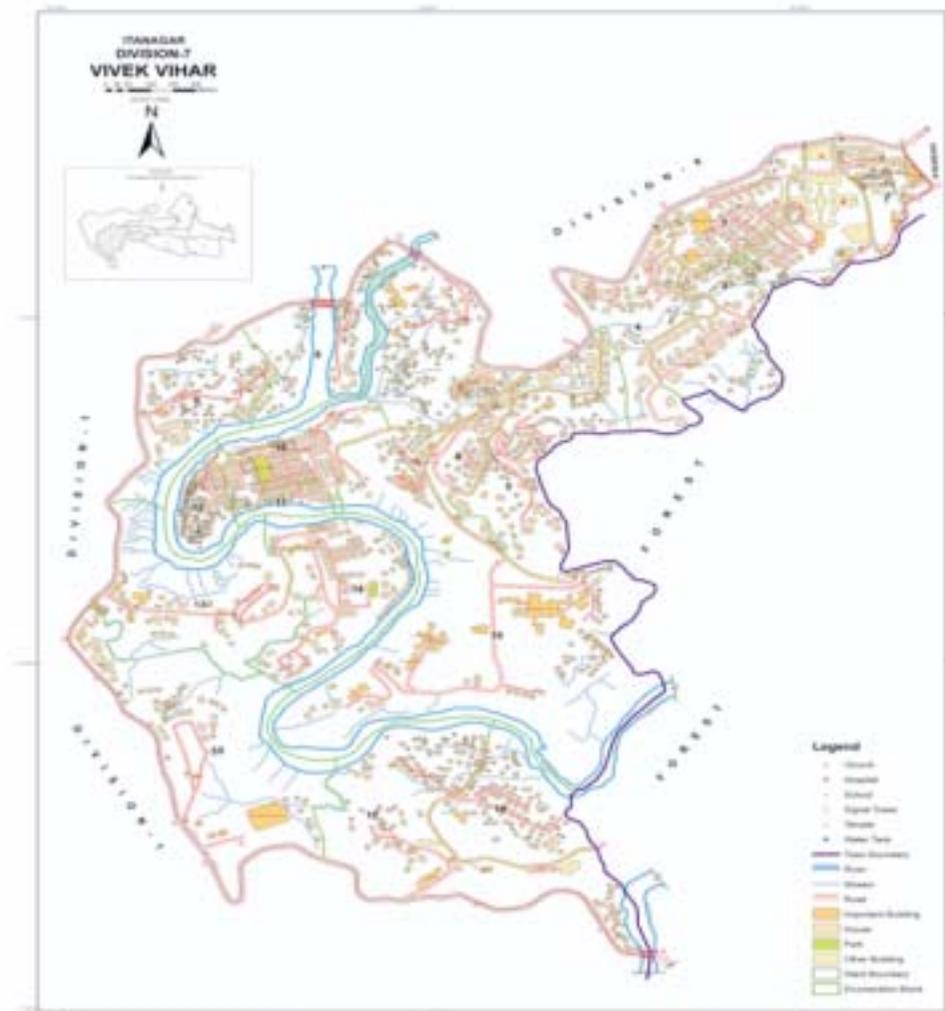


Fig. 6.10

Achievements

Survey of India has supplied high resolution satellite imageries of 22 capital cities to office of Registrar General of India for drawing ward boundaries and collection of requisite information from field. Digitisation

of Ward map of 1082 ward maps is completed so far and plots & digital data of 827 ward maps has been supplied to Registrar General of India.

Science and technology programmes for socio – economic development

(i) Topographical activities:

(a) Control Work:

- Traverse ... 864 linear km
- Levelling ... 1,536 linear km

(b) Surveys:

- Boundary demarcation(Indo-Pak) ... 212 linear km
- Boundary demarcation(Indo-Bangladesh) 771 linear km
- Joint demarcation /relocation of missing /
Joint demarcation, relaying & construction of
Boundary pillars (India – Bhutan) BP 24-50 & 75-83
- Verification surveys for IAF ... 15 Aerodromes

(c) Printing:

- Printing of various types of maps ... 1000 Maps

ii) Digitisation and creation of Digital Cartographic databases

- Departmental maps on various scales ... 801 Maps on 1:25,000 scale
- Extra Departmental maps on various scales ... 100 Project maps

iii) Geodetic and Geophysical surveys:

a) Geodetic surveys for monitoring of progress of various developmental projects are in progress.

b) During the year, Survey of India is committed to carry out the following tasks as departmental commitment:

- GPS observations - 594 stations
- Precision Levelling - 2024 linear km
- EDM Traverse - 50 linear km
- Gravity observations - 961 stations
- Installation of Tide Gauges - 12 Stations

Science and technology based services

The following projects based on latest available technologies have been taken up by Survey of India.

(a) 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.

- (i) Kashang Hydro Electric Power Project (Himachal Pradesh):-** Periodical Checking of Tunnel alignment Checking and Supply of Control data (Co-ordinates and BMs Hts.). Work completed in all respect and data has been supplied to indetor
 - (ii) Tidong H.E.P. Project (Himachal Pradesh):-** Supply of control data (Co- ordinates, BMs &Hts,) Work completed in all respect and data has been supplied to indetor.
 - (iii) Khauli H.E.P. Project (Himachal Pradesh):-** Supply of Control data (Co- ordinates, BMs &Hts,) & mapping on 1:1000 scale. Work is under progress.
 - (iv) Kadwan Project (Uttar Pradesh):-** Supply of Control data (Co- ordinates, BMs &Hts,) & Field verification. Work is under progress.
- (b) M.N.R.E. Project: - Survey of India** generates Digital Elevation Model (DEM) of entire country on 1:50,000 scale for Ministry of Non Conventional Resources Energy.
- (c) NRSC Project:- Survey of India** Converted Digital Topographical Data base of 2890 maps on 1:50,000 scale from DGN to Arc Geo data base and supply to National Remote Sensing Centre.
- (d) Special Survey for IAF /Air Ports :-** Survey of India carry out special survey for India Air Force and Prepares IAF(OGM), IAF (PGM) & Land Approach Chart (LAC) etc.

INTERNATIONAL SCIENCE AND TECHNOLOGY COOPERATION

Survey of India represents at various International conferences/Seminars to promote the growth of Surveying and Cartography and to introduce the latest technology for optimum results.

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 vide DST approved Project “Technology Transfer and In-house Capacity Building in Gravity and Magnetic Survey Work” for the Royal Govt of Bhutan.

NATIONAL ATLAS & THEMATIC MAPPING ORGANISATION

National Atlas and Thematic Mapping organization is a subordinate office under the administrative control of the union Ministry of Science & Technology (Department of Science & Technology), Government of India. The organization is headed by a Director and assisted by two Joint Directors, seven Dy. Directors, Twenty seven Group ‘A’ officers, thirty seven Group ‘B’ officers of Gazetted category, one hundred seventeen Group ‘B’ non-Gazetted officers, one hundred forty nine Group ‘C’ officers. The organization has a total strength of 400 till date which includes a large number of qualified professional geographers and Cartographers, perhaps the largest number under one roof anywhere in the world. It is a permanent government organization and premier organization in the field of preparation of thematic maps.

The main objective of organization is to educate people of India about the changing scenario of the political, social, economical & cultural set up of the country and to help the planners to use the maps as development tools for resource mobilization at grass root level. State atlases help in a big way for better

planning when resource data base is available in atlas form. Historical & cultural heritage atlases are the comprehensive cartographic record of historical and cultural heritage of India. To cope up with the demand from the users, atlases for visually impaired are being prepared to help blind persons to have a clear idea about India's physical, cultural and socio economic aspects. Electronic Atlas of India facilitates 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.

Functions:

- a) Compilation of the National Atlas of India in English and Hindi
- b) Preparation of National Atlas Maps in regional languages
- c) Preparation of thematic maps based on research studies on environmental and associated aspects and their impact on social and economic development.
- d) Any other work entrusted by the Central Government to NATMO
- e) Automated Mapping & Geographical Information System for increasing efficiency in mapping technology.
- f) Geographical/Cartographical research & training.
- g) Golden Map Service covering whole India.
- h) Development of Digital Cartographic Database for large-scale Thematic Mapping.
- i) Web-based National Atlas of India.
- j) Maps for Low Vision Persons.
- k) Maps for Visually Impaired.

TARGET AND ACHIEVEMENT FOR THE YEAR 2010 -11 (Up to 31st October, 2010) PROGRAMME

	Target 2010-11 by no. of maps	Achievements 2010-11 by no. of maps (Up to 31st October, 2010)
a. DPMS (Revision)	4 maps	2 maps
b. State Atlas of Jharkhand	10 maps	6 maps
c. State Atlas of M.P.	15 maps	9 maps
d. Special map	4 maps	2 maps
e. School Atlas for visually impaired (English) to be continued as per TIFAC (DST) Programmed on regular basis.	5 maps	3 maps

f. School Atlas for visually impaired in Assameese (to be continued on regular basis).	4 maps	2 maps
g. Electronic Atlas of India	5 maps	3 maps
h. Golden map Service	10 Scenes	6 scenes
i. Punjab State Atlas	8 maps	5 maps
j. Re-printing of National Atlas Maps	6 maps	3 maps
k. Revision of NATMO maps	4maps	2 maps

Key Achievements for 2010-2011

1. NATMO applied for National Award for School Atlas Visually Impaired Persons
2. Draft of NDMA report is submitted

Research, Development and Training:

Regular activities on research and development is a continuing job and 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 during the period.

Other activities done during the period:

- i) Several NATMO officials actively participated in many national conferences and seminars.
- ii) NATMO participated in regional, national and international exhibitions, book fairs to popularize the utility of the maps, atlases and data base of NATMO.
- iii) Database creation through GIS is in progress as an ongoing job.
- iv) NATMO maps in electronic media are an ongoing project and are also done during this period.
- v) Scanning, plotting as a part of extra departmental activity is also done for generating revenues.
- vi) As envisaged in the TIFAC (DST) activity, it was felt that maps and atlases should also be in regional languages for visually Impaired apart in addition to English and Hindi versions. As such the same has been initiated during this period in Bengali (with maps of West Bengal)

TECHNOLOGY, INFORMATION, FORECASTING AND ASSESSMENT COUNCIL

Technology Information Forecasting and Assessment Council (TIFAC) was established in the year 1988 under broad Grouping of among autonomous institutions of DST as Knowledge Service and Expert. Total number of employees in TIFAC is 80.

Important Highlights of 5 Major Research Programmes (2010-11):

Technology Refinement & Marketing Programme (TREMAM)

The Technology Refinement and Marketing Programme (TREMAM) was initiated with the objective of pushing innovative products / prototypes, up the commercialization cycle, towards market through a

network of Technology Commercialization Facilitation Agencies (TCFAs). During the year, the TCFAs network has been extended to seven and one more is under consideration. Thirteen new projects have been initiated this year so far, including side view mirror, novel florescent reagent, automatic cashew decorticating machine, dental / medical aspirator, non-electric water level indicator and sound wave airway sensor.

Agriculture Sector

Technological interventions from TIFAC have made significant impact on the farm productivity of demonstration areas in different parts of the country. Seed production of paddy, wheat and pulses through farmer cooperative were encouraged in the some parts of Bihar and Eastern Uttar Pradesh. In these areas farmers were also motivated and trained on cultivation of aromatic crops like mentha, lemon grass, vetiver, etc. as cash crops for better earnings through crop diversification programme. On farm technological demonstration in different parts of Varanasi district were conducted to bring down the insecticides / pesticide content in the cereals like paddy, wheat and vegetables. To cope up draught like situation in nine rice growing districts of Eastern Uttar Pradesh, Kalanamak (salt tolerant aromatic rice variety with black husk) was promoted in 160 acres of land. To promote organic farming, low cost techniques for the effective crop protection through Trichoderma formulations as one of the component of integrated pest management were demonstrated in Jaipur and Kota districts of Rajasthan in collaboration with Indian Agricultural Research Institute, New Delhi.

Agro Food Processing Sector

The sector envisages technology demonstrations & interventions to improve productivity, quality, value addition including extending shelf life, post-harvest processing and waste utilization through adoption of new technologies in the thrust areas of dairy & fishery. Two projects on frozen loins & steaks of yellow-fin tuna and value-addition of low value marine pelagic fishes in fisheries sector and a project on clean milk production value addition in tribal areas of Jharkhand in dairy sector have been undertaken.

Health Care and Herbal/ Natural Products

A product called Baco-Mind has been developed from *Bacopa monnieri* extract under the project “Standardization and international commercialization of *Bacopa monnieri* extract for its cognition enhancing activity” implemented at Bangalore. Project on Plasma Fractionation: Demonstration of Development and Commercialization of Plasma Products is aimed towards manufacture of low volume and high value virus safe plasma products through the process of fractionation at National Plasma Fractionation Centre under Research Foundation for National Blood Transfusion Services at Mumbai.

Bioprocess & Bioproducts Programme

The Bioprocess & Bioproducts Programme addresses critical technology needs for biotransformation & enzymatic processes towards development of active pharmaceutical ingredients, neutra-ceuticals, phyto-chemicals, bio-energy & bio-fuels. The projects on the biotransformation of chirally pure compounds as drug intermediates, enzymatic detoxification of jatropha seedcake along with the recovery of residual hydrocarbon, development of L-arginine from starch by fermentation etc. have been launched under the programme.

Technology Up gradation of select MSME clusters

The MSME program aims at providing R&D and technical support to select MSME clusters through an approach based on establishing and leveraging academia-industry interaction. A documentary film highlighting the best practices in foundry industry has been prepared and circulated to industries in the Howrah Foundry Cluster. The R&D innovation centre set up at the School of Bioscience and Engineering, Jadavpur under the Baruipur Surgical Instrument Cluster is reaching out with R&D support to the clusters.

India-International Institute for Applied System Analysis (IIASA) Programme

India-IIASA Programme facilitates collaborative research projects among scientists from Indian S&T organizations/academic institutions with IIASA researchers in the areas on mutual interests. The training workshops in specialized areas with a focus on modelling techniques are also convened under the programme. TIFAC in partnership with IIASA had also organized a two-day international workshop on *water resource management and sustainability* in September 2010.

Patent Facilitating Centre (PFC)

Decision was taken for filing fresh 37 patent applications in India. The fifth batch of the women scientists completed their one year training in IPR in May, 2010. The sixth batch of 73 candidates are getting trained in PFC and three other locations. An advanced training course on IPR for NAM and other developing countries was conducted in July, 2010. PFC also conducted a workshop on 'IPR & WTO' in September, 2010 which was attended by 20 scientists and technologists. Other activities, including awareness workshops, training programmes on IPR and handling of DRDO IP applications were continued.

Collaborative Automotive R & D (CAR)

The programme vision is to enhance energy security, environmental quality, economic growth and establish a competitive transportation industry in India. A detailed Technology Roadmap has been developed in order to help implement the programme. The Technology Roadmap comprises of (i) a list of technologies that are critical to the development of a world class automotive vehicle and parts industry, (ii) a list of experts in these technologies, and (iii) a prioritized list of R&D programs to be conducted in order to bring industry to world class technology status.

Collaborative Automotive R&D (CAR) has, from 2003 till now, been functioning as the country's leading R&D program involving many stakeholders. CAR has the support and participation from Department of Heavy Industry, and its constituent agencies. The programme so far has implemented 10 consortium projects, involving a total of 14 national labs/ institutes, 15 companies (automobile & component manufacturers) and 10 technology intensive SMEs.

National missions led and coordinated:

Mission for Geospatial Applications

The mission, originally launched as 'Reinvigorating Indian Agriculture through S&T' was rechristened as 'Mission for Geospatial Applications'. The activities broadly include (i) agricultural assessment, (ii) flood modeling and forecast, (iii) internal security; and (iv) Disaster Management and Monitoring of Developmental Activities

National Mission on Bamboo Applications (NMBA)

The NMBA supports projects for promoting and facilitating bamboo technologies and products for various end-uses and applications.

Foresight reports and analysis:

Bioprocess & Bioproducts Programme

Two specialized technology reports on nation-wide survey on the availability of Indian biomass resources and biomass derived bioproducts – assessment of technology trends, gaps & opportunities have been published for wider dissemination.

Collaborative Automotive R & D (CAR)

Under the CAR Programme, during the year, a specific roadmap for Electric-drive Vehicles (EV) was prepared based on the specific request from the National Manufacturing Competitiveness Council (NMCC), and in collaboration with the Department of Heavy Industries. The EV roadmap has two components (a) policy document by DHI, and (b) detailed technology roadmap prepared by the CAR group. CAR recently completed the three studies, viz. (i) Grid impact of plug-in electric vehicles, (ii) Transmission technologies – an India perspectives and (iii) Light weighting of public transport vehicles with aluminium.

Technology Up gradation of select MSME clusters

Malda Food Processing Cluster: A feasibility study for commissioning of aseptic packaging plant at Malda is underway and preparation of DPR is under consideration.

Agartala Rubber Cluster: A study, titled ‘Technology Status and Gap Analysis Study for the Rubber Cluster of Agartala, Tripura – Both Primary Rubber Processing Units and Rubber Products Manufacturing Units’, is ongoing with National Institute of Technology (NIT), Agartala, as the Knowledge Partner. Twelve more studies are being taken up at different institutions around the country. These studies will bring out the technology gaps and also present technology intervention plan for the clusters.

PATENT FACILITATING CENTRE

PFC has been in the fore-front of the national scene in creating awareness about intellectual property rights (IPR) in the country, assisting scientists and technologists in protecting their inventive work, spreading the IPR culture to the State level, evolving policies at the national level, providing technical input to the government on IPR related issues and interacting and supporting other government departments in protecting their innovations.

PFC has a mechanism to extend full technical and financial support to R&D institutes, universities, educational institutions and schools in protecting their inventions in India and abroad. These institutions do not have the necessary financial resources and expertise to carry out this work. PFC’s intervention has proved a boon for the Indian inventors in universities and R&D institutes.

During this year 65 fresh proposals from various universities, educational institutions and government agencies were received for patent filing in India. All these proposals were evaluated at PFC for novelty

and inventiveness of the inventions and 49 cases were put before the committee for recommendation. The committee recommended 37 cases for filing of patent applications in India. Out of these 37 cases, 20 cases have already filed and the rest of them are in the process of being filed. PFC had also entered into a MoU with DRDO in 2004 whereby PFC is filing and prosecuting IPR applications of DRDO. PFC has sent 55 cases for patent filing on behalf of DRDO out of which 20 have been filed and balance are in the process of being filed. In all 40 cases (20 for universities and 20 for DRDO) have been filed till now by PFC and 52 are in pipeline. In respect of inventions from DRDO, four patents have been granted in India, one patent has been granted in South Africa, four trademarks have been registered and one design has been registered during this period.

PFC has been guiding many ministries and government departments at the central and state level on IPR related matters. PFC is maintaining the IP portfolio of DRDO and is filing IP applications on its behalf. Similarly, PFC has provided direction and focused support to the Ministry of MSME in initiating programmes to help the medium and small enterprises to protect their innovations. Ministry of MSME has created Intellectual Property Facilitation Centre (IPFC) in many PICs to create IPR awareness in MSMEs and helping them in protecting their IPRs. Separate grants are being provided to them by the Ministry of MSME. PFC has been made the coordinator for all such IPFCs. Similarly, PFC has been helping and guiding the Department of Information Technology in implementing their IPR programmes.

One geographical indication (GI) has been registered for Phulkari which was filed by the Patent Information Centre (PIC), Punjab with the assistance from PFC.

PFC has recently appointed a new panel of attorneys for a period of three years whom it entrusts all the work related to filing, prosecution and maintenance of intellectual property emanating from the requests it receives from various agencies.

A new committee has been constituted by PFC for recommending cases for filing patent applications abroad.

While continuing with its mandate of awareness creation in the area of IPR, PFC conducted 3 patent/IPR awareness workshops in various states, sensitizing about 500 scientists and technologists. PFC plans to conduct about 15 workshops during this financial year.

The fifth batch of the women scientists completed their one year training in IPR in May 2010. They were given a certificate at the end of the training.

The training for the sixth batch of the 73 selected candidates started from May 10, 2010 at PFC-Delhi, CCSTDS-Chennai, IIT Kharagpur and URDIP-Pune. The candidates were selected by a rigorous process comprising of an all India examination followed by an interview. The candidates from all the centres went through an extensive six-week long orientation programme at Delhi conducted by PFC-TIFAC in the months of May and June, 2010. During this programme they were exposed to various aspects of IPR by the most prestigious IPR faculty of the country. The programme had about 70 lectures on IPR for the candidates. They were given lectures on topics like historical aspects of IP, IP audit, FTOs, IP portfolio management and many more. They were also given hands on experience on patent searches during practical sessions. After the orientation programme the candidates have been placed with different agencies involved in IPR for the on going job training for about 10 months.

Three training programmes on IPR were organized this year by PFC. The first one was a two days training on IPR for IPCUs (IPR Cells in Universities) at TERI Retreat on May 13-14, 2010. It was attended by the nodal officers of 30 IPCUs. PFC has established 53 IPR cells in 53 universities (IPCUs) in 12 states. The IPR cells in the universities have been created with the aim of guiding the university academicians in the matters related to IPR like patent searches, IP audit of the university and coordinating with PIC at the state level for filing and prosecution of the IP applications emanating from the research activities at the university.

The second training programme, “International Advanced Training Course on IPR for NAM and other Developing Countries” was organized in collaboration with NAM S&T Centre from July 12-17, 2010. Representatives from 27 countries from Africa, South America and Asia participated in the programme. The course was designed and conducted by PFC.

DST has entrusted the responsibility of conducting two training programmes on “IPR and WTO issues” for the scientists under its programme National Programme for Training of Scientist and Technologist. The first one was organized from September 6-10, 2010 at TERI Retreat. It was attended by about 20 scientists from various scientific organizations. The second programme on the same topic would be organized in the month of December, 2010.

VIGYAN PRASAR

Vigyan Prasar (VP) was established as an autonomous organization under the Department of science and technology in 1989 for communication of science and technology. It promotes and propagates a scientific and rational outlook in the society, nurtures interest in science, encourages creativity and develops capacity for informed decision making.

The institute develops and disseminates original and interesting communication material for print, electronic and digital media, imparts training to science communicators, catalyzes creative activities and conducts research in various aspects of science and technology communication.

International Year of Biodiversity – 2010

As part of International Year of Biodiversity (IYB 2010), VP has taken up a number of projects/programmes for various target groups. The activities undertaken by Vigyan Prasar as part of its outreach campaign are:

- Vigyan Prasar, in association with All India Radio, produced a 13 Episode radio serial on Biodiversity. The serial was broadcast in 19 languages through 117 radio stations of AIR.
- Content generation and pilot outreach for biodiversity conservation by small farmers.
- Vigyan Prasar produced training materials for capacity building on biodiversity conservation for *zilla* and *gram panchayat* members.
- Vigyan Prasar organized a Press Meet on International Biodiversity Day May 22, 2010 at Press Club of India, New Delhi. This was well attended by representatives of various media houses.
- A seminar was organised in November 2010 at Bangalore on conserving Biodiversity in Agriculture.

Publications

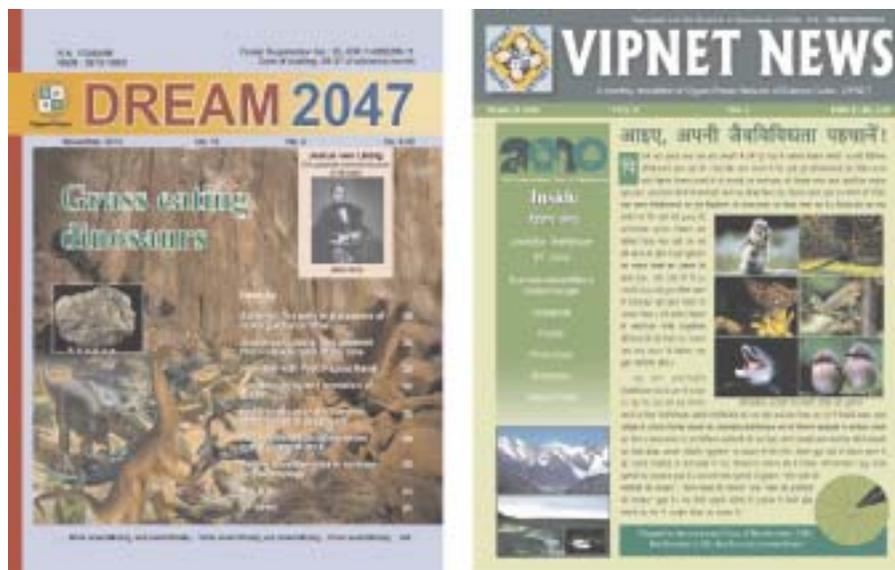


Fig. 6.11

Under the publication programme, Vigyan Prasar brought out 10 titles under different series.

These are “Heretic to Hero: Galileo Galilie A Rebel Astronome”, “Understanding of Planetary Motion”, “Gregor Mendel”, “Dinosaurs: Myths & Facts”, “Charles Darwin”, “Aapekshikta ka Adbhut Sansaar”, “Brahmand Sundari”, “Ham Nanhe Vigyani Hai”, “Cyber Apradh” and “Chinu visits Microworld”.

Vigyan Prasar has been bringing out monthly bilingual (Hindi and English) newsletter – cum – popular science magazine “Dream 2047”. The newsletter reaches scientists, teachers, students, schools, research organizations, libraries and individuals interested in science communication. The present circulation of the newsletter is 52000.

“VIPNET News” – monthly newsletter for VIPNET Science clubs has been regularly brought out.

Science Programmes on Radio

- VP, in association with All India Radio, produced a 52 episode radio serial “Beyond Stars”. This serial was broadcast in 19 Indian languages and from 117 radio stations of All India Radio. The serial was broadcast from September, 2009 to May, 2010.
- Live discussion on Technology Day was conducted on 11th May 2010 on All India Radio. 10 stations of All India Radio participated.
- VP in association with All India Radio produced a 13 Episode radio serial on Science & Technology in Modern India “Golden Waves”. The serial was broadcast from October, 2010.

Three regional workshops were conducted in Kolkata, Ahmedabad and Mumbai for preparing briefs related to serials i) Science & Technology in Modern India ii) Biodiversity, Chemistry and iii) Women in Science & Technology.

Science Programmes on Television



Fig. 6.12

Glimpses of the science serial *Baatein Raaz ki*

- A 26-part video serial on the theme of Astronomy, titled “Taron Ki Sair” – as part of the International Year of Astronomy – 2009 was telecast during September, 2009 to May, 2010.
- A 13 episode science serial “Baatein Raaz ki” was telecast during May, 2010 to August, 2010. In each episode, science related to real life situations has been explained.
- A 13 episode video serial “Mukhaute- Sach Kaa Chera” was telecast from August, 2010 on DD National. The 13 episode serial took a systematic approach in communicating issues like HIV is not AIDS and AIDS is not death, modes of transmission, vertical transmission, no high-risk-group, just high-risk- behaviour, living with HIV, etc.
- VP has entered into a MoU of regular telecast of S&T related television programmes through *Lok Sabha TV*. A 13 episode serial *Dekh Khel Ke* was telecast during October, 2010 during the Common Wealth Games 2010. Regular transmission will commence from February, 2011.

Networking through Edusat Interactive Terminals

The Edusat Transmission reception system has been upgraded in 2010.

Multicast of science programmes –both on awareness and capacity building to train teachers, communicators and science activists on its SIT Network has been continued. Special programme is planned during the International Year of Chemistry – 2011.

Vigyan Prasar Information Systems

Vigyan Prasar has a dynamic portal (www.vigyanprasar.gov.in) where users reach a comprehensive site linking all facets of science and technology communication. New features are continuously being added and queries are attended promptly.

- **Digital Library**

All the publications of Vigyan Prasar are available in electronic version in Digital Library of Vigyan Prasar. Over 2 lakh people have visited digital library and over 10000 have registered providing

details like email ID, address, qualification etc. These database can be utilised in conducting surveys and organising workshops/seminars in different parts of the country.

- **Discussion Forum**

This e-platform for S&T discussion has become very popular among students. There are many students groups who are utilising this platform to ask questions on science and technology and also answering fellow participants queries.

Live Chat Sessions on various S&T topics are conducted on a regular basis.

- **Development of Interactive CD – ROM**

VP developed two multimedia CDs on Computers for housewives and CD based on Astronomy Kit.

- **Popular Lecture Programme**

A country-wide popular science lecture programme was organized in collaboration with National Council of Science Museum, (NCSM), Kolkata. The programme has begun in March, 2010 for a year.

- **Development and Maintenance of Websites of DST**

VP continued with the development and maintenance of websites of various divisions of the Department of Science & Technology; viz. International Division, NSTMIS, SERC, SEED, Good Laboratory Practices (GLP) Programme and Indian Women Scientists.

Vigyan Prasar Network of Science Clubs (VIPNET clubs)



Science clubs activities

Fig. 6.13

Number of VIPNET clubs is 13000. At present VIPNET clubs are present in 446 districts of India.

VP has developed a number of manuals on Biodiversity, Map reading, Energy efficiency, Chemistry and Astronomy to do activities by existing science clubs.

Vigyan Prasar is developing programmes on income generating activities for science clubs.

A series of sensitisation-cum-orientation programmes were organised to form new science clubs in different parts of the country.

Workshops on Innovative activities in science

Vigyan Prasar has developed a number of innovative activities and experiments that can be performed by students and teachers. Activities are aimed at conceptual understanding of the subject rather than verification of scientific principles. Most of these activities can be performed using commonly available objects.

Vigyan Prasar has organised five regional level workshops to train teachers in using innovative activities in the classroom. Over 200 teachers were trained.

Astronomy Programme

- Vigyan Prasar conducted a series of lectures and night sky watching programmes in different parts of the country.
- Vigyan Prasar participated in the World Wide Telescope (WWT) workshop organised at Inter University Centre for Astronomy Astrophysics (IUCAA) in September 2010.
- Vigyan Prasar participated in the Astronomy Camp organised at Modi College, Patiala during 19 to 21 September 2010.

Ham Radio

- Vigyan Prasar participated in a training programme on digital ham radio communication technologies for the IAS Probationers at Centre for Disaster Management, Mussorie.
- Vigyan Prasar participated in a workshop to design low cost ham radio kit at Indian Institute of Technology, Kanpur
- Vigyan Prasar participated in a technology demonstration programme organized by Snow & Avalanche Study Estt. (Research & Development Center), Ministry of Defence, DRDO, Chandigarh.
- Vigyan Prasar participated in a ham radio awareness programme organized for CBSE teachers from different schools at New Star Academy School, Pitampura.
- Vigyan Prasar conducted a training Sessions on ham radio and GPS Technology was organized at Haryana Agricultural University, Hisar.

Science Mela

Vigyan Prasar participated in Perfect Health Mela organized by Heart Care Foundation in Delhi. A series of activities like quiz on health, painting competition, model and science kits making were organised by Vigyan Prasar. Software and publications of Vigyan Prasar were displayed in a stall.

Technology Communication

National Seminar on Gender Technology and Communication – 2010

A two day national seminar on Gender, Technology and Communication was held on the occasion of National Technology Day during May 10 – 11, 2010 at Delhi. This was organized jointly by Vigyan Prasar and National Science Centre, Delhi.

New Initiatives

- VP has initiated efforts to prepare science & technology communication materials specifically aimed at people with fragile literacy skill, slow learners and other socially disadvantaged sections in particular on areas related to agriculture etc.

- Rashtriya Vigyan Chalchitra Mela and Competition

Vigyan Prasar organized the first Rashtriya Vigyan Chalchitra Mela during the Indian Science Congress 2011 to felicitate, nurture, recognize and encourage outstanding science film producers. Awards were given in the following categories:

- i. Best Popular Science Programme (duration more than 20 minutes)
- ii. Best Short Film on Science and Technology (duration less than 20 minutes)
- iii. Best Animation and Graphic film/video on Science and Technology

- National Photography Competition

As a part of International Year of Chemistry 2011 Vigyan Prasar organized a ‘National Level Photography Competition’, giving a scope to amateurs and professional photographers, teachers, students and common man to associate in science outreach. Praiseworthy photographs and their explanations can be used in preparing resource materials like posters, desk calendar, charts, etc with the due credit.



Fig. 6.14

Book Fairs and Exhibitions

Vigyan Prasar participated in Delhi Book Fair, World Book Fair and in a number of book fairs organised in different parts of the country.

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 resources both manpower as well as financial devoted to scientific and technological (S&T) activities by conducting national surveys both through in-house as well as sponsored studies.

(i) *S&T Resources Studies*

The national survey for the year 2009-10 for collection of data on resources devoted to research and development activities has been launched. For this survey, both hard copy as well as electronic questionnaires have been designed and sent to respondents. E-questionnaires have been designed for all sectors so that online data can be submitted by them. This will reduce the time for completion of data collection. To facilitate online submission of e-questionnaires, problems faced by respondents during the previous survey 2005-06 were thoroughly studied and necessary improvements have been carried out in the software.

The national level report based on the above mentioned survey 'Research and Development Statistics 2009-10' will provide information and analysis in forms and variety like financial and human resources deployed by research institutions/laboratories of major scientific agencies, central ministries/departments, 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 personnel, Plan/Non-Plan allocation for S&T, stock of scientists, engineers, technicians for selected countries, and R&D expenditure per capita and as percentage of gross national product etc.

The publication entitled 'Directory of R&D Institutions 2010' has been brought out by the division. The present Directory, ninth in the series contains list of 4288 R&D institutions with complete addresses arranged alphabetically by sector. Details on various communications modes such as phone, fax, e-mail, website addresses have also been given wherever possible. The scope and coverage of the present edition of the Directory was enlarged by adding addresses of additional industries registered with the Department of Company Law Affairs (See fig.1 and 2).

To align with the changing paradigm centered on innovation, the NSTMIS launched a new initiative 'Science Technology Innovation and Creation of Knowledge (STICK)'. 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. The recently evolved framework by the NSTMIS, DST would be used to measure the innovation and knowledge creation capabilities of the manufacturing industrial enterprises through a survey instrument at the national level. The framework adopts the internationally accepted concepts and definitions on the measurement innovation. Based on the various innovation indicators, a STICK Scorecard would be formulated to judge the innovativeness of the various sectors/ regions of the national innovation system. This will provide policy actions, appropriate incentive structures, international comparisons for planning, and fostering the innovation eco-system of the country.

Studies for the development of Bibliometrics Indicators were commissioned based on the advice of the newly constituted Experts Committee to provide evidence-based evaluation and monitoring of scientific research for policy planning.

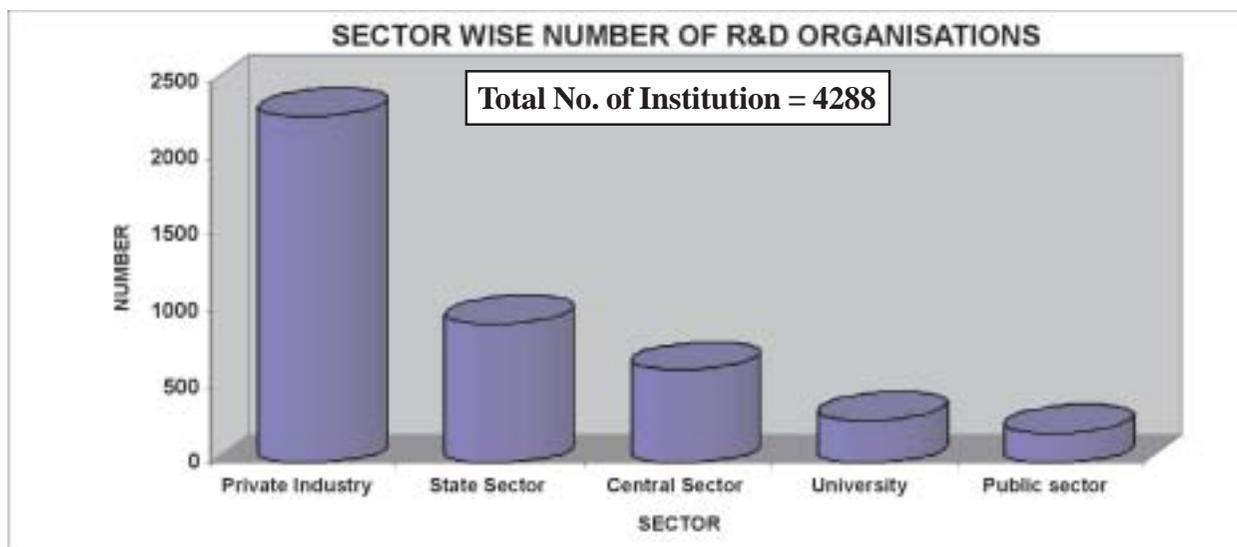


Fig. 6.15

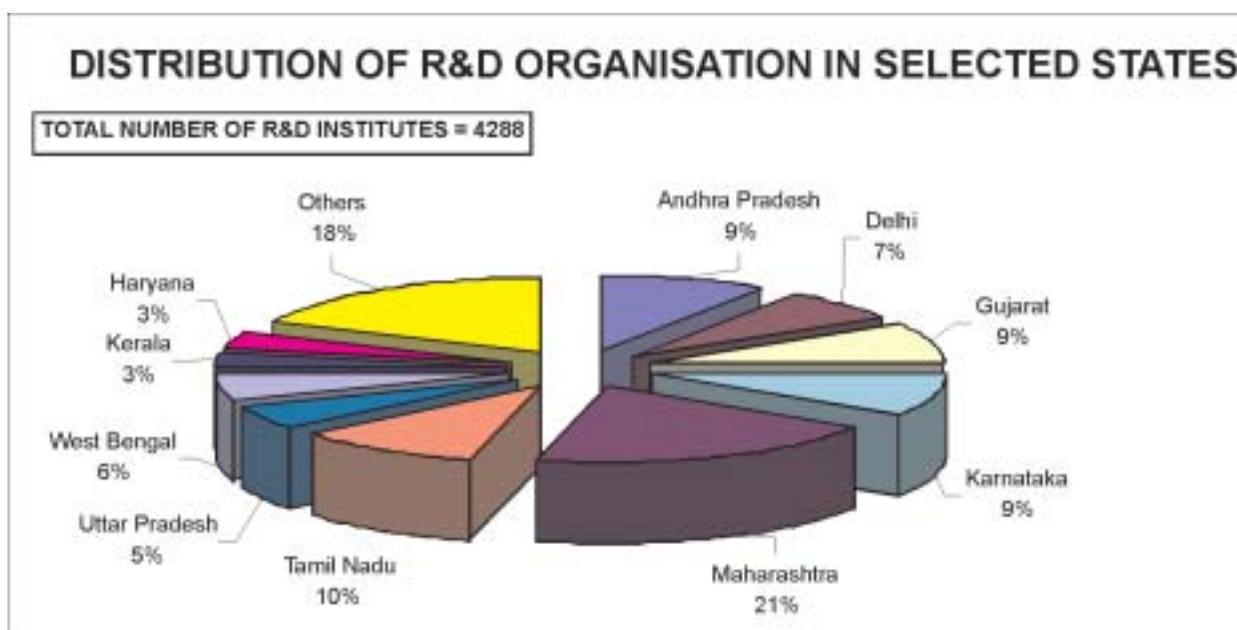


Fig. 6.16

(ii) *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 National Science and Technology Management Information System (NSTMIS) division of the Department of Science and Technology (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 Research and Development Projects funded during the year. The directories for the years 2008-09 and 2009-10 are under preparation.

(iii) Sponsored Studies

Apart from the in-house efforts in bringing out the R&D statistics at national level, the NSTMIS division sponsored a number of 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) Creation of Database of Equipment funded under R&D Projects – A Feasibility Study.
- ii) Development of Database of R&D Manpower in Socio-economic Ministries/Departments including Public Sector Industries: 2009.
- iii) Preparation of Directory of Indian Science, Technology and Medical Periodicals.
- iv) Development of database of PGs and PhDs in Science and Technology and their career profile in North-East India.
- v) Development of protocols for evidence based Ayurveda.
- vi) Directory of R&D capabilities in the field of Tuberculosis.

(iv) 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 UIS and OECD meetings. The divisional officials actively participated in the 2010 South Asian Regional Workshop on Science, Technology and Innovation Indicators. 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”

NATIONAL ACCREDITATION BOARD FOR TESTING & CALIBRATION LABORATORIES

National Accreditation Board for Testing & Calibration Laboratories (NABL) was established in the year 1998 under broad Grouping of among autonomous institutions of DST as Service Organization. Total number of employees in TIFAC is 40.

Objectives

To promote implement and maintain an accreditation system for laboratories in accordance with the relevant national and international standards, suitable for the country and responsive to changing needs.

- 1) To organize awareness programs on all aspects of laboratory accreditation by various means including seminars, workshops, laboratory-industry-accreditation body meets etc.
- 2) To provide timely and effective accreditation services to accredited and applicant laboratories.
- 3) To undertake appropriate training programs in support of laboratory accreditation and related activities for laboratory personnel, assessors, NABL staffs, proficiency testing service providers, reference material producers etc.
- 4) To prepare and maintain database of assessors and experts in different disciplines of calibration and testing and undertake regular monitoring of assessors.

- 5) To encourage proficiency tests / inter-laboratory comparisons in order to ensure accuracy, reliability and reproducibility of testing and calibration results.
- 6) To acquire traveling standards, artifacts, certified reference materials etc. for purpose of conducting proficiency testing programmes and measurement audits.
- 7) To develop and operate mechanisms to deal with complaints against all parties involved in accreditation process as well as appeals against NABL decisions on accreditation.
- 8) To establish and maintain linkages with international and regional bodies such as International Laboratory Accreditation Cooperation (ILAC), Asia Pacific Laboratory Accreditation Cooperation (APLAC), etc, through active participation in various meetings and activities of such bodies.
- 9) To undertake all the activities that shall promote bilateral / multilateral (mutual) Recognition Arrangements between NABL and accreditation bodies in other countries for wider acceptance of test results of NABL accredited laboratories.
- 10) To construct, improve, alter, demolish or repair buildings and structures as may be necessary or convenient for carrying out the activities of NABL.

Research Profile

Major Research Accomplishments (within last 5 years)

During the period from April-September, 2010, total number of laboratories accredited by NABL was 112 (241) with details as follows:-

- Testing Laboratories : 59 (84)
- Calibration Laboratories : 25 (47)
- Medical laboratories : 28 (110)

During the F.Y., 250 laboratories in 500 disciplines / sub disciplines are expected to be granted fresh accreditation till 31.03.2011.

NABL carried out 185 final assessments, 151 surveillance assessments, 184 Desktop surveillances, 499 re-assessments and 67 verifications / others upto 30.09.2010. Thus, the total assessments carried out during this period are 1086.

The total number of assessments expected to be carried out during 2010-11 is 2000.

Major and Unique National Facilities created

NABL has initiated construction of its own building in Gurgaon at an estimated cost of Rs.9.34 Crores. The total floor area of building will be around 21,000 sq.ft. Structure has been completed. Finishing works and electrical works are in progress.

Important collaborations (National and Global) established:

Implement Accreditation System for Laboratories

- NABL grants accreditation to Testing & Calibration Laboratories as per ISO/IEC 17025 and Medical Laboratories as per ISO 15189.

- NABL operates its own system as per ISO/IEC 17011.

International Recognition of NABL

- NABL is signatory to Asia Pacific Laboratory Accreditation Co-operation (APLAC) Mutual Recognition Arrangements (MRA) and International Laboratory Accreditation Co-operation (ILAC) MRA since 2000.

Important Output

As on 30.09.2010, NABL has valid accreditation of 1232 laboratories in 2539 fields/subfields with details as follows:

- Testing Laboratories: 716 (in 1137 fields)
- Calibration Laboratories : 313 (in 502 fields)
- Medical Laboratories : 203 (in 900 fields)

NABL has developed the expertise of laboratory accreditation system as per international standards. NABL has also expertise in imparting training to assessors to conduct assessment of laboratories

GOOD LABORATORY PRACTICE

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 (NGCMA)** was set up in April 2002, under the administrative control of Department of Science and Technology, 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 became a Provisional Member of the OECD's working group on GLP in April, 2003. Major activities of NGCMA include conducting GLP inspections, grant of GLP certificate, GLP compliance monitoring of certified test facilities (through annual surveillances), awareness generation on GLP, Training on OECD principles of GLP and training of GLP inspectors to maintain a pool of quality inspectors for conducting GLP inspections on behalf of NGCMA.

Some of the major achievements of the Indian GLP programme are given below:

- OECD carried out the evaluation of the Indian GLP Programme through their Mutual Joint Visit (MJV) on February 14-18, 2010. The MJV team consisted of experts from the GLP authorities of Australia and UK and observers from OECD Secretariat, Paris.

As a result of efforts made by Indian GLP Compliance Monitoring Authority in developing procedures and documents in harmony with international norms and acceptable to all OECD – member countries, the OECD Working Group on GLP, the Joint Chemicals Committee and finally the OECD Council has agreed to invite India to fully adhere to the MAD Council Acts,

which would mean that pre-clinical health and safety data generated in Indian test facilities certified by NGCMA would now be accepted in all OECD member countries to include the developed markets in UK, USA , Japan and South Africa etc..

This would also mean:

- ❖ India would join the group of 33 nations from developed countries who have a “fully adherent status”.
- ❖ Indian test facilities would not be required to be inspected by member OECD countries, thereby saving time and money involved in multiple inspections.
- ❖ The data generated by Indian test facilities would have a validity and acceptability in all OECD countries for review and consideration for registration or licensing of products in the respective OECD member countries.
- ❖ It would lead to tremendous employment opportunities in the country as it is hoped that a number of contract research Organizations would be set up, further enhancing Indian status for trade and economy of the country.

What does it mean to India as a country?

- India gets recognition across the globe as a country on par with any OECD member countries (including countries like USA, UK, Japan, and countries in EU) for scientific conduct of safety evaluation of studies for companies in India and sponsors across the globe.
- The NGCMA, India would have a rightful opportunity to provide policy information and also be a party for approval of certain policies for the world body in the current area.
- Indian R&D companies developing products (e.g. pharmaceuticals, pesticides or others) for the world can conduct studies in Indian GLP-certified facilities. There would be no need to go for laboratories in abroad for GLP studies.
- Indian scientific capability and availability of young scientific personnel are potential opportunities for Indian companies strengthening existing GLP facilities and/or setting up new facilities.
- India already has about 17 GLP-certified facilities. There was always certain reservation on the acceptance of data from these laboratories earlier by certain regulatory systems in countries like, UK, Japan, etc. However, now India becoming “Full Adherence” status, there would be no such secondary treatment to data generated from such facilities in India.
- Beyond GLP recognition of India for MAD status, the OECD in the larger context of trade and economy has recognized India with “Enhanced engagement” status for trade and economy. This status has been considered for countries like Brazil, China, India, Indonesia and South Africa.
- The full adherent status to India would also facilitate testing of chemicals being exported from India as stipulated under the REACH Legislation of EU.
- The fully adherent status to India would address the issue of non-tariff trade barrier.

- Two new test facilities were granted the GLP-compliance status. These include:
 - a) **IIT Indian Institute of Toxicology, Pune**
 - b) **Syngene International Limited, Bangalore**
- Seven new test facilities were re-certified. These include:
 - a) **Intox Private Limited, Pune**
 - b) **Laboratory Animal Research Services (L.A.R.S.), Reliance Life Sciences Private Limited, Navi Mumbai**
 - c) **IIBAT International Institute of Biotechnology and Toxicology, Padappai.**
 - d) **Aurigene Discovery Technologies Limited, Hyderabad**
 - e) **Gharda Chemicals Limited, Dombivli**
 - f) **Jai Research Foundation, Vapi**
 - g) **Torrent Research Centre, Torrent Pharmaceuticals Limited, Ahmedabad**
 - h) **Ranbaxy Research Laboratories, Gurgaon**
- Annual Surveillance inspection of following three test facilities was done and their GLP-compliance status was continued for a period of another one year :
 - a) **Orchid Chemicals and Pharmaceuticals Limited, Chennai**
 - b) **Advinus Therapeutics Private Limited, Bangalore**
 - c) **Toxicology Centre, Shriram Institute for Industrial Research, Delhi**
- A one-day Brainstorming Meeting of NGCMA with Test Facility Managements was organized (July 25, 2010).
- **Third Training Course for GLP Inspectors** was organized at TERI Retreat, Gurgaon with 32 participants from Government Departments/ Laboratories all over the country from October 3-9, 2010. The faculty of this Training course included foreign faculty from UK, Germany and South Africa
- The website of National GLP Programme “www.indiaglp.gov.in” has been re-designed and is continuously being updated.

MISSION PROGRAMMES

DST has fortified its programme on technology development in key areas by undertaking mission mode programmes for implementation and deployment existing technologies. Key technology areas in which Mission programmes are being operated are missions on Climate Change, Mission on Nano Science and Technology, National Mission on Bamboo applications and Mission project on reinvigorating of Indian agriculture. The Mission project on reinvigorating of Indian agriculture that has now been expanded and renamed as “Mission for Geospatial Applications” the activities of this mission include Agricultural Assessment, Flood Modeling and Forecast.

DST has been entrusted with the responsibility of coordinating two out of eight national missions launched under the National Action Plan on Climate Change. The mission on sustaining Himalayan ecosystem aims to develop and build national capacity in studying and protecting Himalayan ecosystems. Under the mission on strategic knowledge for climate change, knowledge centers in climate change science are being established.

The Mission on Nano Science and Technology (Nano Mission) has been launched as an umbrella programme on May 2007 for promoting pre-competitive R&D in this area of research. Under the nano mission, basic research in nano science has been actively fostered. More than 250 PhDs have been produced and about 2700 publications in prime journals have been published from the projects supported under the mission.

National Bamboo Application Mission (NMBA) has been successful in adding value of bamboo materials through technologies for applications. Structural materials and Public service facilities like schools, hospitals etc have been constructed from bamboo in short spans of time. Leh has received 60,000 Sq.ft constructed area for housing after the recent floods.

CLIMATE CHANGE & ADAPTATION PROGRAMME

The Climate Change Programme (CCP) is a new initiative of the Department of Science & Technology, Ministry of Science & Technology which is spearheading two out of eight national missions on climate change as part of the National Action Plan on Climate Change (NAPCC). These are: (a) National Mission for Sustaining Himalayan Ecosystem (NMSHE) and (b) National Mission on Strategic Knowledge for Climate Change (NMSKCC).

The broad objectives of NMSHE include - understanding of the complex processes affecting the Himalayan eco system and evolve suitable management and policy measures for sustaining and safeguarding the Himalayan eco-system, creating and building capacities in different domains, networking of knowledge institutions engaged in research and development of a coherent data base on Himalayan ecosystem, detecting

and decoupling natural and anthropogenic induced signals of global environmental changes in mountain ecosystems, studying traditional knowledge systems for community participation in adaptation, mitigation and coping mechanisms inclusive of farming and traditional health care systems and developing regional cooperation with neighboring countries, to generate a strong data base through monitoring and analysis, to eventually create a knowledge base for policy interventions.

The NMSKCC has been launched with the broad objectives of mapping of the knowledge and data resources relevant to climate change and positioning of a data sharing policy framework for building strategic knowledge among the various arms of the Government, Identification of knowledge gaps, and Formation of global technology watch groups to help accomplish the task of technology selection and prioritization, Networking of knowledge institutions after investing critical mass of physical, intellectual and policy infrastructure resources, creation of new dedicated centers within the existing institutional framework, building international cooperation on S&T for climate change agenda through strategic alliances and assistance to the formulation of policies for a sustained developmental agenda.

The two missions envisage building upon and creating synergy amongst existing initiatives of various Ministries and Departments of the Government of India which provide support for research and development in climate change through intra- and extra-mural systems. The missions propose to create linkages with state governments and their establishments/ institutions on climate change related aspects.

Some of the major initiatives taken up and progress made by CCP in respect of the two missions are as under-

a. NMSKCC

- Mission deliverables were approved by the PMO in September, 2010 wherein DST was given go ahead to initiate follow-up action.
- Actions initiated in respect of key mission deliverables - Setting up of Centres of Excellence, Strengthening of Existing Centres of Excellence, launch of Major R&D Programmes and major Human Capacity Building programmes in the month of September, 2010.
- The Mission document was sent to all State Governments and Union Territories requesting them to set up coordination mechanism and enroll R&D Institutions engaged in climate change aspects into the mission. A number of state governments have responded. Response from other states is awaited.
- A meeting of Stakeholders including state governments, R&D institutions, NGOs, Civil Society Organizations is being planned.

b. NMSHE

- Approval on Mission document was received from PMO in September, 2010. DST was asked to initiate further action for submission of a Cabinet Note.
- The mission document was sent to all 12 Himalayan States requesting them to communicate their comments and designate nodal coordination point at their end. Majority of states have responded. Response from a few of them is awaited.
- A meeting of Stakeholders which include governments of all 12 Himalayan states, concerned central ministries/ departments, NGOs, Civil Society organizations, Institutions working on Himalayan ecosystem is being planned.

- The Expert Committee set up for preparation of Detailed Project Report (DPR) on National Centre for Himalayan Glaciology has submitted its report.

NATIONAL MISSION ON BAMBOO APPLICATIONS

The objectives of the National Mission on Bamboo Applications (NMBA) are development and scaling up of bamboo based economic activities in the country to enable enhanced opportunities, employment generation, entrepreneurship, exports and the environment protection. The thrust area of the Mission includes:

- Knowledge, information gathering and dissemination.
- Technology development and validation.
- Demonstration and promotional activities for bamboo based value added products and applications.
- Support to entrepreneurial projects and the commercialization of technologies.
- Disaster management.

Amalgamation of Technology with Bamboo

The amalgamation of technology in various aspects with bamboo has been fruitful and over the years NMBA has collaborated with SDR Technologies, Delhi and talks are on with other agencies in this regard as well.

Products such as Bamboo microscope, bamboo kaleidoscope, and bamboo solar garden light, bamboo speakers were developed with bamboo as a green alternative, replacing plastics, metals and wood etc. In term of initiating the fusion of electronics, bamboo solar light were developed. The prototypes of products have already been developed.



Fig. 7.1 Solar light



Bamboo microscope

Fig. 7.2



Bamboo speaker

Fig. 7.3

Contribution towards Society

NMBA intends to facilitate the erection of 144 structures of various sizes to be used as schools and hospitals in the disaster stricken area of Leh along with providing shelters to the homeless of Leh. These are being erected to help the homeless and these structures can sustain any high temperature or weather conditions.



Fig. 7.4: School structure

In order to fill the gap between the producer and the consumer community, steps like procurement of material at the NMBA warehouse has been initiated in order to help the producers market their products and the consumers could be well aware of the bamboo alternative available in the market.

In addition to this, NMBA has been actively participating in various expos and fairs to help promote the bamboo industry.

Bamboo timber- A breakthrough innovation

Bamboo timber in the form of Reinforced compressed Bamboo Beam and Board. It is a 100% substitute of wood timber as it can be cut sawn, sanded and polished in any direction. India has the second largest bamboo resource after china & a long term sustainable alternative to wood timber can be found by setting up Bamboo timber unit. Bamboo timber is a revolutionary type of board that has been growing in market .It is now the most popular type of bamboo flooring board on the market. It can be used for all other wood application such as doors, windows and furniture. Both products have huge potential in India as we are a wood timber deficit country.NMBA supported M/s DLS Industries Pvt Ltd for establishment of Bamboo Timber manufacturing unit at Chichala Distt Nagpur.

Hydroponics

Hydroponics is a method of growing plants using mineral nutrient solutions in water, without soil, using PVC pipes mounted on aluminum frame. M/s World Kids Inc, Mumbai is developing Hydroponic unit made of Bamboo which will replace the plastic and aluminum version along with rooftop hydroponics demo garden.

Centre for Bamboo Training and Product Development

NMBA has decided to support the establishment of a Centre for Bamboo Training and Product Development (CBTPD) for purposes of skills training, entrepreneurship development, product development and related applications in the bamboo sector in the Public Private Partnership (PPP) mode or in joint collaboration with the State Bamboo Agency or Mission or similar autonomous agency set up by the State Government for the promotion of the bamboo sector. The above project has already been approved for establishing 10 Centers for Bamboo Training and Product Development, where MoU has already been signed with six centers and machines are also in the process of installation for the four centers with the various state agencies.

NANO SCIENCE & TECHNOLOGY MISSION

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. During the year 2010-11, Nano Mission continued to record expansion in its activities and also continued to break new grounds in promotion of R&D and human resource development in this field of nanotechnology. *Also, the process of laying down a regulatory framework for Nanotechnology in India has been initiated.*

BASIC RESEARCH PROMOTION

40 new individual scientist-centric R&D projects were funded this year which aimed at investigating fundamental scientific aspects of nano-scale systems. Some of the topics on which projects were funded are - development of innovative peptide and peptide hybrid material based multifunctional nanostructures for cancer imaging and targeted drug delivery, nanoscale fabrication with metal phosphides as anode for next generation lithium-ion battery applications, nanosensor array for real time monitoring of toxic volatile organic compounds, computational study of functionalized nanoparticles, characterization of composite materials and application of nanomaterials for sustainable energy and development of polymer nanocomposites for nanocoating and nanostructured magnets.

Support to ongoing projects was continued. Some important achievements from the supported projects are summarized below:

Chitosan nanoparticles and chitosan tripolyphosphate were used to deliver DNA vaccine in aquatic animals. A CD-14 co-receptor nanopeptide agonist was successfully designed and bioproduced which can be used for targeted delivery of drugs to monocytes, dendritic cells and macrophages. Different types of glass matrices have been prepared and processing procedure for quantum dot growth was optimized. Gold and ZnO nanoparticles were prepared by liquid phase pulsed laser ablation and wet-chemical route respectively and were embedded in polymer matrix for non-linear optical applications. In a study, it was observed that rheological properties of many soft materials at micro and nano scale are helpful for manufacture of better paints, gels, toothpaste and many other commercial products. Stable ferro fluid of different capabilities has been developed. New magnetic resonance active colloidal amine-functionalized Fe_3O_4 nanoassembly with enhanced T_2 contrast properties has been fabricated which can be used as an effective carrier for drug molecules and a source of hyperthermia treatment for cancer. Studies using low concentration of TiO_2 nanoparticles were carried on human skin cell line demonstrating the cytotoxic and genotoxic effect of TiO_2 nanoparticles. Sulfur nanoparticles were prepared using an effective and easy route. Also, the mechanism of formation of AgBr nanoparticles in aqueous surfactant solutions was developed. Cellulose microfibrils extracted from four different sources were studied by different methods of analysis. It was found out that using nanoparticles with biodegradable polymer matrix such as cellulose microfibrils can lead to biodegradable nanocomposites.

INFRASTRUCTURE DEVELOPMENT FOR CARRYING OUT FRONT-RANKING RESEARCH

6 new Units/Research facilities on Nano Science were established during the year and support to existing Units /Centers continued. Some important achievements from these units & centers are summarized below:

Detailed investigations were carried out on the catalytic effect of carbon nanomaterials with different structure morphology for improving the hydrogen storage behavior of complex hydrides. The carbon nanovariants used are single walled carbon nanotubes (SWCNTs), multiwalled carbon nanotubes (MWCNTs), twisted graphitic nanofibres (TGNFs) and planar graphitic nanofibres (PGNFs). It was observed that TGNFs possess superior catalytic effect than that of other carbon nanostructures. Thus 2 wt. % TGNF admixed NaAlH_4 exhibits fast hydrogen desorption at lower desorption temperature. The catalytic effect of graphitic nanofibres (GNFs) on improving the hydrogen storage behavior of NaAlH_4 was observed for the first time Carbon nanomaterial catalyzed NaAlH_4 can be used as a hydrogen storage material for vehicular applications.

Studies were made on hydrogen adsorption behavior of functionalized graphene synthesized by thermal exfoliation of graphite oxide. Hydrogen adsorption was carried out at 300 K and at 77 K by applying constant H₂ pressure. Hydrogen adsorption rate on graphene was found to increase with an increase in applied hydrogen pressure.

The maximum amount of hydrogen adsorbed at 300 K under 80 atm is ~ 0.5 wt.% H₂. However, at 77 K under 50 atm H₂, ~ 2.2 wt.% H₂ gets adsorbed with higher adsorption rate. The binding energy calculated using *ab-initio* simulation for perpendicular adsorption of H₂ molecule on the bridge site of graphene with and without epoxy oxygen is 13 meV and 28 meV, respectively with the mean adsorption distance of 0.34 nm.

It was found that graphene possess better hydrogen adsorption behavior at liquid N₂ temperature. Thus the maximum amount of hydrogen adsorbed at 77 K under 50 atm H₂, ~2.2 wt.% H₂. It was also observed that the epoxy oxygen functionalities in functionalized graphene increase the hydrogen adsorption energy.

Very high strength carbon nanotubes/ aerogel composite were prepared. Tuning the photoluminescence emission of Cu doped CdSe was achieved. Electron energy levels were determined in ZnSe/ZnS core/shell nanostructures. It is observed that the wave function can be engineered in these nanostructures. First principle calculations to understand effect of stoichiometry on passivation of nanocrystals. ZnO nanocrystals show size dependent anti-bacterial activity for E Coli.

Agarose based 3D scaffolds through lyophilization with uniaxial macroporous distribution were fabricated successfully. This topology mimics the natural hepatic lobule matrix environment and hence was exploited for *in vitro* hepatic regeneration studies. It was proved that incorporation of Fibrin to these constructs enhanced their potential to induce *in vitro* cell proliferation & differentiation.

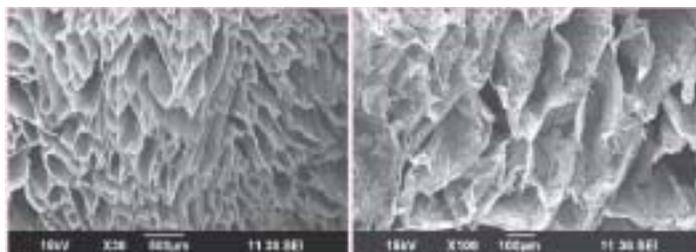


Fig. 7.5: SEM images of Agarose- Fibrin scaffold showing the uniaxial topology and uniform distribution of fibrin nano-particles over the scaffold

Membrane scaffolds for wound healing using chitin/chitosan gels containing nanoparticles were created.

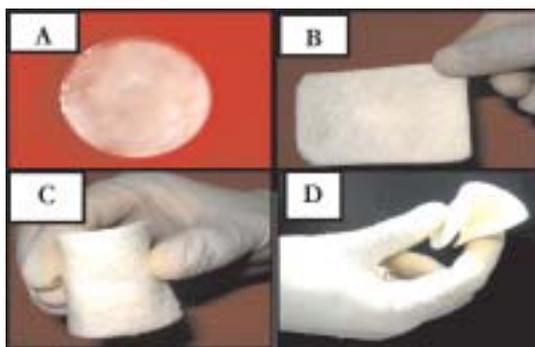


Fig. 7.6: A) Chitosan/ZnO Hydrogel, (B), (C) & (D) Chitosan/ZnO Hydrogel nanocomposite Sponge

Bioactive fibrin-alginate composite scaffold with uniformly dispersed nano-graphene, resulting in biocompatible gels with superior control over mechanical properties was prepared.

A novel method for the fabrication of Fibrin based electrospun scaffolds for tissue engineering applications was developed. The hMSCs adhered and migrated well in to the composite scaffold with excellent cytoskeletal organization compared to PCL scaffold.

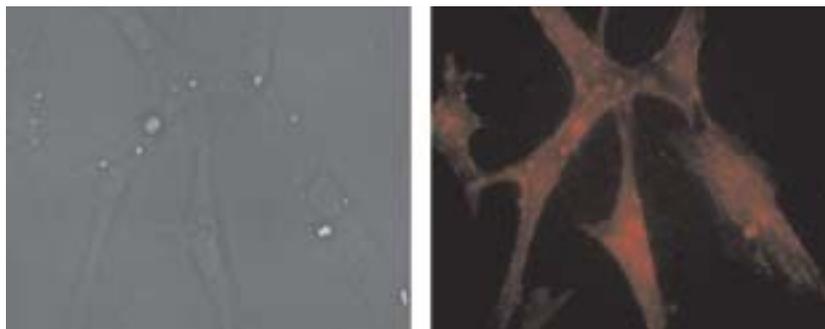


Fig. 7.7: Targeted imaging of human mesenchymal stem cells using antibody conjugated ZnS nanocrystals (i) bright field image and (ii) fluorescence image

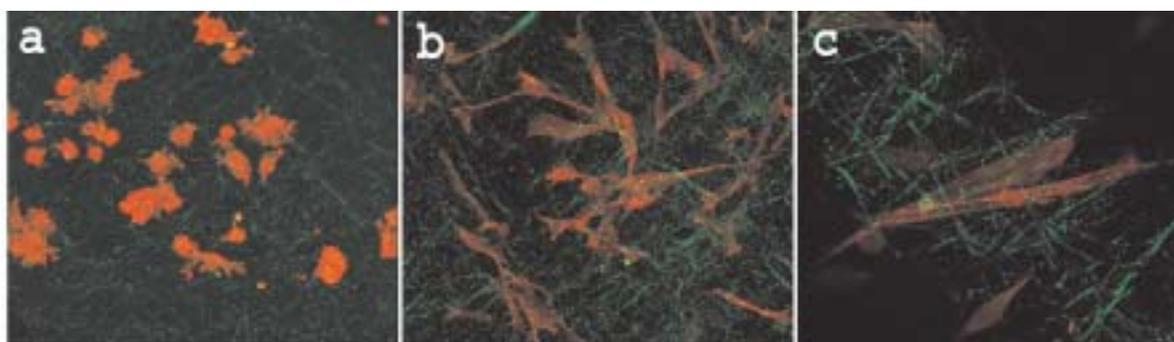


Fig. 7.8: Confocal Images of hMSCs seeded on a) electrospun PCL Micro nano scaffold b&c) PCL fibrin scaffold. Fibers are shown in green colour.

A new class of magnetic resonance (MR) active aqueous Fe_3O_4 magnetic nanoparticle nanoassemblies (Fe_3O_4 MNNA) of ~ 40 nm size comprising 6 nm particles was formulated. Intercalation and characterization of pravastatin and fluvastatin drugs in $\text{Mg}^{\text{II}}/\text{Al}^{\text{III}}$ layered double hydroxides (LDHs) has been investigated to form stable drug carrier. The mechanism of drug release has been investigated in detail. A novel arginine-based dendritic block is grown on the surface of APTES-coated Fe_3O_4 nanoparticles by conventional growth approach of Michael addition/amidation reactions. The nanocarriers showed good capacity to encapsulate DOX, with loading as high as 65% (w/w) and a pH-responsive sustained release of 54% at pH 5.0. Also, the release of DOX from the nanocarriers increased up to 80% on application of an AC magnetic field. A temperature sensitive folate targeted doxorubicin containing magnetic liposomes has been developed for thermo chemotherapy of cancer. Enhanced uptake into tumor cells by virtue of the synergistic effect of biological and magnetic targeted liposomes has been observed. Highly mesoporous spherical three dimensional (3D) ZnO nanoassemblies have been fabricated by a simple approach. The drug-loading efficiency of the nanoassemblies was investigated using doxorubicin hydrochloride (DOX) as a model drug. The studies suggest that drug release is dependent on the pH of the medium and externally applied ultrasound.

Zinc blende alloy nanocrystals were designed which composed of Cd, Zn and S and doped with Cu to produce composition/size dependent tunable dopant emission in entire visible spectrum have been designed. This is the first alternative to work horse CdSe in group II-VI semiconductor systems to produce such a large window tunable emission with all visible color.

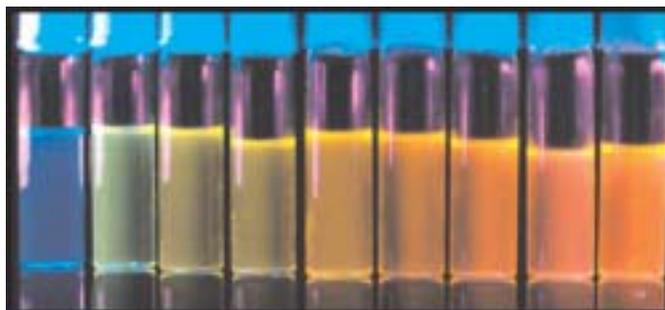


Fig. 7.9: Digital image Cu doped alloyed nanocrystals of Cd, Zn and S, samples collected at different intervals.

Human Resource Development

2 new Post Graduate Programmes [M.Tech (Nano Science & Technology)] were started in two more Universities and support to 15 ongoing Post Graduate programmes continued.

Attractive Post-doctoral fellowships to encourage talented Young researchers towards advanced research in the field of Nano Science & Technology continued through JNCASR-Bangalore. 6 Post Doctoral Fellows have completed their research while 5 are continuing at present.

Support to 1 *Ramanna Fellowship* also continued.

International Collaborations

Support to India-Japan Beamline established at the Photon Factory, KEK, Tsukuba, Japan during last year continued. Experiments were carried out on different modes i.e. powder diffraction, single-crystal diffraction and small angle scattering using one Goniometer under low temperature and high pressure conditions. Scientists and researchers from IISc-Bangalore, JNCASR-Bangalore, BARC-Mumbai, IUC-Indore, BHU-Varanasi, SNBNCBS-Kolkata and SINP-Kolkata are using the beamline.

The process of financial sanction of PETRA-III project is in progress. Indo-Canada collaborative project is also under process.

Development of Nano Technologies and their applications

Support to ongoing projects in this category continued. Significant progress has been made in these projects. Some important achievements from the supported projects are summarized below:

A solar cell module was developed which can also store electrical energy in the same thin film. The principle of the new generation device is to coat the photovoltaic thin film layers with thin film storage layers that is also nanostructured and uses titania nanotubes providing very high capacitances. A double layered titania structure was used for photovoltaic storage device.

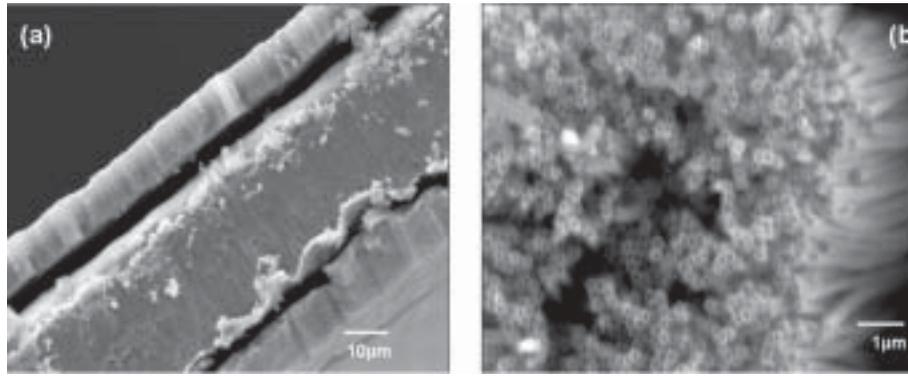


Fig. 7.10: Double layered titania nanotubes for generation-storage devices

For the first time in the world, ZnO nanotube thin films were processed which have the potential to boost the solar cell efficiency when combined with titania nanotubes.

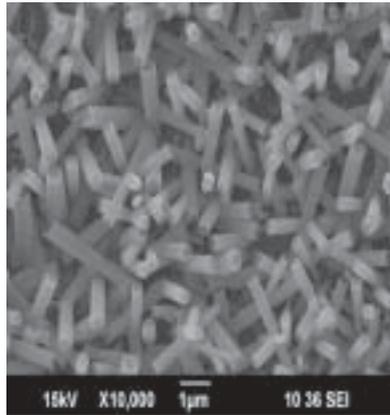


Fig. 7.11: SEM image of vertically oriented ZnO nanotubes electrochemically deposited on Indium doped Tin oxide (Photo anode)

Silicon sheet/tubes of 5-10 cm size were prepared and experiments were performed for melting silicon under different conditions. All experiments resulted in good melting of silicon without oxide layer. Computer simulations were performed through programmes developed by numerical techniques and different software to control the furnace operating parameters such as electrical power to the heater, pulling rate of the silicon sheet and gas flow and silicon feed rates etc.



Fig. 7.12: (a) A LiF sheet grown with slow (2mm/min) speed (bottom) and fast (30 mm/min) speed (top), (b) and (c) side view of a 25 mm dia and 15 mm long LiF crystal growing in the form of a tube but the cylindrical portion was melted during detachment. The growth had to be suspended due to time constraints.

Si sheets measuring 5-8 mm wide and 8-10 cm long and 0.5-1 mm thick could be grown at 5-10 mm per minute as shown in the figures above.

Novel hydride catalysts were prepared using hydrogen decrepitation technique which provide fresh surfaces with large surface area, free from oxidation which further increases the catalytic sites for the formation of CNTs. High hydrogen absorption, large decrepitation and low cost makes these hydrides better catalysts for large scale production of CNTs.



Fig. 7.13: Automated experimental facility for CVD process (10 g of CNTs in a single step)

Also, single furnace fully automated CVD facility has been indigenously fabricated using mass flow controllers, furnace and quartz tube to get a yield of ~10 gm in a single step. Carbon nanotube/Folic acid/ Fe_3O_4 magnetic nanovectors were developed which have the potential to destroy cancer cells by hyperthermia treatment.

The new discoveries were made in the Research Programme on Smart and Innovative Textile are Nanofinishes, Thermo-regulated textiles and nanofiber based automotive filters.

Nanofinishes: A silver nanoparticle based anti-microbial finish and was developed for the first time in the country. The finish is stable for several months and does not impart undesirable color to the fabrics on application and the finish gives nearly 100 % activities durable for over 30 washes.

Thermo-regulated textiles: A novel technology was developed to stabilize Phase Change Materials (PCM) formulations. Using this technology, PCMs were developed for 29 °C and -15 °C that show negligible super cooling and have high stability for large number of transition cycles.

Nanofiber based Automotive Filters: A proprietary technology for continuous production of nanofiber webs of large widths at a linear speed was developed for the first time in the country. The technology is able to produce highly uniform nanowebs even at very low amounts of depositions. Studies have been made on the effect of electrospinning process parameters on the nanofiber diameter, pore size distribution of nanowebs and its subsequent effect on filtration behaviour. Using the knowledge, a prototype automotive oil filter has been developed with filtration efficiency up to 99 % for 1 μm size standard dust without sacrificing their dust holding capacity.



Fig. 7.14: Prototype of automotive filter using Nanowebs

1 National Review & Co-ordination Meeting and 1 Advanced School was organized. Support to 10 International /National conferences, Seminars, Workshops were provided.

Output Indicators

Outputs from Individual R&D projects, Units/Centers projects and Industry-Institute Collaborative projects have led to a good number of publications in cited journals and Patents. A good number of PhDs have been produced from these projects. Also, a large number of technical and other manpower have been trained. The details of the cumulative output indicators from projects, units and centers supported under Nano Science & Technology Initiative (NSTI) and Nano Mission are summarized below:

Research papers in cited Journals	2687
Research papers in Conferences	375
Patents	82
PhDs produced	253
Other Manpower trained	737

MISSION FOR GEOSPATIAL APPLICATION

The Mission Mode project was started during 2007 as “Reinvigorating Indian Agriculture through S&T” at a total cost of 4.90 crore for the 11th Plan. The project has now been expanded and renamed as “Mission for Geospatial Applications” and the outlay for 11th Plan has been revised to Rs.24.50 crore.

Brief activities of the Mission

- (I) **Agricultural Assessment** - The project was initially started with the objective of tracking impact of severe weather events such as hailstorm, floods and drought. The objective is to provide data on crop coverage, crop health, output, etc up to village level on real time basis to Central/State

Governments and other users. Information on the above parameters is being provided to different sugar mills, state governments and other government agencies.

- (II) Flood Modeling and Forecast** – The objective is to provide a warning system and build a flood index of the vulnerable river basins with probabilities before the actual flood event occurs. The capabilities developed include (a) area of inundation up to village level, (b) flood inundation maps up to village level, (c) volume of inundated water, (d) depth of inundation, (e) flood forecasting up to village level (based on rainfall and river discharges), (f) rainfall recharge to rivers, (g) approximate time of flooding after release of discharges from various dams and reservoirs, (h) submergence period of a particular area/village, (i) left bank/right bank inundation, etc.

Flood modeling of Tapi river basin in Gujarat and Mahanadi in Orissa have been under taken in collaboration with respective state agencies. The NDMA has expressed desire to expand this with high resolution DEMs to other flood prone states and rivers.

(III) Internal Security –

A. 3-D Terrain Models: Under this project the mission is developing 3-D terrain models integrating high-resolution satellite imagery and digital topo maps. The models showing difficult terrains and slopes with other attributes to help navigation and operational planning are being used in Control Rooms of MHA and other Government agencies dealing with internal security. Terrain Models have been provided to MHA, Govt. of Jharkhand, Chhattisgarh, N.E states, BSF, CRPF etc.

The Mission has developed 3-D models of Jharkhand, 19 towns of Jammu & Kashmir plus Jammu and Punch, Chhattisgarh, Orissa, Tripura, 12 districts of Bihar, 07 districts of Madhya Pradesh, Part of Manipur (to be completed).

B- Cadastral: The Deptt. Of Land Resources has assigned the task of preparing cadastral maps using satellite imagery as well as ground surveys. This is a pilot project and in case successful, the centre will advise states to update and modernize their cadastral maps in digital format using this approach.

C. Communication System:

- (i) Wideband Receiver** - This receiver is intended for government, military, security, surveillance, broadcast monitoring, and demanding applications. This software contains numerous advanced features such as analog and digital signal reception, three types of scanning, five types of squelch, many tuning options and virtually unlimited memories.

A prototype has been developed and after successful testing handed over to BSF.

- (ii) HF/VHF SDR Tactical Radio System** - An SDR in general is a radio that has:-

- Primary functionality (mod/demodulation, filtering, etc) defined in software
- DSP algorithms implemented in configurable hardware and/or PC software.

- (iii) GPS Vehicle and Portable Trackers** - The mission for geospatial Applications has developed AVLS and personal GPS/GPRS/GSM trackers for asset, personnel and fleet management. These trackers may be also used for covert operations and mission planning and control as the personal trackers also feature two way voice communications.

(iv) **Electronic Sensors & Fencing** - Uses RF, Laser and Ultrasonic Sensors for Surveillance and electronic fencing over difficult terrain and rivers. Water Level Sensors with high accuracy and remote programming and data fetch capability using GPRS

Above noted communication systems have been provided to Central Police Organisations like BSF, CRPF, CISF and state police of Jharkhand. Other Police organisations like SSB, ITBP and State Govts. of MP, West Bengal, Jammu & Kashmir and North-East States have also made similar requests.

D. Disaster Management and Monitoring of Developmental Activities : Besides the above activities recently the Mission has embarked upon new areas of Disaster Management and Monitoring of Developmental Activities. Govt. of Manipur has requested this Mission to monitor their developmental activities like road construction, rural housing, etc. Similarly Uttarakhand Govt. has also approached this Mission for their landslide monitoring.

S & T PARTNERSHIP BUILDING AND INTERAGENCY PLATFORMS FOR S & T OUT REACH

INTERNATIONAL S&T COOPERATION 2010-11

The International Science and Technology Cooperation Division continued with the responsibility of negotiating, concluding and implementing Scientific and Technological Cooperation Agreements and Programmes of Cooperation between India and other countries at bilateral, multilateral and regional levels. The division executed its responsibility in close cooperation 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 Spectral Ministries of Government of India; Indian Scientific Agencies and Indian Science and Engineering Academies. The division 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) complement and supplement the national efforts in ongoing national programmes of priority, (ii) accelerating institutional and human capacity building vital to India becoming a global player in knowledge based economy (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 selected countries ; (iv) Joint research projects; (v) Joint R&D centers, (vi)

Networking of centers 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. (xvi) Partner groups; (xvii) Exchange of Sr. Scientists and young researchers; Institutional Partnerships etc.

Salient New Activities carried out during the year

- ◆ **New Inter Governmental S&T Cooperation Agreements/MoU/ Working Programmes** were concluded by India with Australia, Belarus, Batswana, Egypt, Ethiopia, Ghana, Greece, Iran, Indonesia, Israel, Japan, Mauritius, Myanmar; Nigeria, Portugal, Russia, Saudi Arabia, Singapore, Slovenia, Spain, Switzerland, Thailand, Turkey, Turkmenistan, UK, Vietnam and Zimbabwe.
- ◆ **Joint S&T Committee/ Council meetings** were held with ASEAN, Australia, Brazil Germany; Greece, Indonesia, Israel, India-EU Summit, Japan, Portugal, Russia, SAARC, Slovenia, Spain, Sweden, Taiwan, Thailand, UK, US and Vietnam. Governing Body meeting of Indo- US S&T forums, Indo- German S&T Center, Indo- France Centre for Promotion of Advance Research, ASEAN-India S&T Development Fund, and UNESCO-India S&T Cooperation.
- ◆ **India-Australia Strategic Research Fund:** Building the success of the India-Australia S&T cooperation, both sides have increased the fund to support more bilateral activities. The expended fund introduced a new ‘grand challenge’ component, supporting large-scale research projects designed to deliver practical solutions to some of the major challenges shared by both countries. The areas of focus are “energy”, “food and water security”, “health” and “the environment”. The expanded fund also introduced a substantial new fellowship program, comprising exchanges for early-career researchers from both countries and short-term visits by senior scientists. A call for proposal was announced in the areas of food and water security and environment under the grand challenge’ component.
- ◆ **Indo-German S&T Centre:** Indo-German Science and Technology Centre (IGSTC) established in India with office in Gurgaon. The IGSTC will provide links to research, academia and Industry and support flagship joint projects between India and Germany in the areas of Biotechnology; Energy; Environmental technologies; Health research; and Production technologies. Both governments committed to contribute equivalent amount of • 2 Million Euro per year initially for a period of 5 years.
- ◆ **Indo-Russian S & T centre:** Department of Science & Technology and the Russian Ministry for Education & Science have agreed to create Indo-Russian Scientific & Technological centre with its offices at Delhi and Moscow. A Joint Work Document spelling out obligations / Right of the two sides for establishment of the Centre was concluded on 21st December 2010 in presence of the Hon’ble Prime Minister and visiting Russian President. The Centre will pioneer in commercialization of joint research outcomes between the two countries
- ◆ **India-ASEAN S&T Development Fund:** The operational guidelines for management of AISTDF have been finalized and the 1st meeting of the Governing Body of AISTDF was held in June 2010.

The web portal of AISTDF (i.e. www.AISTDF.org) was launched. Four activates viz. i) India-ASEAN virtual Centers on Technology Commercialization ii) ASEAN-India Virtual Centre on IPR; iii) Technology mission on Functional Food; and iv) Renewable Energy were approved by the GB for implementation. The research attachment training programme for ASEAN scientists and experts was organised at ARCI, Hyderabad under the on-going project on “Surface Engineering”.

- ◆ **Indo US Bi National S&T Endowment Fund:** Joint Endowment Board has been constituted for facilitating innovation R&D and commercialization. First meeting of the board is to be held shortly.
- ◆ **New Africa S&T Initiative:** The CV Raman fellowships for African researchers were launched in February 2010 (Total 416 fellowships in three categories every year). Total 85 candidates were selected for the fellowship from the various African countries.

Bilateral Research Projects

- ◆ **Argentina:** Under the ongoing programme of cooperation 10 projects in the area of structural chemistry, bio-pesticide, health, and food industry were continued to be supported. Exchanged visits of nearly 10 scientists from both sides have been realized. A new joint call for proposals is in the process of being negotiated.
- ◆ **Australia:** Under the on going programme in “Competitive Category”, 28 Indo-Australian research projects have been supported in the areas of agricultural research, astronomy and astrophysics, microelectronic devices & materials, nanotechnology, renewable energy & marine sciences. 60 exchange visits of scientists were taken place under the projects.

A new call for proposal was announced in the areas of Agricultural Research; Astronomy and Astrophysics; Environment Sciences (including climate change research); Micro-electronics Devices and Materials; Nanotechnology; Renewable Energy; Marine Sciences; Earth Sciences; and Information and Communication Technology. 137 projects received against the call are under technical evaluation.

- ◆ **Belarus:** 1st Joint Working Group meeting on S&T (JWG) between the two countries was held during October 25-26, 2010 in New Delhi. The JWG, realizing the significance of cooperation in the fields of science, production, technologies, innovations and investments facilitate mutual understanding in different spheres of knowledge and represents constituent factor for consolidation and development of R&D potential and means of economic development discussed various ways for increasing the cooperation level in science, technology, innovation and investment cooperation. The two sides, thus, agreed to launch a joint call for proposals, which was finalized and announced on November 01, 2010.
- ◆ **Brazil:** 10 new projects in the area of ICT and Life Science approved and support to 5 ongoing projects continued.
- ◆ **Bulgaria:** In addition to support to 17 ongoing projects, 11 new projects in the areas of new materials, water technology, astronomy, microelectronics, health and nutrition were initiated. Nearly 60 project based exchange visits of scientists from both sides were realized.
- ◆ **European Union (EU):** 3 new projects approved in the area of Solar Energy and support to 6 ongoing projects in the area of Computational Materials Science continued.

- ◆ **Finland:** 4 projects in the area of Green Chemistry approved.
- ◆ **Germany:**
 - (i) DST-DAA PPP programme: Support to 20 on-going joint research projects was continued and 10 new projects sanctioned in the areas of nanosized composite oxides for catalytic applications; Proteomic multilevel nutrient; nonporous materials; radiation response in human cells etc.
 - (ii) DST-DFG Programme: The support continued for 20 on-going projects and 10 new projects were sanctioned in the areas of Vascular complications of type 2 diabetes; Cosmology and Astrophysics; modeling of metal powder compacts; perfusion-induced brain injury etc.
 - (iii) An Indo-German Centre on Computer Science was established at IIT Delhi with 10 thematic groups from each side collaborating on different research aspects of Computer sciences. 4 DST-MPG partner Groups covering the areas Polymer synthesis; Algorithms and Complexity; Quantum Field Theory; Biological Physics etc continued to be supported during the year. One DST-MPG fellowship was also sanctioned.
 - (iv) DST-AvH Programme: The Indo-German (DST-AvH) Frontiers of Engineering symposia were supported which was held in Berlin in June 2010. 35 Indian engineers and 40 German experts and engineers deliberated on the newer areas of engineering.
- ◆ **Israel:** A new call for proposal was announced in the area of Information Technology (Imaging Sensor and Robotics) and Solar Energy (Solar Thermal & Photovoltaic). 6 to 8 proposal are expected to be funded.
- ◆ **Japan:** Under DST-JST Cooperation, 4 new projects approved and support to 14 ongoing projects in the area of ICT continued.

The collaboration with Japan Society for the Promotion of Science has running successfully with the support of 40 ongoing projects and 20 new projects in the areas of Molecular Structure, Spectroscopy & Dynamics; Advanced Materials including Nano-materials; Modern Biology and Biotechnology including biomedical science; Manufacturing Sciences; Space science; Surface and interface sciences including catalysis. A Mizushima-Raman Lecture on “Spectroscopy, Fluorescence and OLED” was delivered by Indian Scientist in Japan. Nearly 100 exchange visit of scientist from both side were taken place.

- ◆ **Mexico:** Besides 16 ongoing projects in areas of earth and atmospheric sciences, polymer chemistry, astrophysics, new materials, and marine biology which continued receiving support, 4 new joint R&D projects in areas of computational biology, ICT and polymer chemistry were identified for implementation. The projects have enabled nearly 50 exchange visits of scientists from the two sides
- ◆ **Netherlands:** Call for proposal was announced. 6 projects in the area of Biomedical devices may be funded jointly.
- ◆ **Portugal:** Indo-Portuguese Joint S&T Committee (JSTC), in its 3rd sitting at Lisbon, on 2nd July, 2010, considered 61 joint proposals and approved 21. Out of these 21 projects 16 in areas such as new materials, smart textiles, microelectronics, mechanical engineering, health and biotechnology were sanctioned for implementation by the two sides during a course of three year period. In addition, 19 on-going projects were continued to be supported jointly. A new programme of cooperation in S&T between the two Governments, for the period 2010-2012, incorporating future areas of cooperation was also concluded.

- ◆ **Republic of Korea (South Korea):** 5 joint projects in the areas of Biotechnology, Environmental & Engineering Technology, Nano-Technology and Information Technology were implemented during the year.
- ◆ **Russia:** 80 joint projects in 10 thrust areas related to frontiers of Science & Technology. namely: Biotechnology & Immunology; Materials Science & Technology; Laser Science & Technology; Catalysis; Accelerators & their Applications; Hydrology; Computer & Electronics; Biomedical Science & Technology; Oceanology & Oceanic Resources and Engineering Sciences; and seven select areas of basic research in science, namely: Mathematics; Applied Mechanics; Earth Sciences; Physics & Astrophysics; Ecology and Environmental Protection; Chemical Sciences and Life Sciences were implemented under the Integrated Long Term Programme (ILTP) of Cooperation in Science and Technology. 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.

While Indian supercomputer PARAM 10,000 is already successfully functioning at the Russian-Indian Centre for Advanced Computing in Moscow; Indian Supercomputer PARAM PADMA RU is being jointly developed in Russia. Projects on development of software for the applications like Computational Fluid Dynamics, Seismic Data Processing and Development of Parallel Compiler were also implemented.

In the area of Earth Sciences joint projects on Creating basic observations and knowledge products pertaining to solid earth, viz., Lithosphere / Asthenosphere structure, earthquake catalogues, hazard and risk maps, earthquake precursor observations, etc; Setting up and application of new technologies for understanding the complex geodynamic processes; Seismic / Geophysical instrumentation development were undertaken under the programme.

In the area of Biotechnology & Life Sciences projects on development of intelligent adaptive prosthetic leg; development of softwares viz., viroMIRNA and miUTRpred, which are being used extensively to predict miRNAs and their targets in animal as well as plant viral genomes e.g. Hepatitis –B, Human T-cell Lymphotropic Gemini and Tomato Mosaic viruses. Three Cry 1Ac genes have been developed based on protein-protein docking and site directed mutagenesis. Computer aided diagnostics for cardio-vascular disease using biomedical images and signals successfully implemented. Programme on holistic health care through energy level diagnosis, genomic profile, evaluation and non-pharmacological intervention; “Prakriti & Genome Profile” and “Protocol for Ayurveda Evaluation” were also undertaken under ILTP.

In the area of Materials Science & Technology projects on Opening of raw materials, mechanical activation & soft mechanochemistry; Solvent extraction for value added products from wastes; Autoclave processing / pressure metallurgy for metal extraction and materials synthesis; Electro-thermal processing for light metals extraction; Development of advanced flotation technologies were approved for implementation under the Indo-Russian Non-ferrous metallurgy centre.

- ◆ **DST-RFBR Arrangement:** About 70 joint R&D projects are being supported in collaboration with Russian Foundation for Basic Research.
- ◆ **Slovenia:** In addition to 4 ongoing projects that continued to receive funds 12 new joint R&D projects in areas of health & biomedical sciences, metal science & new materials, polymer chemistry, mathematics, electronics, alternate energy sources have been supported.
- ◆ **South Africa:** Mega projects were approved in the area of HIV/AIDS for funding under top down approach. 8 new proposals were approved for funding and to support 14 ongoing projects continued.

- ◆ **Spain:** Support continued for 25 ongoing Indo-Spanish joint research projects in the areas of Renewable Energy, Information Technology (including Computer Science), Health and Medical Research, Life Science and Biotechnology (including Pharmaceuticals), Agriculture Technology and Food Processing, Nanotechnology. 60 exchange visit of scientists were taken place under the project.
- ◆ **Sweden:** 5 projects in the area of ICT approved.
- ◆ **Switzerland:** The support was extended to the on-going 20 joint research projects and 4 Institutional partnership projects under the programme.
- ◆ **Taiwan:** Support to 20 on-going projects was continued and 10 new projects were sanctioned in the areas of Nanotechnology; Formation and Evolution of Star Clusters; Advanced Nano-composite Materials for the Development of Biosensors and Energy Storage Devices; Developing flood forecasting etc
- ◆ **Thailand:** 3 joint projects were supported during the year under the India-Thailand S&T Cooperation programme.
- ◆ **Tunisia:** 8 ongoing projects were supported.
- ◆ **UK:** Two major new initiative between DST-RCUK on i) - “Bridging the Rural/Urban Divide” - to provide technological solutions to improve the quality of life of rural inhabitants in both countries; (worth up to £12m or Rs84 crore) and ii) “to develop the next generation of environmentally-friendly fuel cell technologies” partnerships (worth up to £6m or Rs. 42 crore) were launched.

A new programme namely, **India-UK Science Networking envisages organization** of a small 3 days scientific meeting to bring together groups of early to mid career scientists from India and the UK for the purpose of the scientific discussion, to promote collaboration and knowledge transfer by encouraging interaction within the wider research community was initiated. In this regard a call for proposal was announced to organize the Indo-U.K Scientific meetings/seminars in India/U.K. 37 proposals received against the call are under technical review.

Under **DST-UKIERI** programme, 25 ongoing projects were supported in the areas of Nano-Science and Technology and Advance Materials; Bio technology including Stem Cell Research; Telecommunications; Climate Change and Weather Forecasting; New Energy including Hydrogen energy. 65 exchange visits of scientists from both sides were taken place under the project.

- ◆ **USA:** Support to 5 ongoing projects continued under the Materials Network Programme.
- ◆ **Vietnam:** Four new joint research projects were sanctioned in the areas of Smart Antennas for 3G/4G mobile communications; Power Source Converter for AC Photovoltaic’s; etc

STIO’s Projects: Support continued for the 25 on going projects in the areas of Physical Science, Chemical Science, Mathematics, Biotechnology and Nano materials.

- ◆ **India-Brazil-South Africa Cooperation:** 2 Nano Schools organized in India and South Africa. About 100 young students were trained.

Industrial R&D Programs

Indo- Canada Industrial R&D Program: 4 industrial R&D projects were supported in the areas of Aerospace, Geospatial, Bio-fuels and Communication.

A new call for proposal was announced to invite the joint workshops/seminar/proposals in the areas of Alternate Energy and Sustainable Environmental Technologies, Earth Science and Disaster Management, Information and Communications Technologies, Aerospace and Photonics, Nano science / Nanotechnology. Out of total 15 proposals received commonly by both sides, 6 project workshop proposals have been agreed to support by both sides.

India-Israel-Canada Trilateral Meeting: Trilateral R&D Partnership Development Activity on Water Technologies is scheduled to be held during February, 2011 in Ontario, Canada. The purpose of this trilateral meeting is to harness the complementary technology strengths shared by Canada, India and Israel, and stimulate collective action on global water issues with an initial emphasis on India. It will aim to identify and address specific water challenges; propose new technology-based water solutions that leverage the strengths of all three countries; and deliver downstream economic benefits to all participants.

A virtual Indo-Canadian Nanotechnology Network Centres of Excellence has been established. Initially Five Canadian Universities namely BC, McGill, Waterloo, Toronto and Alberta are participating in such a network and have committed to provide a seed fund of Cdn \$ 40,000 each for a period of 1 year. India side is also providing matching grant to support the following activities:

- a) Faculty-to-Faculty Research Collaboration (involves faculty-to-faculty research collaboration between a faculty in one of the 5 Canadian Universities and a Faculty / Scientist from one of the academic / R&D institutions in India)
- b) Distinguished Visiting Scholar (DVS) Programme (1 DVS from NINT to visit 2 laboratories in India and 1 DVS from India to visit NINT / University of Waterloo / University of McGill / University of Toronto)
- c) Graduate Student (PhD) School on Nano-Fabrication & characterization at NINT/ University of Alberta (15 students + 5 faculty from each side)
- d) Focused Workshops on Nano-medicine to be held at University of Toronto (15 Indian participants + 25 Canadian participants)

Indo Israel Industrial R&D Program (I4R&D): A new call was announced in the area of Cleantech (Environment, Water Technology / Water Management, Renewable Energy, Agro Technology, Materials). One proposal has been shortlisted by both sides to support against this call

Indo-Swiss (DST-CTI): One flagship project in the area of Medical research has been sanctioned against the Joint call for proposal launched inviting industrial R&D project proposals.

Joint R&D Centers of Excellence

Support continued for 13 Joint Thematic Centers of Excellence in their respective thematic areas. These centers are pursuing high end science, working out new technologies and interacting with user community for possible technology transfer. These joint centers are:

- Powder Metallurgy & New Materials, Hyderabad
- Vaccine Manufacturing Facility, Bulandshahr
- Advanced Computing, Moscow

- Biotechnology, Allahabad
- Gas Hydrate, Chennai
- Ayurvedic Research, Moscow
- Earthquake Research, New Delhi
- Water Research, Hyderabad and Bangalore
- Advanced Manufacturing and Fabronics, Kanpur
- Advanced Materials Research, Bangalore
- Non-ferrous Metallurgy, Jamshedpur
- Biomedical Technology, Trivandrum
- Laser & Accelerators, Indore

Fellowships/ Tanning under Bilateral Frameworks

Outgoing Fellowships for Indian Scientists:

1. **HOPE Meeting:** 9 students in the area of Physics have been deputed to Japan to meet Japanese Nobel Laureates.
2. **Lindau Nobel Laureates Meeting:** 20 students/young researchers in Interdisciplinary areas i.e. Physics/Chemistry/Physiology & Medicine were deputed for participation in the Meeting of Nobel Laureates and Students at Lindau Germany during June/July 2010.
3. Four Indian scientists/experts awarded fellowships to visit Germany for a period of 30 days under DST-DAAD Senior Scientists exchange programme.
4. 12 Indian PhD students awarded fellowships to work in Swiss R&D institutes for upto 12 months duration under Indo-Swiss Research fellowship programme.
5. 10 Indian senior scientists' awarded fellowship to use advance facilities at Swiss Institutes under Indo-Swiss JUAF programme.
6. 5 Indian young scientists supported under DST-MPG Fellowship programme.

Incoming Fellowships for Foreign Scientists to India:

Research Training Fellowship for Developing Country Scientists (RTF-DCS Program) :

- ◆ **ILTP Fellowship:** ILTP Fellowships were awarded to Russian scientists to work in Indian laboratories. Based on the recommendations of the last ILTP Joint Council, terms of this fellowship have been revised. It will provide better environment to the Russian scientists to Work in Indian laboratories in sophisticated manner.
- ◆ **CV Raman Fellowships for African Researchers:** The fellowships programme was launched in February 2010 (Total 416 fellowships in three categories every year). Total 85 candidates were selected for the fellowship from the various African countries.

- ◆ 5 Swiss scientists and PhD students awarded fellowships to work in India research institutions under ISJRP programme.
- ◆ **An international training on IPR** was organized by NAM S&T Centre which was supported by DST.
- ◆ **Asian Science Camp:** 40 students from Asian country and 30 senior scientists from different parts of world participated in the camp.

International Advanced Research Facilities- India's Engagements

- ◆ **Facility for Anti Proton Research (FAIR):** India signed the FAIR Convention Act to become member share holding country at the Facility for antiproton and Ion Research (FAIR), at Germany. The FAIR Convention and other documents are being processed for approval of Cabinet.
- ◆ **Indian beamline at KEK Japan:** Indian beam line has been fabricated at Photon Factory KEK, Japan and ready for conducting the experiments concerning powder diffraction, single- crystal diffraction and small angle scattering etc. 50 % of the total beamline will be available to the Indian users and remaining 50% will be available to the general users.

Following Bilateral Workshops were organized under S&T Programme of Cooperation

Themes of Bilateral Workshop	Partner Country	Venue/Dates
Sustainability	Germany	IIT, Delhi, February, 2010
Solar Energy	Australia	Amity University, Noida, February, 2010
Solar Physics	China	IIA, Bangalore, March, 2011
Nanotechnology 2010	Australia	Australian National University, Canberra Jun,
Information Technology	Spain	IISc Bangalore , Jun, 2010
Satellite Symposium on Transcription	Japan	Okinawa, Japan, July, 2010
Artificial Intelligence	Russia	Surat, September 2010
Biodiversity	SAARC	BHU, Varansi, September, 2010
Frontiers in Molecular Spectroscopy: from Gas Phase to Proteinsand	Japan	Kobe, Japan, September, 2010
Fuel Cell Technology September, 2010	UK	Centre For Fuel Cell Technology, Chennai,
Chip design for embedded systems	Taiwan	BITS Pilani, September, 2010
Bridging the Urban / Rural Divide	UK	Magan Sangrahalaya Samiti, Wardha, October, 2010
Advanced Materials	Russia	Moscow, October 2010
Hypospadias DSD	SAARC	AIIMS, New Delhi, October 2010
Earth System Sciences	Russia	Moscow, November, 2010
Themes of Bilateral Workshop	Partner Country	Venue/Dates

High Performance Computing	Russia	Pune, November 2010
Infectious Diseases	Russia	Chandigarh, November, 2010
Environment	SAARC	ATRRE, Bangalore, Nov. 2010
Energy storage devices	Taiwan	IISc Bangalore, Nov., 2010
Asian Academic Seminar on “Recent advances in the study of clusters, nanomaterials and surfaces with new properties and functions”	Japan	SINP, Kolkata, November,2010
Water & Bio-resources	EU	New Delhi, November, 2010
Water Technology	EU	IISc. Bangalore, November, 2010
Global Outreach of Indian & European Innovation Clusters	EU	MDI Gurgaon, December, 2010
JSPS-DST School on “Synchrotron X-ray Techniques for Nano Structured Materials”	Japan	SINP, Kolkata, December, 2010
Preparation and characterization of silicon for photovoltaic application	Russia	New Delhi, December 2010
Electronic structure of Novel Magnetic and Superconducting Materials	Japan	University of Tokyo, Japan January, 2011
Astronomy	Russia	Nainital, February, 2011
Advanced Manufacturing	Japan	IIT, Delhi March, 2011
Water Technology	Tunisia	Tunis



Fig. 8.1: Recent signing of Integrated Long Term Programme of Cooperation in Science, Technology & Innovation with Russia on December 21, 2010 at New Delhi

DST-india And RC-UK Research Initiative on Solar Energy

The Department of Science and Technology, India 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. 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. The areas of mutual interest identified for cooperation include the following:

1. Thin Film Performance and Stability
2. PV power systems and distribution
3. Cost Effective isolated PV Systems
4. Low cost materials for PV and
5. Excitonic Solar Cells with focus on cost reduction

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

Sr. no.	Proposal Title	Lead Partner - India	Lead Partner - UK
1	Advancing the efficiency and production potential of excitonic solar cells (APEX)	Dr Suresh Chand NPL, New Delhi	Prof Hari Mohan Upadhyay, University of Loughborough
2	Stability and performance of Photovoltaic (STaPP)	Prof Rajesh Gupta, IIT Bombay	Dr Ralph Gottachalg, University of Loughborough

These projects are Multi-Institute Projects which involve large number of participating Institutes with engagement of many researchers and faculty members from participating institutes from UK and India. These proposals would be funded from SERC (R &D) Program of DST for supporting the Indian side. The total tentative cost of these projects is around Rs 20 Crores.

NATIONAL S&T OUTREACH STATE SCIENCE AND TECHNOLOGY PROGRAMME

State Science & Technology Programme (SSTP) formerly known as “*Scheme for Assistance for development of State Councils for Science & Technology*” is the only scheme of the Central Government focused on the specific objective of promotion of Science & Technology at state level. The scheme, formulated at the instance of Planning Commission, is being implemented by Department of Science & Technology (DST), Government of India since VI plan. The core support and programme support provided under the programme has played an important catalytic role and facilitated State Science & Technology Councils to act as a nodal organization for planning, formulating, evaluating and implementing Science & Technology activities at State level. The core support provided by the department has enabled State S & T Councils to equip them with requisite S & T manpower and office infrastructure which has contributed to their effective functioning. The programmatic support, on the other hand, aims to demonstrate, through carefully chosen projects, the contributions that science & technology interventions can make in the development process of the State.

As a result of catalytic role played by DST in close cooperation with the Planning Commission and States/Union Territories (UTs), State S&T structures have been set-up in all the States. The most significant

areas promoted by State S&T Councils are popularization of Science, S&T Entrepreneurship Development, S&T for Weaker Sections and Women, Programmes for Young Scientists, Biotechnology Programmes, Application of Remote Sensing Technology, Environment Programmes, Non-Conventional Energy Programmes and location specific need based R&D Projects for providing solution to local problems of the nationals residing in various states.

In order to give focused attention to identification and demonstration of S&T projects including field trials, a special mechanism in the form of Core Group on State S&T Demonstration projects is operational. The mandate of this Core Group is to facilitate identification of technologies developed in the S&T institutions alongwith their field trials and demonstration in various states at a sizeable scale so that the benefits of intervention are quite visible. This group, in one of its meeting considered 22 new projects in diverse areas of Socio-economic importance and also monitored 33 ongoing projects. The group recommended demonstration of specific indigenous technologies in the fields of bio-fuel, waste management, decentralized energy generation and water purification at appropriate locations.

The following thrust areas have been identified by the Department for providing technological solutions for the state development by identification of local problems on basic needs of society such as Food, Shelter, Water, Energy, Health.

Some of the important achievements during the year under various activity heads of the programme are enumerated below:

1. Core Support to State S&T Councils

Core support was continued to the State S&T Councils of 25 States/Union Territories. The support was oriented towards providing S&T manpower to strengthen S&T capabilities of the State S&T Councils to undertake programmes in newer and emerging areas. An amount of ₹ 9.40 crores was provided under this during the year.

2. Demonstration Projects including Replication of Success Models

Some of the major achievements were in the following areas:

Micro-Hydel System: A decentralized energy generation plant of 2 X 50 KW capacity based on indigenous micro-hydel technology was installed and commissioned at Dailong village in Manipur.



Fig. 8.2: Micro Hydel Power Plant in the Power House at Dailong Village, Manipur

- **Soil Reclamation:** A project on planned development of protocols for utilization of the tide land for brick manufacture after analysis of geo-consequences of mining was initiated in the state of Tripura
- **Water Purification Technology:** One defluoridation plant of 4000 LPH capacity was installed at Nagla Chandrabhan in Village Farah, Mathura. The plant design is made for feed water having TDS upto 5000-6000 ppm & fluoride ranging from 1 ppm to 8 ppm. It has been designed to serve a community of 3000 to 4000 people.



Fig. 8.3: Low Energy Membrane Desalination & Defluoridation Plant installed at Nagla Chandrabhan Village, Mathura, U.P.

- **Organic Agriculture:** Organic Agriculture programme based on Science and Technology inputs was successfully completed in the State of Sikkim. 3740 farmers were registered as organic farmers in East, West and South Sikkim over a period of three years.
- **Natural Resources:** A project was initiated on Production and Demonstration of High Quality planting material of elite genotypes of medicinal plant species of Haryana at Centre of Plant Biotechnology, Hisar, Haryana.

3. Information Exchange

A Brain Storming meeting of Scientific Advisory Council to PM (SAC-PM) with State S&T Councils was held on 27th March, 2010 at INSA, New Delhi. The meeting was presided over by Prof. CNR Rao, Chairman, Scientific Advisory Committee to Prime Minister. It was attended by S&T Secretaries of State and Union Territories and State S&T Council Heads. The theme of the meeting was “The role of State S&T Councils in emerging National context.”

4. Local Specific Research & Technology Development :

Following are the projects funded to different State S&T Councils during this period:

- **Development of Solar-powered rodent trap under the project Impact assessment of bamboo flowering on ecological and socio economic accounts in the Eastern Himalayas at North-Eastern Regional Institute of Science and Technology, NERIST Arunachal Pradesh**



Fig. 8.4: Prof. C.N.R. Rao, Chairman, Scientific Advisory Council to the Prime Minister addressing the Brain Storming Meeting



Fig. 8.5: Set up of the master and supporting rodent traps in agricultural field at Arunachal Pradesh

- **Development of Human Resource in Blue Green Algae and *Azolla* and their Promotion in Agriculture at Centre for Conservation and Utilisation of Blue Green Algae, Indian Agricultural Research Institute, New Delhi-110 012.**
- **Developing onshore broiler culture technology for fattening of baby rock lobster for export at Centre for Marine Science and Technology Manonmaniam Sundaranar University, Kanyakumari District**
- **Biodiversity, Biosystematics and Predatory activity of spider fauna of Jammu and Kashmir at Sher-e-Kashmir University of Agricultural Sciences Technology of Kashmir, Shalimar Campus, Srinagar – 191 121**
- **Improvement of economic traits of silkworm, *Bombyx mori* through fortification at KSSRDI, Bangalore-560 062.** Keeping in view the relationship between nutritional quality of mulberry leaf and cocoon yield, the formulation of fortificant combination has been worked out. The crude extracts



Fig. 8.6: Field training and demonstration to the farming community on Blue Breen Algae and Azolla

of shortlisted plants (*Viz. withania somnifera & Tribulus terrestris*) have been tested through bioassay. The larval weight, cocoon weight etc. were significantly higher in silkworm batches (PM x CN2, PM x C110) treated with new formulation of fortificant. The soluble sugar and soluble proteins in rainfed mulberry is less than irrigated mulberry leaves and in such areas the field trials were conducted.

The activity of digestive amylase; values of larval weight and silk gland weight are significantly higher in treated batches compared to control batches. The silk gland weights and bioenergetics study were conducted for fortificant combination with *Withania Sp.* (treatment) as one of the sources of fortificant. This cue was exploited during the field trial studies. Field validation of fortificant formulation was conducted in different villages of Chamarajanagara district for 15 sericulture farmers. The improvement of cocoon yield was observed through use of fortificant formulation and it is tentatively named as '**Poshaka**' for commercialization.



Fig. 8.7: Mulberry leaves fortified with Poshaka fed to silk worms

- **Medicinal Mushroom Cultivation: rendering self reliance to the Women Self Help Group and Disabled persons and alleviating poverty** at Kongunadu Arts and Science College, Coimbatore – 641 029, Tamilnadu. The project aimed on creating scientific intervention on Medicinal Mushroom Cultivation: rendering self reliance to the Women Self Help Group and Disabled persons and alleviating poverty.
- **Capacity building and Awareness Campaign on Global Climate Change, vis-à-vis, Disaster Mitigation** at Goa State Council for Science & Technology, Opposite Saliago Seminary, Saligao, Bardez, Goa. The project aimed to create awareness, organize capacity building programs/ workshops including field observations/visits, for a number of stake holders/beneficiaries, so as to sensitize students, teachers, general, public, NGO's, for the concern towards combating global climate changes, disaster mitigation, prevention, preparedness, response, recovery etc. It also includes development, procuring and reproducing requisite resource material like hand outs, slogans, brochures, tit bits, power point presentation, films, CD's and documentaries on the subject of climate change, global warming and disaster mitigation, for the campaign and workshops.
- **Delineation of Potential Areas for commercially important Medicinal and Aromatic plants in different Agro – ecological Zones of Karnataka using GIS** at Central Institute of Medicinal and Aromatic Plants (CIMAP) , Research Center, Bellary Road , Allalasanra GK VK Post , Bangalore-560065 in collaboration with National Bureau of Soil Survey & Land Use Planning (NBSS & LUP) , Hebba , HAF Post , Bangalore. The project is aimed to develop inventories and characterize the bio-physical, chemical and climatic factors for commercially important MAP's in their natural habitats and cultivators fields in different agro-ecological zones (AEZ) of Karnataka. This information will be used to correlate the agro-ecological condition with productivity and quality of MAP's and delineate potential areas for different MAPs in different AEZs in Karnataka using GIS.
- **Heavy metal pollution of Adyar waters: Analysis and Bioremediation of Sri Ramachandra University Chennai.** The project is aimed to sample Adyar surface waters at different locations, analyze the presence of major heavy metals and their concentrations and draw a conclusion to localize the exact point/points where the influx of these metals happen specifically for a period of two months to assess the seasonal variations. The total Heterotrophic Bacterial Count at the sampling site will be determined and the heavy metals will be removed *in vitro* using bacteria. The reduction in the concentration of heavy metals will be analyzed after bioremediation for further demonstration of this technique.

ADMINISTRATION & FINANCE

Department of Science and Technology is the nodal Department of the Ministry of Science and Technology. The Organizational Structure of the Department has evolved over the years to respond quickly to the issues relating to the promotion and development of Science & Technology in the country. It has two Subordinate Offices, viz., National Atlas and Thematic Mapping Organisation (NATMO) and Survey of India (SOI) under its administrative control. In addition to it, the Department also supports Autonomous Research Institutions/other bodies and 5 Science/Engineering Academies/Associations, which are working in diverse areas for the promotion of Science and Technology.

The Administration and Finance Divisions of the Department look after the support facilities for the Subordinate Departments and Autonomous Bodies including the personnel and financial administration. The activities undertaken by the different wings during the period under report are given as under:

RECRUITMENT CELL

Recruitment Cell in this Department is 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 and Technology Group 'A' Gazetted posts (non-ministerial, scientific and technical) Rules, 2004.

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 two posts of Scientist 'D' and one post of Scientist 'C' (Hearing Impaired) by direct recruitment in this Department. Also, recruitment on contract and co-terminus basis was made for two posts of Scientist 'E' in Nano Mission Department of Science & Technology. In addition to this, recruitment was also made to 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 (NSTEB) on contract and co-terminus basis.

The Assessment of eligible departmental Scientists for in-situ promotion under FCS reviews as on 01.01.2009, 01.7.2009 and 01.01.2010 was also done.

STAFF POSITION

DST has a total number of 219 Group 'A' and Group 'B' (Gazetted) Officers. A detailed break up is given below:-

	General	SC	ST	OBC	PH	Total
Group A						
Scientific	102	09	02	-	03	116
Non Scientific	26	-	01	-	-	27
Group B						
Scientific	06	02	01	01	-	10
Non-Scientific	52	09	05	-	-	66
Total						219

	General	SC	ST	OBC	PH	Total
Group B (NG)	98	25	03	04	01	131
Group C	57	12	04	07	—	80
Group D	52	63	06	03	01	125
Total	207	100	13	14	02	336

TRAINING

During the year 2010-11, 41 training programmes were held which include two training programme postponed from 2009-10 to 2010-11. During 2010-11, 39 training programmes had been successfully conducted and two training programme postponed from 2009-10 to 2010-11 were also held. The training programmes were held on various topics as per following table:

Institution	Name of Training Programme/ duration	No. of Programmes
Administrative Staff College of India, Hyderabad	Science Administration and Research Management (2 weeks)	2
	Creativity and innovation Management in Research (2 weeks)	2
	Advance Techno-management for Middle Level Scientists (5 weeks)	2
	General Management Programme for senior scientists (2 weeks)	2
	General Management Programme for middle level scientists (2 weeks)	2
	Technology Valorisation and Management Programame (2 weeks)	2
National Institute of Advanced Studies, Bangalore	Multidisciplinary Perspectives on Science, Technology & Society (2 weeks), National Security (1 week)	1
Lal Bahadur Shastri National Academy of Administration, Mussoorie	Science & Technology for Rural Societies Programme for Jr. & Middle level Scientists (2 Weeks)	2
	Management and Leadership Development Programme (1 week)	2
	Ethics and Values (1 week)	1

Institution	Name of Training Programme/ duration	No. of Programmes
Indian Institute of Public Administration, New Delhi	Enabling Administrative personnel of S&T Departments (3 weeks)	2
	Advanced Computer Application (1 week)	2
	Cyber Laws and Information Security (1 week)	2
	Foundation Trg. Programme for scientists (12 weeks), Cyber laws, Information Security (1 week)	1
Wilelife Institute of India, Dehadun	Biodiversity Conservation (1 week)	1
Consumer Unity & Trust Society, Jaipur	Technology Diplomacy (1 week)	2
Centre for Cellular & Molecular Biology, Hyderabad	Bioinformatics – Current Trends and Perspectives	2
Indian School of Mines University, Dhanbad	A Primer on Geostatistics (1 week)	1
Indian Council of Forestry Research and Education, Dehradun	Climate Change and Carbon Mitigation	1
Xavier Institute of Management, Bhubaneswar	Communication and Presentation Skills (1 week)	1
National Institute of Financial Management, Faridabad	Financial Management in Scientific Organisations (1 week)	1
Indian Institute of Forest Management, Bhopal	Natural Resource and Environment Management (1 week)	1
All India Institute of Medical Sciences, New Delhi	Research Methodology (1 week)	1
Institute of Management Training and Research, Goa	Leveraging Innovation for Scientists & Technologists (1 week)	1
Management Development Institute, Gurgaon	High Performing Team (1 week)	1
Technology Information, Forecasting and Assessment Council, New Delhi	IPR and related WTO Issues (1 week)	2
The Energy Resources Institute, New Delhi	Advances in Biotechnology (1 week)	1

3. Under the Foreign Training Component, 25 junior scientists were deputed for five day training in Taiwan during the current financial year.

WOMEN COMPONENT PLAN

Under women component plan '14' training programmes exclusively for women scientists were planned. The training programmes were held on various topics as per following table.

Institution	Name of Training Programme/ duration	No. of Programmes
Xavier Institute of Management, Bhubneswar	Communication and presentation skills (1 week)	1
National Institute of Advanced Studies, Bangalore,	Gender Issues in Science & Technology (1 week)	1
Wildllife Institute of India, Dehradun	Role of Scientists in Biodiversity Conservation (1 week)	1
Indian Institute of Forest Management, Bhopal	Role of Scientists in Community Resource Management (1 week)	1
Administrative Staff College of India, Hyderabad	High Performing Team and Leadership Issues (1 week) General Management Programme (2 weeks))	1 1
Indian Institute of Public Administration, New Delhi	Cyber Laws and Information Security (1 week)	1
Academy of Human Excellence, Baroda	The science of living (1 week)	1
All Indian Institute of Medical Sciences, New Delhi	Research methodology (1 week)	1
Indian Council of Forestry Research and Education, Dehradun	Climate Change and Carbon Mitigation (1 week)	1
M. S. Swaminathan Foundation, Chennai	Issues of sustainable development (1 week)	1
Management Development Institute, Gurgaon	Gender Issues in Human Resource Development (1 week)	1
Institute of Management Training and Research, Goa	Excellence and Attitude (1 week)	1

PARLIAMENT UNIT

The Parliament Unit is assigned with the responsibility of handling entire parliamentary work of the Department. It ensures that the parliamentary work pertaining to the Ministry of Science & Technology is accomplished as per the prescribed schedule and procedures. The Unit maintains liaison with the Ministry of Parliamentary Affairs, Secretariats of Lok Sabha/Rajya Sabha, and other Ministries/Departments (including Scientific Departments) with a view to fully discharge the parliamentary obligations of the Ministry of Science & Technology. The Unit also coordinates the visits of Parliamentary Committees to various scientific institutions which are under the administrative control of this Department.

The Parliamentary Standing Committee on Science & Technology, Environment and Forests met on 30th March, 2010 to discuss the Demands for Grants for the year 2010-11 of the Department and submitted its recommendations in its 209th report presented to the Parliament on 23rd April, 2010. The Action Taken Report on the recommendations of the Parliamentary Standing Committee was also submitted to the Secretariat of the Committee as per schedule.

CDN SECTION

A total number of 235 RTI Applications including Appeals were received in CDN for the period 1-4-2010 to 11.11.2010. Almost all the applications have been replied in time by the concerned Divisions. Appeals have been disposed as per the provisions of the RTI Act.

HINDI SECTION

The Department of Science & 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 there under 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 which caters to the need of the Department of Science & Technology and also its subordinate offices / Autonomous Institutions. Besides monitoring the implementation of the Official Language Policy and the Annual Programme, 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 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 to be published very shortly 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 2006-2007 and 2008 were invited.
- The officers of Hindi Section conducted inspections of Subordinate offices / Autonomous Institutions and 6 sections of the department regarding progressive use of Hindi.
- During the year, quarterly meetings of Departmental Official Language Implementation Committee were organized regularly. Likewise, Hindi workshops were organized to encourage the officers / staff of the department to do their maximum work in Hindi.
- Action is being taken to reconstitute the Hindi Salahkar Samiti of this Ministry.

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 28 September, 2010 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 18 aided institutions, 5 professional bodies and 1 statutory board, it deals with complaints received from Central Vigilance Commission, Central Bureau of Investigation, Department of Personnel & Training and individuals. Vigilance Unit also plans annually the vigilance inspections of the institutes and subordinate offices. As per the approved plan, inspection of Sree Chitra Tirunal Institute of Medical Science and Technology, Thiruvananthapuram and Northern Printing Group, Survey of India, Dehradun were carried out during the current financial year, 2010-11.

Vigilance Awareness Period was observed in the Department during 25th Oct.2010 to 01st Nov., 2010, wherein in addition to administering pledge to Officers and staff of DST & DSIR, a talk on "Generation of Awareness and Publicity against Corruption" was delivered by the ex-Director, Central Vigilance Commission, New Delhi. (Photographs are enclosed)

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.



AUTONOMOUS S&T INSTITUTIONS AND PROFESSIONAL BODIES

The Department supports a 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, 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.

AGHARKAR RESEARCH INSTITUTE

Agharkar Research Institute, Pune was established in the year 1946. The Institute is grouped as an academic institution under Life Sciences. The total number of Employees are 155 out of 46 is research faculties.

AREAS OF RESEARCH FOCUS

Division of Animal Sciences - Biometry: Community nutrition, Anaemia in women, Human nutrition and health; Chemistry: Pheromones, Natural Product Chemistry and analytical chemistry; Geology: Georesources and Mesozoic biosphere evolution of Peninsular India and Andaman Nicobar islands. Paleoenvironments, Paleoclimates and biological evolution of Tertiary and Quaternary deposits of west coast of India; Zoology: Developmental biology

Division of Microbial Sciences - Microbiology: Exploring natural microbial researches for betterment of human life and environment, Bioremediation and biodegradation of toxic chemopollutants, Bioenergy, Microbial diversity and conservation; Nanobioscience: to improve agriculture, human health and environment.

Division of Plant Sciences - Botany: Biodiversity evaluation, conservation and Bioprospecting; Standardization of medico-botanical resources; Core activities – Herbarium (AHMA) and crude drug repository; Genetics: Crop Improvement

Mycology: Fungal Biodiversity and Bioprospecting, Biodiversity and Bioprospecting of Lichens from Western Ghats, Biodiversity of Fungi and their biotechnological Applications

MAJOR RESEARCH ACCOMPLISHMENTS:

Division of Animal Sciences

Research in human nutrition and health revealed some interesting facts. Apo-B was found to be a better predictor of risk for high systolic blood pressure in the studies on understanding early origins of blood pressure among young rural adults. Supplementation of protein-rich soybean based foods among

primary school children led to upward shift in height status. In the All India Coordinated Project on prevention of anaemia among young rural women in India through various social actions survey tools for data collection were standardized.

Studies in phytochemistry, semiochemicals, pheromones demonstrated pheromone-like properties of de-oiled leaf extract of *Swertia densifolia* towards *Apis cerana indica*. Essential oil of *Terminalia chebula* fruits was shown to possess repellent properties for the Indian honeybee *Apis florae*. A Simple Route for Isomerization of geraniol into nerol and Linalool using γ -Irradiation was developed. Analytical method for analysis of phyllanthin and hypophyllanthin in the extract of *Phyllanthus amarus* was developed.

Palaeobiology studies focussed on holocene mangrove vegetation dynamics of Konkan Coast; ichnofauna and Palaeoenvironment of the Jaisalmer formation Rajasthan and Palaeocene formation of Kuchh, Gujarat; phylogenetic studies of fossil palms; application of foraminifera for sea level changes, neotectonics and evolution of Andaman coast and Savitri estuary.

Research in developmental biology led to isolation and characterization of *Noggin* gene from hydra for the first time. Protein structures of *Homo sapiens* (A), *Xenopus laevis* (B), *Nematostella* (C) and hydra (D) Noggins were deduced using Swiss Model program based on homology modelling (Fig.1).

Division of Microbial Sciences

Microbial production of biodegradable plastic was scaled up. Production of biodegradable co-polymer, poly- α -hydroxy butyrate-co-poly- α -hydroxy valerate (PHB-co-PHV) by moderately haloalkalitolerant bacterium *Halomonas campisalis* MCM B-1027 in 14 L SS fermenter resulted in 51% yield of the polymer on dry cell weight basis under oxygen limiting condition (Fig.2). Halophilic archaea isolated from Andaman islands were found to produce poly- α -hydroxy butyrate (PHB), a biodegradable polymer. A microbial consortium capable of microbial enhanced oil recovery from dead reservoirs was developed for extracting oil from dead reservoirs around 96°C temperature and 2000 psi pressure. It has given recovery of oil in the range of 11-24% in core flood studies. The culture is being used in field at a scale of 2,00,000 L.

Lanthanum Strontium Manganese Oxide (LSMO) nanoparticles coated with dextran (Dex-LSMO) have been identified as a new heating agent for potential application in treatment of cancer by hyperthermia. Based on μ Spore[®] DNA preservation technology two new products viz. μ Spore^{fidelity} for transportation of DNA samples and μ Spore^{infinity} for long term preservation are now available for commercialization. Anti-diabetic potential of *jasada bhasma*, a traditional zinc based ayurvedic (nano) medicine, was validated in rat model. A novel prototype kit employing molecular recognition element (MRE) tagged magnetic nanoparticles has been developed for rapid identification and antibiotic susceptibility testing of microbial pathogens.

Division of Plant Sciences

A manual for field botany was published. Three soybean and twelve wheat entries developed by ARI were included in national initial evaluation trials. Institute supplied 94 and 243 quintals of soybean and wheat breeder seed, respectively to seed multiplying agencies.

A Catalogue of Lichen Herbarium at Ajrekar Mycological Herbarium has been prepared. It gives the passport information of 30,000 lichen specimens.

IMPORTANT HIGHLIGHTS OF MAJOR RESEARCH PROGRAMMES (2010-2011)

Division of Animal Sciences

Plant based attractant and repellent formulations for honey bees were developed. Applications of the attractant formulations for crop improvement were demonstrated.

Division of Microbial Sciences

High biohydrogen yielding *Clostridium* sp. DMHC-10 was isolated from sludge of distillery waste treatment plant. An alkaliphilic strain of *Exiguobacterium aurantiacum* is reported for the first time to produce cyclodextrin glycosyl transferase (CGTase) that converts starch into cyclodextrins having industrial applications. Bread prepared using CGTase was better in texture, firmness and durability than the normal bread.

Preliminary studies on dextran coated Lanthanum Strontium Manganese Oxide (Dex-LSMO) as targeted hyperthermia agent for treatment of cancer are complete and Dex-LSMO is now ready for demonstration of radio frequency induced hyperthermia and tumor regression in animal model. A platform technology (μ Spore DNA preservation technology) for DNA preservation at room temperature has been developed.

Division of Plant Sciences

Seven species of family Amaryllidaceae were critically studied in situ for distribution diversity, ecology. The germplasm was maintained live in nursery and studied for propagation through vegetative methods.

MACS 6222 a bread wheat variety was identified and subsequently released for cultivation in peninsular zone of India covering Maharashtra and Karnataka. This variety recorded the highest average yield (47 q/ha), showed early maturity, high test weight and high resistance to black and brown rust.

Major and Unique National Facilities created (2010-2011)

Under the National Certification System for Tissue culture raised plants (NCS-TCP), the laboratory in the Genetics and Plant Breeding Group have been recognized as Accredited Test Laboratory (ATL) for genetic fidelity testing of tissue culture raised plants mainly for banana and sugarcane.

COLLABORATIONS (NATIONAL AND GLOBAL) ESTABLISHED (2010-11)

University of Agricultural Sciences, Dharwad, Karnataka

Sree Chitra Tirunal Institute for Medical Sciences and Technology, Trivendrum

Shivaji University, Kolhapur

IMPORTANT OUTPUT INDICATORS (2010-11)

1.	Publications	95
2.	Patents/ know-hows	6
3.	Designs and other intellectual Products	Monographs 5
4.	Post Graduate and PhDs trained	PhD 49, PG 15

EMINENCE INDICATORS (2010-11)

For Academic Institutions

1.	Impact Factor Aggregates	111.993
2.	Citation frequencies	Biometry 147, Nanobioscience 226
3.	Number of Fellows of the Academy and SSB winners	1 Dr SM Ghaskadbi, FNASc, Allahabad

For Applied Research based Institutions

1.	Technology products developed/ patent portfolio	3
2.	National missions led and coordinated	Implementation WOS-B scheme, DST
3.	Any other original Expert system devised	New system for online submission of proposals under WOS-B scheme

VISUAL OUTPUTS

5 Monographs on medicinal plants were published by ICMR in volume 8 of Quality Standards of Indian Medicinal Plants.

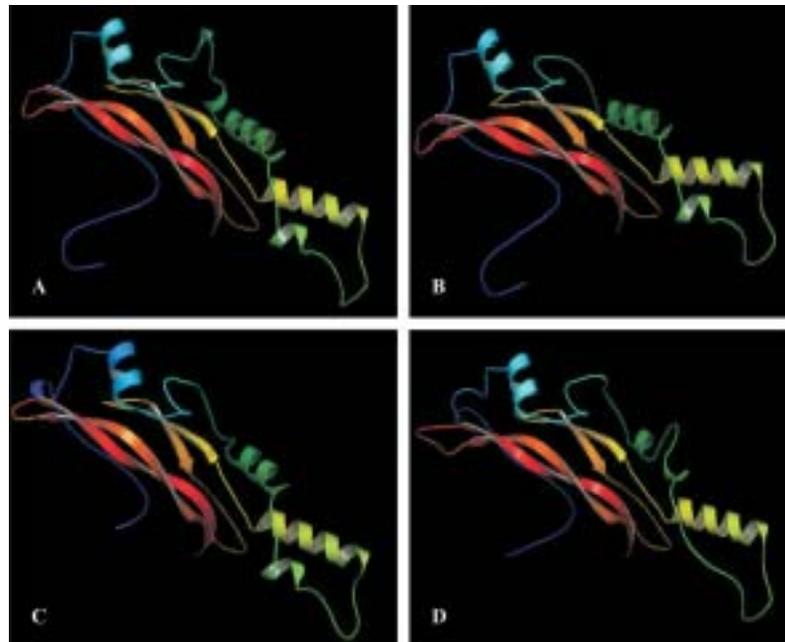


Fig. 10.1: Comparative analysis of hydra Noggin protein structure

Protein structures of *Homo sapiens* (A), *Xenopus laevis* (B), *Nematostella* (C) and hydra (D) Noggins were deduced using Swiss Model program based on homology modelling.



Fig. 10.2: Polymer bags prepared using PHA films formed by *Halomonas campisalis*

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)

The Institute continued its endeavor to make important scientific contribution in the front-line problems of astronomy & astrophysics and atmospheric sciences. The synopses of the ongoing knowledge creation activities and facilities in the different research groups, which have been published as research papers in refereed National and International scientific journals and major developments and academic activities carried out are summarized below:

1. ARIES is establishing a 3.6 meter Devesthal optical telescope (DOT) as a national facility in optical astronomy at Devesthal to fulfill the major aspiration of the Indian astronomical community. The activities related to the DOT are going in full swing. The Zerodur 3.7 meter blank of the primary (M1) mirror has arrived LZOS, Russia from Schott, Germany for polishing. The M1 mirror is polished within 12 micron. The polishing of Astrosital M2 mirror was completed in March 2010. The design of the enclosure and extension building was completed during the period. The contract for civil work up to plinth level and site development was awarded to M/s Vidyawati, Allahabad.
2. A contract to design and install aluminizing plant for aluminizing mirrors upto 3.7-meter size has been given to M/s HHV, Bangalore. The ARIES Devasthal Faint Object Spectrograph and Camera (ADFOSC) will be the first light instruments at the axial port of the Cassegrain focus of the 3.6-m Devesthal Optical Telescope. The instrument will cover the wavelength range 350-1000 nm and it will have two distinct mode of operation – (i) Direct broad and narrow-band imaging capabilities with spatial resolution of less than 0.2 arcsec in 10 arcmin field of view and. (ii) Low-to-medium resolution spectroscopy with spectral resolution (250-4000) covering the optical wavelengths 360-1000 nm. The optical and mechanical design of ADFOSC is under progress.
3. The 130-cm telescope manufacturing has progressed at the contractor's factory. After the initial testing by the contractor, the telescope was shipped in March 2010. The 130-cm building at Devesthal has been completed. The roll-off-roof has been made operational.
4. The Schmidt telescope was assembled and inspected on dummy steel piers at M/s Avasarala Technologies Ltd., Bangalore. The mechanical parts of the telescope have been delivered at ARIES site in March 2010.

5. The optical alignment of the 38-cm Cassegrain-Mie telescope of the LIDAR has been carried out. Department of Science and Technology has approved a Stratosphere-Troposphere (ST) Radar at ARIES, Nainital. Foundation stone for ST Radar building was laid by Prof. B. M. Reddy, Emeritus Scientist and Chairman of Project Management Committee (PMC) for ST Radar on 4th November, 2009. Civil work for this building has been awarded to M/s Zepplin, Indore. The design reviews of ST Radar system are over and it is now on the manufacturing stage by the vendor ECIL, Hyderabad.
6. The construction of hostel building, science centre, Electronics Lab/Lecture Theater, Workshop Buildings, Schmidt telescope building has been completed.
7. Academic staff members continued to pursue vigorously 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. *Astrophysical Journal*, *Monthly Notices of Royal Astronomical Society*). Forty-five papers were published/accepted in refereed journals, and another seven were published as circulars and conference proceedings. Two Ph. D. theses have been awarded and another two have been submitted. Academic and technical interaction with various institutions and universities were continued. Following are the major scientific results:
 - (i) A multiwavelength investigation of star-forming region Sh2-100 reveals that the spatial distribution of infrared excess stars correlates well with the association of gas and dust. The positions of infrared excess stars, ultracompact and compact H II regions at the periphery of an H I shell, possibly created by a WR star, indicate that star formation in Sh2-100 region might have been induced by an expanding H I shell.
 - (ii) The integrated parameters for synthetic clusters as well as the observed integrated parameters for galactic open clusters, Large Magellanic Cloud (LMC) and Small Magellanic Cloud (SMC) star clusters have been estimated. It is found that the colour evolution of the MS population of star cluster is not affected by the stochastic fluctuations, however, these fluctuations significantly affect the colour evolution of the whole cluster population. Therefore, in the absence of a careful modeling of stochastic effects, age determination of young star clusters by comparing their integrated colours with whole cluster synthetic colours may yield erroneous results.
 - (iii) X-ray temporal and spectral properties of two WR binaries, V444 Cyg and CD Cru, observed with high-sensitivity EPIC instruments on board the XMM-Newton satellite were analysed. The study of the X-ray spectra reveals cool as well as hot temperature plasma components of binary stars, which are fitted consistently with 2T plasma models. The cooler plasma component was found to be constant at all phases with a mean value of ~ 0.6 keV for both binaries. The presence of a cooler component could be a result of the distribution of small-scale shocks in the radiation-driven outflows from either the primary or the secondary star in the binary systems.
 - (iv) Using the analysis of H-beta and MgII emission lines of a sample of QSOs, the black hole masses and Eddington ratios were estimated. It is found that both equivalent widths (EW) and FWHM of lines anticorrelate with Eddington ratios. The EW distributions provide no evidence for the hypothesis that a weak jet component in the RQQSOs is responsible for their microvariability.

- (v) Using three different techniques to search for periodic oscillations in RXTE ASM data of 24 blazars, an apparently real periodic component of about 17 days and 420 days for the blazars AO 0235+164 and 1ES 2321+419 was found. Most likely detected periodic oscillations arise from the intersections of a shock propagating down a relativistic jet that possesses a helical structure.
- (vi) A multi-wavelength analysis of a long duration white-light solar flare(M8.9/3B) occurred on 4 June 2007 indicates that the activation of successive helical twists in the magnetic flux tubes/ropes plays a crucial role in the energy build-up process and triggering of M-class solar flare without a CME.
- (vii) Regional population is shown to have maximum contribution (16.5 ppbv) to ozone levels during May-June and it is about 7 ppbv on annual basis while contribution of long-range transport is greatest during January-March (8-11 ppbv). The modeled stratospheric ozone contribution is 2-16 ppbv.
- (viii) Analysis of BC mass concentrations, during ICARB, from a network of eight fixed stations showed lowest values of BC over Nainital, even lower than that of Port Blair, indication antropogenic influence over the island site and prevalence of cleaner environment over here.
- (ix) 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 programme, (ii) projects as part of academic course work, (iii) visits of students and staff from other institutions, and (iv) summer project student programme.
- (x) Several public outreach activities took place during the year including National Science Day on March 22, 2010 which had several exhibitions, talks and viewing of the night sky.
- (xi) The total solar eclipse observations of 2009, July 22nd from Anji, China has been successfully performed by the ARIES expedition team, and the analysed observations will provide the clues of magnetohydrodynamic (MHD) oscillations in the solar corona. In addition, experiments related to atmospheric science were also performed by ARIES team, which included the measurements of surface ozone along with all the meteorological parameters. These observations will be used to investigate the influence of total solar eclipse on surface ozone variability.
- (xii) 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 a bright future of the Institute.



Fig. 10.3. JHKs colour-composite (J, blue; H, green; and Ks, red) image of the Sh 2-100 star forming region. Locations of the associated compact and ultra-compact HII region in the complex are also marked.



Fig. 10.4. Mie LIDAR observations carried out at ARIES, Nainital



Fig. 10.5. 50-cm B-N Schmidt telescope and dome at ARIES, Nainital.

BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY

Birbal Sahni Institute of Palaeobotany, Lucknow was established in the Year 1946 under earth sciences. The total number of Employees is 168, and the total Number of Research faculties is 63, out of 51 scientists are having post-Doctoral research experience.

AREAS OF RESEARCH FOCUS:

Research activities are being focused on under following Thrust Area Programmes:

- 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).

MAJOR RESEARCH ACCOMPLISHMENTS:

Institute is carrying out researches with a commitment to ensure growth in basic and applied aspects of Palaeobotany and allied Earth System Sciences, especially focusing on past plant life and palaeoclimate. The palaeobotanical researches are being conducted right from Archaean to Recent in age ranging from 3200 Ma to 400 AD, which includes the Archaeobotany and Dendrochronology (tree-ring analysis) for the interpretation of climate change.

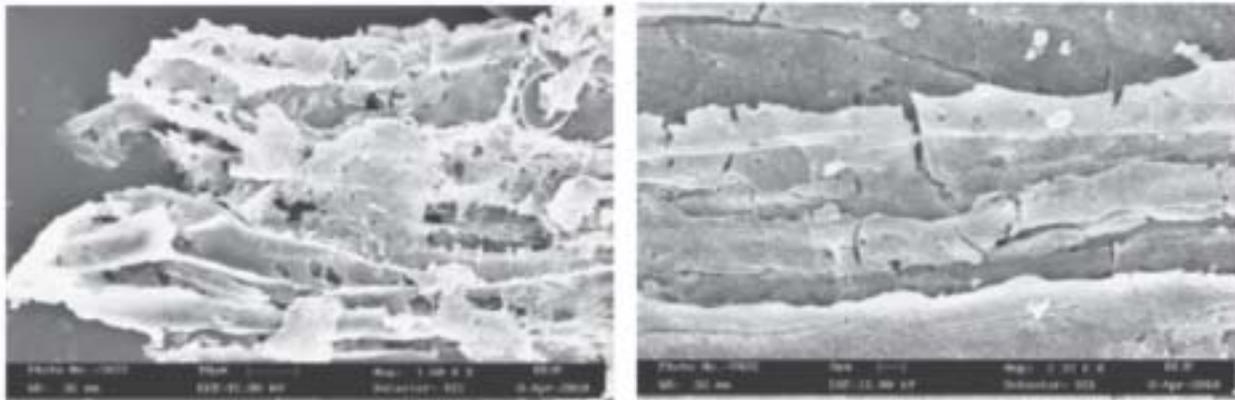
Emphasis has been laid to derive knowledge about the diversification of Precambrian life, diversity, distribution and inter- and intra-basinal correlation of Gondwana and Tertiary floras, terrestrial and marine microfossils and their application in solving geologic problems and hydrocarbon exploration, coal/lignite quality and to understand the interaction between the climate and vegetational changes during Quaternary Period.

IMPORTANT HIGHLIGHTS OF MAJOR RESEARCH PROGRAMMES:

- In search of early life, recorded a variety of cyanobacterial remains from the cherts of Bhandar and Salkhan Limestone sequences (Vindhyan Supergroup) exposed in MP. Organic-walled microfossils have also been recorded from Singhara and Raipur Groups of the Chhattisgarh Basin.
- Continued documentation of plant fossils (from Permian Gondwana sequences of Satpura, Mahanadi and Wardha basins, and Cretaceous sequences of South Rewa and East Coast K-G basins), and

spores-pollen assemblages from the coal-bearing Gondwana sequences (of Rajmahal, Birbhum, Raniganj, Tatapani-Ramkola, Sohagpur, Ib-River, and Godavari Valley coalfields) in order to demarcate their significance in biostratigraphic interpretation and coal seam's correlation, besides morphotaxonomy.

- Generated additional data on plant megafossils (from the Palaeogene horizons of Rajasthan, Gujarat, Maharashtra, Himachal Pradesh, Uttarakhand, Assam & Meghalaya) and micro-remains (pollen, dinocysts, nanno, DOM, etc.— from Kutch, Rajasthan, Assam-Arakan & Andaman basins) from certain terrestrial and marine Palaeogene horizons in terms of their palaeogeographic, age, facies and palaeoenvironmental significance, besides morphotaxonomy.
- Evaluated Tertiary lignites from Matanomadh field (Gujarat) suggest that the lignitebearing sequence has the potential to generate both oil and gaseous hydrocarbons on maturation; due to high TOC content and presence of mixed Type II/ III kerogen.
- Chronologies of past global climatic changes have been marked from the data generated (through pollen analysis, tree-ring & ancient plant economy; supported by geochemistry and mineral magnetic) from Late Quaternary sediments of Mahanadi & Godavari Deltas, Karawar Coast, south-western MP, Kumaun, Himachal & Ladakh Himalayas, and Upper Assam.
- Generated significant multi-proxy data on the Quaternary sedimentary samples collected during Antarctic and Arctic expeditions to envisage climate changes. Also studied plant fossils from Weller (Permian) and Lashly (Triassic) formations of Allan hills, Transantarctic Mountains.



SEM images of thermally altered vascular tissues (1) and Ruptured bordered pits (2) from Lashly (Triassic) Formation, Transantarctic Mountains

Fig. 10.6

MAJOR AND UNIQUE NATIONAL FACILITIES CREATED

The calibration for C-14 dates is being carried out as per available latest softwares extending the calibration to about 50,000 yrs BP.

IMPORTANT COLLABORATIONS (NATIONAL & GLOBAL) ESTABLISHED

International	Worked on	National	Worked on
Institute of Botany, Chinese Academy of Sciences, Beijing	Cenozoic Vegetation and Climate changes in China and India and their response to the Himalayan uplift	Working in close unision with WIHG, Dehradun	Palaeobiology, floristics, biostratigraphy, and Quaternary palaeoclimate of Himalayan region
Institute of Geosciences, University of Sao Paulo and Guarulhos, Bra	Palaeobotanical studies on Indian and Brazilian Sedimentary Basins	GSI, Coal Wing, Kolkata	Palynology and coal petrology
University of Texas, USA	Antarctic Gondwana plant fossils	DSI, Visakhapatnam	Quaternary palaeoclimate of K-G Delta
		NIO, Goa	
		NCAOR, Goa	Quaternary palaeoclimate of Antarctic and Arctic regions

Multidisciplinary and multi-institutional research activities with Institutions in India and abroad have been continued in several spheres:

International Programme

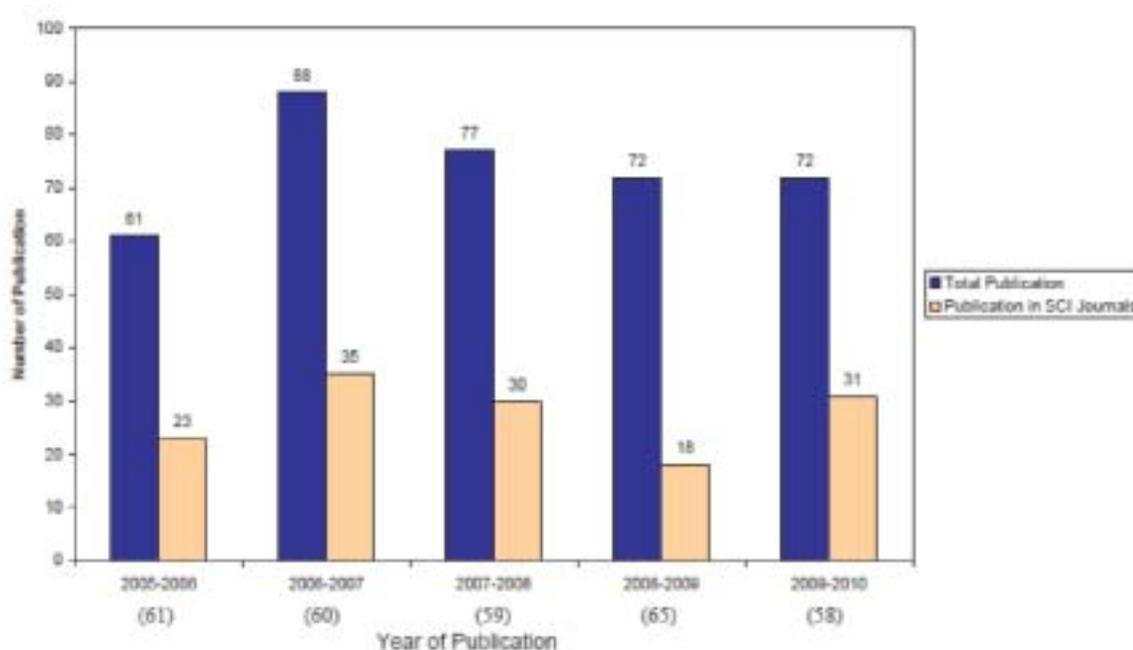
This scientific programme is aimed to assimilate the valuable palaeobotanical datan available at BSIP with international experts of different disciplines. Their further examination and interpretation in global perspective will result into world class research. Under the programme, following 3 eminent experts are visiting BSIP— Prof. Robert A. Spicer (of UK), Prof. Martin J. Head (of Canada), and Prof. Valentin Krassilov (of Israel).

IMPORTANT OUTPUT INDICATORS

1.	Publications	72 Research papers, 70 Abstracts, 44 has been accepted
2.	Patents/ know-hows	Provided technical knowledge for development of Fossil Park in Ghughua (MP) and in Sahebganj (Jharkhand).
3.	Designs and other intellectual Products	Consultancy services are being provided to academic and industrial sectors in expertise fields (plant mega- and microfossils, Carbon dating, SEM, and coal petrology.
4.	Post Graduate and PhDs trained	Recognized as a research centre of Lucknow University (Lucknow) and Andhra University (Visakhapatnam). At present PhD 28 (Pursuing)
5.	Other products	<i>Help to Industry (ONGC)</i> — Palaeobiological studies from the Ganga Basin reveal significant data suggesting Cryogenian to Ediacaran age for the Madhubani Group. The studies indicate possibility of hydrocarbons in Ganga Basin. The biotic assemblage is comparable to Marwar Supergroup of Bikaner-Nagaur Basin, which is already known to contain hydrocarbons.

EMINENCE INDICATORS

For Academic Institutions		
1.	Impact Factor Aggregates	37.372
2.	Citation frequencies	Research articles of Institute scientists are regularly being cited in national and international publications, catalogues, monographs and indexes.
3.	Number of Fellows of the Academy and SSB winners	Dr. N.C. Mehrotra, Director has received 'L Rama Rao Centenary' award by the Geological Society of India (Bangalore) for life time contribution to Indian Biostratigraph and Paleontology.



Publication Profile during last 5 years
(Figure in parenthesis are number of scientists)

Fig. 10.7

BOSE INSTITUTE

The activities of Bose Institute are largely grouped among seven plan projects and a societal project dedicated to Rural Biotechnology aimed at improving the economic status of the rural populace in south West Bengal. In addition, Bose Institute runs a number of national facilities. A few of the major achievements in these areas during the year 2009-10 are listed below.

Plan Project 1. Improvement of Plants: Biotechnological, Genomic and Proteomic Approaches:

Validation and functional characterization of *Sinapis alba* genes induced by *Alternaria brassicicola*; Micropropagation of transformed *Plumbago indica* and optimization of plumbagin production from transformed roots; Epigenetic regulations during plants' response to environmental or developmental stimuli; Identification and expression of insect/pathogen resistant genes in plants; Improvement of cultivated sesame varieties; Genetic diversity analysis of *Corica papaya* as well as rice landraces of West Bengal; DNA

fingerprinting of *Curcuma longa*; Identification of highly allergenic fungal spores in suburban agricultural fields and metropolitan areas; Transcriptional and post-transcriptional regulation of gene expression in plant-pathogen interactions; Inositol metabolism in relation to plant abiotic stress; Identification of MYMIV-resistance genes/proteins in *Vigna munga*; Resource survey analysis of gene pool with reference to seeds; Regulation of gene expression in rice cultivars affected by salinity stress and during fruit ripening in tomato, banana and mango; Molecular documentation of plant diversity in eastern and north-eastern India, including *Xanthoxylum acanthopodium*, *Acorus calamus*, *Digilatis purpuria* and Bamboo; Identification of candidate gene(s) for aphid tolerance in cruciferae; Production of hybrid mushroom strains.

Plan Project 2. Protein Structure, Function and Engineering:

Elucidation of the biological role of colchicines binding sites in tubulin; Analysis and design of peptides with cis peptide bonds: Pro-Pro-Xaa sequence motifs; Conformational studies on the plug domain of protein translocon channel SecYEG; Mechanistic study of the binding of TN16 to tubulin; Cloning, expression, purification and structural studies of proteins from *Vibrio cholerae*; Selection and purification of some lectins; Stabilization of quaternary structure of α -crystallin by Zn^{+2} ; Identification of histidine residues involved in Zn^{+2} binding; elucidation of the role of alternative sigma factors in *M. tuberculosis* gene regulation; Functional implications of the structure of lambda CII.

Plan Project 3. Bioinformatics and Computational Biology:

Study of electrostatic interactions in protein-protein complexes; Mechanism of substrate recognition and discrimination by glutamyl-tRNA synthetases; Characterization of protein-nucleic acid interface; Analysis of cavities in rprotein structures and development of a scoring function to identify the native structure from a set of decoys based on packing considerations; Empirical estimation of the contribution of interface residue to binding free energy; Functional evolution of bacterial dioxygenases; Establishment of the role of protein disorder on the evolution of protein-protein interaction network; Molecular dynamics simulations of biotechnologically important proteins; Design of a virtual library and screening of potential drug-like molecules for *P. falciparum*.

Plan Project 4. Molecular Medicine:

Regulation of host immune response in visceral leishmaniasis with Amphotericin B; Elucidation of the molecular basis of switchover from resistance to apoptosis for cancer chemoprevention; Analysis of disease resistance in marine shrimp *Penaeus monodon*; Development of possible biomarkers to predict coronary heart disease; Synthesis and bioevaluation of organic small molecules and microbial antigenic complex oligosaccharides; Demonstration of the gain of cellular adaptation due to prolonged p53 impairment leading to functional switch-over from p53 to p73 during DNA damage in acute myeloid leukaemia cells; Regulation of tyrosine kinase activity during capacitation in goat sperm and characterization of arylsulphatase A in a 70 kDa protein (isolated from goat spermatozoa) having Na^+ , K^+ -ATPase inhibitory property; Studies on the protective action of bio-active molecules in organ patho-physiology.

Plan Project 5. Microbial Genomics and Infection Biology:

Elucidation of the role of asymmetric DNA bending in DNA transaction processes in *Mycobacterial* plasmid complex; Demonstration of the phosphorylation of FipA, a product of the ORF Rv0019c of *M. tuberculosis* by PknA, required for cell division under oxidative stress; Study of Penicillin-binding protein 1* of *M. tuberculosis* as regulator of cellular morphology; Regulation of immune response by *H. pylori* secretory antigen HP0175; Identification of the role of epigenic mechanisms affecting microtubular stability

and chromosome segregation in *E. histolytica*; Demonstration that the host protein HflID in bacteriophage lambda impairs transcription activation by CII by preventing the binding of CII to DNA; Generation of several mutants of mycobacteriophage L1 repressor by site-directed mutagenesis; High fidelity chromosome segregation in budding yeast; Establishment of the role of sister chromatid cohesion (SCC) in spindle length maintenance in budding yeast.

Plan Project 6. Development of Systems Biology:

Formulation of a mathematical model to explain and characterize the transient nature of Jasmonate (JA) activity in plant systems; Quantitative characterization of single cell expression levels of *mprA*, *sigE* and *rel* genes in the stringent response pathway of *M. smegmatis* with *gfpas* the reporter; Study of novel pathways in bacterial assimilation of PAHs;

Plan Project 7. Basic and applied problems in Physical and Environmental Sciences:

Studies on quantum information, including the entanglement cost of quantum operations; Quantum entanglement in spin systems; Spinon excitations in spin ladder models; Improved synthesis of 2-Alkyl/aryl-1,8 phenanthrolines and screening of condensed Thiazoles for inhibition of COX-1 and COX-2; Development of a biomembrane model for the elucidation of the crystal structure of Cholesteryl Oleyl Carbonate (COC); Study of the role of magnetic field in the hadron-quark transition in neutron stars; development of effective models to study the Quantum Chromodynamic (QCD) phase transition at large chemical potential; Comprehensive monitoring of aerosols at Darjeeling for a complete understanding of the chemical and transport processes; Formulation of a protocol for transferring intraparticle hybrid entanglement to an interparticle entanglement; Simulation of cosmic ray showers; Study of magnetoacoustic waves in solar plasma and prediction of testable results in high resolution, multi spacecraft observations; development of software for an augmented millimetre wave high resolution Radar for 2D and 3D imaging in simulated far-field conditions; Rain reflectivity measurement under clutter environment at microwaves through design and development of suitable instrumentation and related software; Calculation of quark number susceptibility, isospin, electric charge and strangeness in the PNJL model; Calibration of the low-cost PET detector for strangelet searches and detection of very low energy Coulomb fission of nuclei in PET; Development of the DAQ software for use in the proposed active detector array for cosmic ray showers at Darjeeling; Measurement of soft photons and charged particle fluxes during the total solar eclipse of 22 July 2009 at Siliguri; Observation of low-lying collective excitations of a molecular dimer formed by two electrons in GaAs semiconductor quantum dot; Study of the effect of the rain drop size distribution on earth-space radio path; Study of the frequency dependent dielectric relaxation in complex perovskite oxides over a wide temperature range; Impedance spectroscopy study of II-VI nano-semiconductor.

Rural Biotechnology Programme:

Hands-on training on Mushroom cultivation and preservation, Vermicomposting and vermiculture, Sericulture and Epiculture.

National Facilities at Bose Institute:

- Centre for Astroparticle Physics & Space Science – A National Facility at Bose Institute, supported under the IRHPA scheme of SERC, DST, Govt. of India.

- Facility for Proteomics and Genomics at Bose Institute, supported under the IRHPA scheme of SERC, DST, Govt. of India.
- Bioinformatics Centre – A Centre of Excellence of the Department of Biotechnology, Govt. of India.
- Centre for advanced research in DNA fingerprinting and diagnostics of medicinal potential in plants from eastern and north eastern India, supported by ICMR, New Delhi.

CENTRE FOR LIQUID CRYSTAL RESEARCH

Centre for Soft Matter Research Formely Centre for Liquid Crystal Research was established in the year 1991 and was taken over in 1995 as an autonomous institute under the Department of Information Technology, Government of India. The Centre was taken over by the Department of Science and Technology (DST) in 2003 and continuous under DST. The name was changed to Centre for Soft Matter Research (CSMR) w.e.f. 1.9.2010. The Institute is grouped as an academic institution in Life Sciences. The total number of Employees is 21 in which total Number of Research faculties (Post Doctoral): Scientists is 13 as on 30.09.2010.

AREAS OF RESEARCH FOCUS

The Centre was established to focus on basic and applied research in liquid crystals. Now, Centre has broadened its scope in Soft Matter like polymers, gels, membranes and so on.

MAJOR RESEARCH ACCOMPLISHMENTS (2010-11):

The Centre published 20 papers during the period 2010-2011 (as on 30.09.2010) and 43 papers during 2009-2010 in peer reviewed international journals. Some of the important works carried out since 1.4.2010 are given below:

1. Enhancement of anisotropic conductivity, elastic and dielectric constants in a liquid crystal-gold nanorod system

We have found that anisotropic self assembly of liquid crystal (LC)-gold nanoparticles (GNP) systems exhibit large increase in electrical conductivity even at low GNP concentrations. The LC- anisotropic shaped nanoparticle complex, shows not only orders of magnitude higher conductivity, but also stabilizes its anisotropy. The dielectric data indicates an increased ordering in the nematic phase, and an improved anti-parallel correlation of the molecules in the isotropic phase.

2. Nanoscale electrical conductivity of a monolayer of a mesogenic oligomer

Employing a current sensing AFM, the electrical conductivity of Langmuir-Blodgett films of a mesogenic oligomer hexatriphenylene substituted anthraquinone deposited on a gold coated silicon substrate was studied. Interestingly, the analysis of current (I) - voltage (V) characteristics of the metal-LB film-metal junction showed a transition in the tunneling mechanism, from direct tunneling to an injection tunneling, as a function of bias voltage. The barrier height and the effective mass of electron in the metal-LB film-metal junction have also been studied. These studies have potential applications in molecularly engineered electronic devices.

3. Confinement-driven weakening of the rotator phase transitions in an alkane through a possible tricritical point

We have performed calorimetric and X-ray measurements in the hexagonal, rectangular and tilted rotator phases of a long chain alkane in bulk and confined to porous matrices (PTFE and Anopore) of two different mesoscopic length scales. Probing the order within and normal to the layers, in the anopore case having a length scale (200 nm), drastic weakening of the transitions is seen. The effect on the tilting transition is to such an extent that it results in the first observation of a confinement-driven second order transition in these systems. These findings, lead to a new means of realizing a tricritical point.

4. Anomalously large bend elastic constant and faster electro-optic response in anisotropic gels

Experimental results on a nematic liquid crystal gelled by small concentrations of a dipeptide molecule showed that these gels are thermoreversible and exhibit LC gel to LC sol transition as confirmed by dynamic rheological measurements. It was found that both splay (K_1) and bend (K_3) increase on going from LC sol to LC gel state. While K_1 has only a marginal increase, K_3 (and thus the ratio K_3/K_1) increases by nearly two orders of magnitude with a strong dependence on the concentration of the gelator.

5. Composites of a liquid crystal with hydrophilic aerosil particles:

The first high pressure investigations of the nematic-isotropic transition in the composites of a liquid crystal compound with hydrophilic aerosil particles is investigated. The low concentrations of the aerosil particles used create soft gels of the composites. We find that in these nanocolloidal systems, the slope of the pressure-temperature boundary exhibits a non-monotonic dependence with the aerosil concentration, which is qualitatively similar to that of the transition temperature.

6. Supramolecular liquid crystalline tris (*N*-salicylideneamine)s

Supramolecular liquid crystalline tris (*N*-salicylideneamine)s (TSANs) featuring both inter- and intramolecular hydrogen bonding have been synthesized and characterized for the first time. These TSANs formed by condensing three equivalents of 3,4,5-trialkoxybenzoyl-hydrazine with 1,3,5-triformylphloroglucinol exist as the single C_{3h} -symmetric *keto-enamine* product solely, unlike the previously reported TSANs. Our studies established their self-assembly into supramolecular fluid hexagonal columnar (Col_h) phase over a wide thermal range.

7. Synthesis of tetraalkoxy-substituted anthraquinones (1, 2a-b, 3a-b and 4)

A number of novel tetraalkoxy-substituted anthraquinones (**1**, **2a-b**, **3a-b** and **4**) differing in the number and nature of nitroxide radicals have been prepared and characterized. It is found that they exhibit electrochemical (redox) activity and paramagnetic behaviour. Of the two radicals investigated for their stable multi-step discharging process, the mono-substituted PROXYL compound appears to be more promising when compared to its disubstituted analogue. Also the mono-substituted PROXYL radical shows a heat-responsive magnetic property.

8. Multiple electroconvection scenarios in a bent core nematic liquid crystal:

Multiple convection scenarios are found in the voltage-frequency plane, depending on the temperature. They involve both classical and nonclassical periodic roll structures, the former conforming to the standard model and observed for the first time in a bent-core system. Temperature induced transition

between the longitudinal and normal inplane roll states is another novel finding that points to elastic anisotropy as the main factor in wave vector selection. Well above threshold, narrow disclination loops evolve in regular arrays, their area density being exponential in voltage.

9. Effect of polymer coating on the magnetic properties of oxygen-stabilized nickel nanoparticles

We have studied the magnetic properties of polymer coated (pc-) and uncoated (uc-) Ni nanoparticles prepared by chemical reduction method. Both samples have been found to have a tetragonal crystal structure, different from its usual fcc structure. This structural modification of fcc-Ni occurs due to the presence of interstitial oxygen atoms in the Ni lattice and results in appreciably modified magnetic properties.

IMPORTANT HIGHLIGHTS OF MAJOR RESEARCH PROGRAMMES(2010-11):

- 1. Enhancement of anisotropic properties in a liquid crystal-gold nanorod system:** The LC-anisotropic shaped nanoparticle complex, shows not only orders of magnitude higher conductivity, but also stabilizes its anisotropy. The dielectric data indicates an increased ordering in the nematic phase, and an improved anti-parallel correlation of the molecules in the isotropic phase.
- 2. Nanoscale electrical conductivity of a monolayer of a mesogenic oligomer :** The analysis of current (I) - voltage (V) characteristics of the metal-LB film-metal junction showed a transition in the tunneling mechanism, from direct tunneling to an injection tunneling, as a function of bias voltage.
- 3. Anomalously large bend elastic constant and faster electro-optic response in anisotropic gels:** Experimental results on a nematic liquid crystal gelled by small concentrations of a dipeptide molecule showed that these gels are thermoreversible and exhibit LC gel to LC sol transition.
- 4. Synthesis of tetraalkoxy-substituted anthraquinones (1, 2a-b, 3a-b and 4):** It is found that they exhibit electrochemical (redox) activity and paramagnetic behaviour.
- 5. Multiple electroconvection scenarios in a bent core nematic liquid crystal:** Multiple convection scenarios are found in the voltage-frequency plane. They involve both classical and nonclassical periodic roll structures, the former conforming to the standard model and observed for the first time.

EMINENCE INDICATORS (2010-11)

For Academic Institutions		
1.	Impact Factor Aggregates	2010-11 (as on 30.09.2010) : 59.769
2.	Number of Fellows of the Academy and SSB winners	Two

International	National
Research Institute for Solid State Physics and Optics of the Hungarian Academy of Sciences, Hungary under INSA-Hungarian Bilateral Exchange Programme.	Bharat Electronics Limited (BEL)
Bulgarian Academy of Sciences under DST Indo-Bulgarian Joint Bilateral Programme	Raman Research Institute (RRI)
Kent State University, USA, Tokyo Institute of Technology, Japan	Indian Institute of Science (IISc)

IMPORTANT OUTPUT INDICATORS (2010-11)

1. Publications	The Centre published 20 papers during the period 2010-2011 (as on 30.09.2010) and 43 papers during 2009-2010 in peer reviewed international journals.
2. Post Graduate and PhDs trained	PhD: 2; PG: 2
3. Other products (to be specified)	For popularization of science, the faculty of the Centre has given 5 lectures since 01.04.2010. During 2009-2010 the faculty had given 35 lectures at various schools/colleges.

VISUAL OUTPUTS

The sequence of patterned states observed at 120 °C in a 15.5 μm thick sample of nematic 9CN during a slow increase in voltage, using a single polarizer along the easy axis; $f=3\text{kHz}$, control parameter $D=0.037, 0.05, 0.14, 0.66, 1.35$ and 3.61 for (a) to (f), respectively. (a) Normal rolls, (b) undulatory rolls, (c) Oblique rolls, (d) skewed varicose structure, (e) bimodal structure and (f) quasiturbulent state.

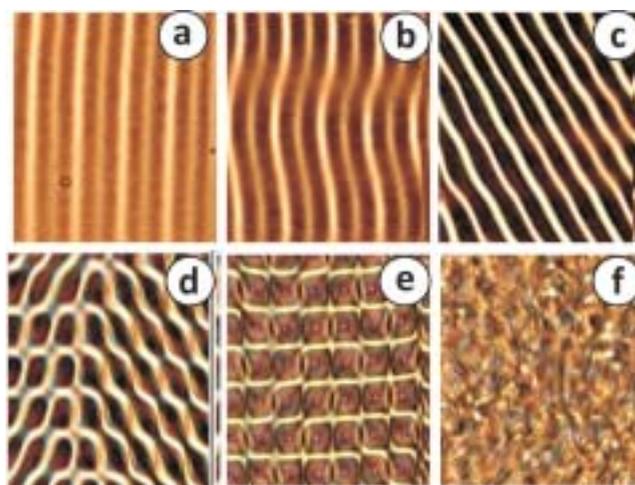


Fig. 10.8. Multiple electroconvection patterns

INDIAN ACADEMY OF SCIENCES

The National Academy of Sciences, Allahabad was established in the year 1930. The Institute is grouped as an academic institution under Life Sciences. The total number of Research faculties (Post Doctoral) is 15.

Research Profile of the Organization

Areas of Research Focus : All the branches of Science & Technology

Major Research Accomplishments (2010-11) : It was in the following areas of research

1. On Water Purification & Conservation – Studies and Awareness Programmes conducted by Prof. V.P. Sharma, M.N.Saha Distinguished Fellow of NASI
2. On Science Communication/Education – Studies and Awareness Programmes conducted by several Fellows of the Academy across the country.

3. On Biodiversity – Studies and Awareness Programmes conducted by Dr. Niraj Kumar, P.I., DBT Project at NASI,
4. On By-pass Desert Cooler – Studies and Awareness Programmes conducted by Dr. Manvendra Tripathi (under a Project of NASI)
5. Library Science & Information – The Academy maintains a very rich library for facilitating the researchers; and also organizes regular meetings/workshops to guide the students.
6. On High Temperature Super Conductivity in Cuprates; and Flow of Electron through a quantum dot or a double dot– Studies conducted by Prof. S.K. Joshi, NASI Platinum Jubilee Chair
7. On Heme-biosynthetic Pathway of the Malaria Parasite as a Drug Target; and Combination Therapy of Malaria using Curcumin and Artemisinin derivatives – Studies conducted by Prof. G. Padmanaban, NASI-Platinum Jubilee Chair
8. On Polymer - Ionic Liquid Composites – Studies conducted by Prof. Suresh Chandra, NASI Senior Scientist
9. On Orchids – Studies conducted by Prof. S.P. Vij, NASI Senior Scientist
10. On Structure and diversity of tropical dry deciduous forest – Studies conducted by Prof. J.S. Singh, NASI Senior Scientist
11. On Nano-gold Catalysts – Studies conducted by Prof. V.R. Chaoudhary, NASI Senior Scientist
12. On High Attitude Biodiversity – Studies conducted by Prof. Upendra Dhar, NASI Senior Scientist
13. On Several Aspects of Rhizobacterium – Studies conducted by Prof. K.V.B.R. Tilak, NASI Senior Scientist
14. On Water Wave Scattering Problems – Studies conducted by Prof. B.N. Mandal, NASI Senior Scientist

IMPORTANT HIGHLIGHTS OF MAJOR RESEARCH PROGRAMMES (2010-11) : The Highlights of major research programme are given below –

- (a) **Research Programme on Water** - NASI (Hqs. Allahabad, U.P.) being a premier organization of scientists, engineers and health professionals is seriously concerned about the present situation prevailing in the country in respect of community water supply and its very critical impact on community health. Several studies were conducted under the leadership of Prof. V.P. Sharma to analyse water quality of different regions; and NASI organized brainstorming sessions with the leading scientists, technocrats and health professionals as well as key policy makers to identify the following research programmes which are to be implemented through different agencies.
 1. Mapping of Water Bodies in National Capital Region (NCR) of India by Prof. S.N. Naik, Prof and Head, CRDT, IIT, Delhi.
 2. Water Resources Mapping and Enhancing the Water Recharging Along with Quality Profile of Garhwal Region. By Dr. B.M. Sharma, Society of pollution and environmental conservations scientists, Dehradun

3. Development of Cost Effective Technology for Recharging in Over-exploited Ground Water Resources in Urban and Rural Areas in West Bengal. By Prof. Arunabha Majumder and Prof. Asis Mazumdar, School of Water Resources Engineering, Jadavpur University, West Bengal.
 4. Assessment of Performance of Existing Rainwater Harvesting Structures in Rural Areas and Development of Methodologies for Efficient Sustainable Rainwater Harvesting System. By S.P. Sinha Ray, President, Centre for ground water studies, Kolkata.
 5. Development of an integrated sample and user-friendly and cost-effective system of Water Quality Monitoring in the rural areas of the country by Dr. P.K. Jha, Sulabh International Academy of Environmental Sanitation.
- (b) **Programmes on Science Education/Communication** : Innovative methods of teaching, development of low cost experimental tools & techniques and organization of several workshops/orientation programmes and refresher courses by NASI along with its 15 Chapters all across the country.
 - (c) **Programme on Biodiversity** – Several programmes were organized to investigate area specific biodiversity; the Biodiversity Registers have also been prepared for a few regions.
 - (d) **Maintenance of a rich Library; and Programmes on Library Science & Information** – The Academy maintains a very rich library for facilitating the researchers; and also organizes regular meetings/workshops to guide the students.
 - (e) **On By-pass Desert Cooler** – Intensive research and awareness programmes were conducted to minimize mosquitogenic conditions; and reduce the menace of malaria, dengue etc. in and around Allahabad region.
3. **Major and Unique National Facilities created (2010-11)** : The Academy has created a unique facility for Water Analysis by developing a portable kit; also the Ganga-gallery construction is to be completed by the end of the year 2011.
 4. **Important collaborations (national and global) established (2010-11)**: The Academy has established its collaborations with the National and International Laboratories through its elected Fellows; and also with other National Science Academies of India and China.

IMPORTANT OUTPUT INDICATORS (2010-11)

1.	Publications	Published all the regular journals and Special Issues of International repute.
2.	Patents/ know-hows	The Senior Scientists patented/applied for patenting their findings
3.	Designs and other intellectual Products	Several scientific and educational CD's were developed
4.	Post Graduate and PhDs trained	JRFs/SRFs working with the Senior Scientists are being trained in their area of research. Also the Academy is giving training to the young researchers through its Summer Research Fellowship Programme, being operated jointly by the three National Science Academies.
5.	Other products (to be specified)	Helping the School/College teachers in developing low cost teaching aids/tools through its Science Communication Programmes.

EMINENCE INDICATORS (2010-11)

For Academic Institutions	
1. National data bases developed	Compilation of research papers through its regular publications; and maintenance of these on a defined website – http://nasi.iiita.ac.in/library
2. Historical data complied	Compiled the History of the Academic; and also News /Views/ Comments/Recommendations on various Science Society Issues of National Importance
3. National missions led and coordinated	The Fellows of the Academy are actively involved in several important missions related to science and society, as several are occupying major responsible positions in the country.
4. Foresight reports and analysis if any	The analysis and reports on Water Conservation Issue, Malaria Control, Biodiversity Conservation, Nutritional Status etc. have been sent to the concerned agencies.
5. Any other original Expert system devised	The Academy has carved a niche in the area of science communication/education programmes.

INDIAN INSTITUTE OF ASTROPHYSICS

Indian Institute of Astrophysics was established in the year 1971. The Institute is grouped as an academic institution Physical Sciences. The total number of Employees is 324 in which total Number of Research faculties (Post Doctoral) is 77. An area of Research Focus of institute is Astronomy and Astrophysics and allied topics.

MAJOR RESEARCH ACCOMPLISHMENTS (2010-11):

- a. Simultaneous high-resolution photometric and spectroscopic observations were conducted for the first time during a total solar eclipse. The long duration of the eclipse (341 s) enabled IIA scientists to reliably study coronal oscillations with periods of around 30 s. These have important implications for understanding the mechanisms responsible for heating the solar corona;
- b. Pre-main-sequence objects exhibit variability due to starspots, accretion disk instabilities, eclipses among binary components etc. A survey and classification of stars in an individual star forming region is very important for more detailed follow up studies. In this connection, the 2 m HCT and 2.3 m VBT of IIA were used to carry out a study of the Orion Nebula Cluster in which a large number of periodic variables were discovered;
- c. Solar type II radio bursts are signatures of MHD shocks produced by flares and are associated with coronal mass ejections (CMEs). By combining data from the Gauribidnur Radio Heliograph (GRH) and space observations. It is shown that the initial acceleration in CMEs is correlated with the strength of flares;
- d. Polarized radio beams of pulsars are produced by relativistic plasmas above their polar cap regions. From a detailed theoretical analysis of the curvature radiation resulting from the plasma constrained to move along curved paths. It is shown that the antisymmetric type of circular polarization is correlated with the polarization angle swing. This study provides an important step in understanding the processes that contribute to the circular polarization of pulsar beams;

- e. A hydrogen-deficient carbon (HdC) star at high Galactic was recently discovered. HdC stars are a rare class of astronomical objects – only 5 Galactic HdC stars (and 51 HdC stars of RCB type) are known so far.

IMPORTANT HIGHLIGHTS OF MAJOR RESEARCH PROGRAMMES (2010-11):

- a. **Solar Eclipse Observations:** The Institute successfully carried out observations during the total solar eclipse of July 11, 2010 using multi slit spectroscopy of the solar corona in the iron green and red lines at a very high cadence and, (b) chromospheric spectra in the hydrogen alpha line as a function of height at a high frequency of about 7 Hz;
- b. **Solar Radio Astronomy:** A major expansion programme of the Gauribidanur Radio Heliograph (GRH) is underway to increase the maximum baseline length from 1.3 km to 3 km in the first phase. This will enable studying the solar corona with high angular resolution and better sensitivity in the frequency range 40-150 MHz.
- c. **Stellar Astronomy - Chemical abundances in the Early Galaxy:** Metal poor stars at high galactic latitudes that may provide important clues for the origin and evolution of heavy elements in the early history of the Galaxy are being studied spectroscopically. Many metal poor stars are found to have enhanced abundances of Carbon indicating pollution by Supernovae from massive stars and intermediate-mass AGB stars in the early galaxy. The CH fraction of high latitude Carbon stars has been determined to be about 37%;
- d. **Space astronomy - Ultraviolet Imaging Telescope (UVIT):** This telescope that is part of ASTROSAT, the first dedicated Indian astronomy space mission, is in an advanced stage of fabrication. Testing of the engineering model (EM) is almost complete and assembly of the flight model will commence by December 2010;
- e. **Adaptive optics (AO):** IIA’s AO program is centered around: (i) Development of efficient and fast algorithms for wavefront detection and reconstruction, (ii) Model atmospheric turbulence for IIA’s facilities to develop advanced system concepts for atmospheric turbulence compensation, and (iii) To develop AO system for IIA’s National Large Solar Telescope (NLST) and existing 1-2 m class telescopes.

IMPORTANT COLLABORATIONS (NATIONAL AND GLOBAL) ESTABLISHED (2010-11):

- a. A multi institutional project between IIA, ISRO, PRL, ARIES and some universities commenced for development of a Visible Emission line Solar Coronagraph to be flown on the Aditya-1 space mission;
- b. A multi institutional international collaboration with the Thirty Metre Telescope (TMT) Consortium has been initiated. India has joined the TMT project with ‘Observer’;
- c. Development of the Hanle Echelle Spectrometer (HESP) for use as a powerful focal plane instrument at the 2.3 m Hanle Chandra Telescope (HCT) commenced as a joint project between IIA and Industrial Research Ltd. (IRL), New Zealand.

IMPORTANT OUTPUT INDICATORS (2010-11)

1.	Publications	106
2.	Post Graduate and PhDs trained	66

Several young scientists and engineers are being trained in important and national projects and for B.Tech. and M.Tech. Degrees as part of their project work.

EMINENCE INDICATORS (2010-11)

For Academic Institutions

1. Impact Factor Aggregates	4.3367
2. Citation frequencies	53
4. Number of Fellows of International Academies	1
5. Number of Fellows of the Academy and SSB winners	3

Several members of the Institute have been elected to the apex professional body in the field viz. IAU, invited to the international committees, associateships and professorships in leading institutions & membership of editorial boards of leading international journals and have been recognized by national awards and honors.

For Applied Research based Institutions

Though the activities of IIA are in the nature of fundamental research, it is engaged in design and development of technique and instruments that are required for its observations. These details are presented in technical notes or scientific papers published in national and international journals. From time to time, these are being deployed in other national astronomical centers. In addition, IIA has developed some specialized techniques in astronomical instrumentation; these are extended to projects of ISRO/DoS, BARC/DAE and other national centers/universities.

IIA has created a unique repository for archival records of Astronomy and Astrophysics which is available for researchers.

Visual Outputs: Photographic images of the solar corona, taken by IIA scientists, during the total solar eclipses of July 22, 2009 & July 12, 2010 – with figure captions.

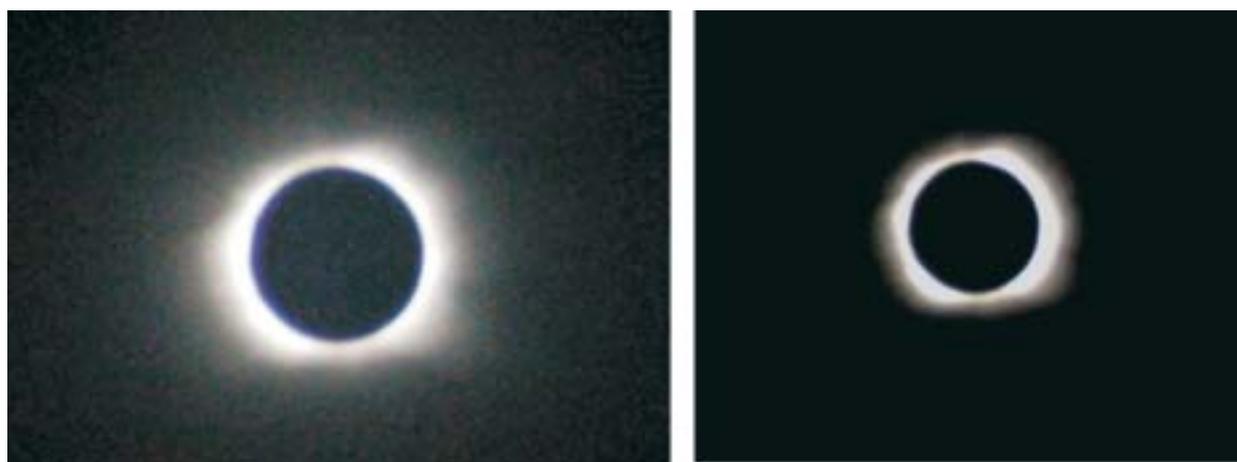


Fig. 10.9. Image of the corona taken with a SLR camera by the team of scientists from the Indian Institute of Astrophysics Bangalore who observed the totality from Easter Island. The team successfully carried out the planned experiments in good sky conditions. The experiments were: (a) multi slit spectroscopy of the corona in the iron green and red lines at a very high cadence and, (b) chromospheric spectra in the hydrogen alpha line as a function of height at a high frequency of about 7 Hz.

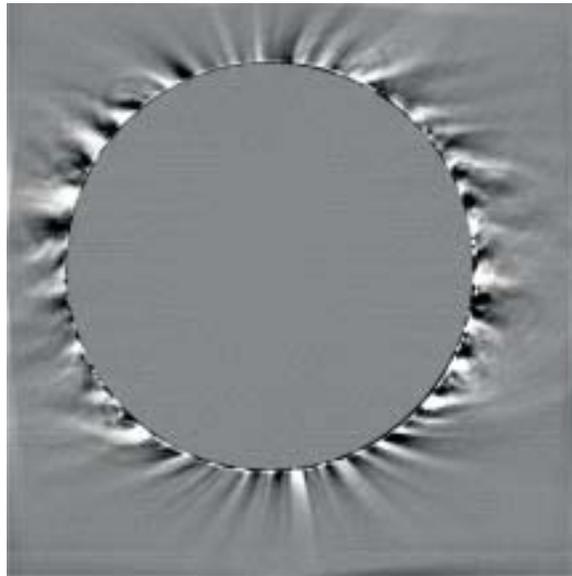


Fig. 10.10 Image of the solar corona after image processing, which reveals finer structures of the corona. This image was taken with a green filter during total solar eclipse, July 22, 2009 from Anji, China.

MAJOR PROGRAMMES FOR THE ELEVENTH FIVE YEAR PLAN

The following are the major programmes taken up during the Eleventh Five Year Plan:

- a) National Large Solar Telescope (NLST)
- b) Ultra-Violet Imaging Telescope (UVIT) and other space pay load programs
- c) Indian Astronomical Observatory – National Facilities
- d) Modernization of the aging instruments and augmentation of the infrastructure facilities
- e) Upgradation of computers, communication systems and library facilities
- f) Center for Advanced Instrumentation Center
- g) National Large Optical/Infrared Telescope
- h) Space Coronagraph – a national collaborative programme.

SIGNIFICANT SCIENTIFIC & TECHNICAL ACHIEVEMENTS DURING 2009-10:

Some of the significant scientific and Technical achievements made during the year 2009-10 are described below:

- a) Testing and calibration of the engineering model of the Ultra Violet Imaging Telescope (UVIT) system was carried out at the new laboratory viz. M.G.K.Menon Laboratory for Space Sciences; this payload will be deployed by ISRO on its ASTROSAT Mission
- b) Design and fabrication of precision instruments and conducting experiments during the total solar eclipse of July 22, 2009 and observations of the annual solar eclipse of January 14, 2010;
- c) Characterization of potential sites and formulation of Critical Design Review Report for setting up the National Large Solar Telescope;

- d) Formulation of a National Detailed Project Report for India's participation in the Giant Segmented Mirror Telescope (GSMT) Projects; this report formed the basis for the DST to obtain 'observer' status in the TMT Project.
- e) Formulated a national proposal for design, development, fabrication and supply of the Space Solar Coronagraph; this was submitted to ISRO for deployment as a payload on Aditya-I Mission;
- f) Strengthening of education and training of young students in astronomical sciences through Ph.D. and I-PhD programmes;
- g) Utilization of HCT, HAGAR and other national facilities at Kavalur, Hanle; Fabrication and development of focal plane instruments for HCT, Hanle; Installation and commissioning of 1.3 m and DIMM telescopes at Kavalur; digitization of the solar archives at Kodaikanal and studies of solar polarization using upgraded facilities;
- h) Upgradation of Gauribidanur Radio Heliograph and associated instrumentation;
- i) Observational studies in solar and stellar astronomy and modellings in the various branches of theoretical astrophysics;
- j) Focussed activities as part of International Year of Astronomy (IYA) 2009 to reach the masses;
- k) Upgradation and augmentation of aging instruments and infrastructure facilities in the HQ and in field stations.

SIGNIFICANT SCIENTIFIC & TECHNICAL ACHIEVEMENTS EXPECTED DURING 2010-11:

- i) Design and fabrication of precision instruments for the observations of the total solar eclipse of July 11, 2010 in the Easter Islands; analysis and publication of the results in leading journals.
- ii) Completion of the UVIT Engineering Model payload instrument and after testing and calibration hand over the system to the ISRO for deployment on ASTROSAT Mission;
- iii) Preparation of the Detailed Project Report for setting up the National Large Solar Telescope (NLST) and preliminary steps towards its realization;
- iv) Commence work on the development of a Space Solar coronagraph for deployment on the Aditya-I Space Mission;
- v) Training of young and motivated students to carry out research in the astronomical sciences through Integrated Ph.D. and Ph.D. Programmes, thereby generating a bank of quality human resources not merely to meet the requirements of IIA as also of other institutions/university departments in the country;
- vi) Commencement of work on the fabrication and development of the Hanle Echelle Spectrograph (HESP);
- vii) Completion of the fabrication of the 1.3 m telescope at the DFM Inc, USA and completion of various associated system for installation of the telescope at Kavalur;
- viii) Upgrading the Gauribidanur Radio Heliograph leading to a substantial increase in its sensitivity;

- ix) Analysis of the Kodaikanal solar data of 100 years digitized recently;
- x) Studies of the sun, solar system objects, nova, supernovae, galactic and extra galactic objects etc. through observations and modellings;
- xi) Conducting schools, workshops and the Chandrasekhar Centenary Conference;
- xii) Commencement of work for setting up of state of the art instrumentation center for I-PhD class rooms, library & Multi Storey Building complex, extension of labs at IAO & CREST.

Measurable performance in terms of papers published, patents filed and granted, technologies transferred to industry and commercialized, value of the money realized etc.

During the period 2009-10, the members of the Institute have published scientific results in 76 papers in leading journals, 54 papers in the Proceedings; in addition, they have brought out two books, edited three books, contributed to 4 Books. They have actively participated in organizing national scientific meetings in the Institute, delivered invited technical lectures in international conferences and meetings, brought out several monographs, technical notes etc.

MAJOR PROGRAMMES PROPOSED FOR 2011-12 AND DELIVERABLES/OUTCOME EXPECTED:

Some of the important and major programmes proposed to be taken up during 2011-12 are given below:

- a) Participation in the pre launch integration of the UVIT system, after testing and calibration in the M.G.K.Menon Lab for Space Sciences, with the ASTROSAT;
- b) Submission of DPR to the Government and preparatory steps for setting up the National Large Solar Telescope (NLST) ;
- c) Work on the development of a Space Solar coronagraph for deployment on the Aditya-I Space Mission;
- d) Training of young and motivated students to carry out research in the astronomical sciences through Integrated Ph.D. and Ph.D. Programmes, thereby generating a bank of quality human resources not merely to meet the requirements of IIA as also of other institutions/university departments in the country;
- e) Work on the fabrication and development of the Hanle Echelle Spectrograph (HESP);
- f) Installation, commissioning and engineering observations of the 1.3 m telescope at Kavalur;
- g) Upgradation and enhancement of computational facilities;
- h) Advanced instrumentation for increasing the sensitivity of the Gauribidanur Radio Heliograph and the observations thereof;
- i) Utilization of the national facilities viz. HCT, HAGAR, VBT and other facilities for observations and studies of the sun, solar system objects, nova, supernovae, galactic and extra galactic objects etc. and modellings;

- j) Conducting summer/winter schools and workshops in Astrophysics and conference to commemorate the 25 years of the Vainu Bappu Telescope.
- k) Commencement of civil works for setting up of Multi Storey Building complex, extension of labs at IAO & CREST, staff quarters etc.

Budget:

The Institute presented to the Finance Committee/Governing Council a budget of Rs. 6150 lakhs for the fiscal year 2011-12 under Plan for the above activities.

INDIAN INSTITUTE OF GEOMAGNETISM

Indian Institute of Geomagnetism was established in the Year 1971 in Navi Mumbai under earth sciences and it's research areas are focused on Geomagnetism and allied fields. The total number of Employees is 180 in which research faculties is 40.

MAJOR RESEARCH ACCOMPLISHMENTS:

The Indian Institute of Geomagnetism (IIG) has the mandate to carry out basic and applied research in Geomagnetism and allied fields. IIG has established various facilities to measure the geomagnetic field, atmospheric and ionospheric parameters, etc at its eleven magnetic observatories located in different parts of India, its two regional centres at Equatorial Geophysical Lab (EGRL) at Tirunelveli and Dr. KS Krishnan Geomagnetic Research Lab (KSKGRL) at Allahabad and at the Indian Antarctic station in Maitri. A variety of data and rock samples are also collected during geophysical surveys. The data from all these observations are used to study the upper atmosphere, ionosphere, magnetosphere, solid earth, global electric circuit (GEC) and aspects of solar terrestrial relationship while the samples are studied in the Paleomagnetic lab and environmental magnetic lab of IIG. The instrumentation division is involved in development and maintenance of various instruments used at IIG.

In the period 2010-2011: Electron acoustic solitary waves are studied theoretically in a three component unmagnetised plasma and it is found that the inclusion of cold electron temperature modifies the existence regime of the solitons and the calculated field parameters are in good agreement with satellite observations. To study low frequency waves in the Solar wind and Earth's magnetosheath 2D hybrid code is being developed.

The role of the geometry of the earth's field in deciding the thermospheric response to the external electric field changes is investigated using simulations from Global Ionosphere-Thermosphere Model (GITM)

Through a standard analysis of low latitude surface geomagnetic data it has been demonstrated that the circumferential modes in the frequency regime of drift waves are generated within the magnetosphere and can be monitored from the ground; these modes resemble the Whispering-gallery mode phenomena observed at St. Paul's Cathedral.

Equatorial Electrojet (EEJ) strength data of 2001-2008 is being analyzed to study (a) the relationship between EEJ strength and scintillations, (b) neutral atmospheric dynamics such as Sudden Stratospheric Warming and Geomagnetic storm effects.

From aeromagnetic data, several hitherto unknown dykes and faults have been delineated in Chattisgarh and Indravati basin at an average depth > 2km; these dykes are intruded later into the Proterozoic sediments and can possibly form locales for mineralization.

In the environmental magnetic lab the magnetic susceptibility proxy has helped in understanding the processes / factors responsible for the distribution and enhancement of heavy metal pollutants in the Zuari estuarine sediments.

Resistivity soundings and ground magnetic studies were conducted in the Kudal-Malvan region of Konkan coast with the aim of studying the effects of saline water intrusion, to delineate the potential groundwater bearing zones and to understand the shallow surface tectonic in these regions.

IMPORTANT HIGHLIGHTS OF MAJOR RESEARCH PROGRAMMES (2010-2011):

Institute participates regularly in the Indian Scientific Expeditions to Antarctica and conducts multi-technique experiments to monitor geo-space environment. Various sensors are installed at Indian Antarctica Base, Maitri, to study geomagnetic field in sub-auroral region and GEC. The downward air-Earth current being delivered to the surface of the Antarctic plateau is larger than the global average owing to its location in high latitudes. Antarctica plateau is strongly coupled to the GEC because of its orography. Recent studies at the institute indicate that continuous monitoring of atmospheric electricity components may be useful in forecasting approaching blizzards.

Upper atmospheric investigations at EGRL were carried out with the optical and radio remote sensing experiments along with a variety of satellite data sets. Airglow imaging observations of instability features at mesospheric heights over Tirunelveli were made for the first time from a low latitude station and they were shown to be associated with intense tropical convection occurring over the Indonesian sector. At EGRL, the design elements for a high altitude balloon experiment that will make use of the 3-axis electric and search coil magnetic field probes were finalized and the launch is proposed during March 2011.

Earthquake related deformation cycle have been investigated using 2004 Sumatra and 2010 Chile Mega-Earthquake GPS data. The persisting transient stresses, spatio-temporal seismic pattern, modeled Coulomb stress changes and southward migration of earthquake activity suggest that earthquakes of magnitude 6 or less are likely to occur in the northern Andaman region, closer to Diglipur. In vindication of this premise, an earthquake of M_w 5.4 occurred on August 9, 2010 close to Diglipur, in northern Andaman (figure 10.11).

From Paleomagnetic studies of intrusives of Jharia Coal fields, conducted at KGSGRL, Allahabad dolerite dykes were assigned the ages of Deccan traps (65 Ma) and lamprophyre sills ages were estimated at 110 Ma relating to the Rajmahal Traps. Rock magnetic techniques have unambiguously identified titanomagnetite, a common mineral in the Deccan basalts, as the major magnetic mineral in the studied samples from mafic flows and dykes of Rewa basin in Eastern Deccan Volcanic Province where such studies are scanty.

ELF/VLF waves radiated by natural (e.g. lightning discharges) and man-made (e.g. VLF transmitters) sources, after reflecting from D-region ionosphere travel long distances in the Earth-ionosphere wave guide with very little attenuation. This property makes VLF waves one of the most important tools to study the D-region ionosphere which is difficult to monitor continuously. In collaboration with Stanford University three VLF receivers are running at Allahabad, Varanasi and Nainital since 2007. Recently intense multiple solar flares occurred on 19 and 20 January 2010, after extended solar minimum conditions and the Narrowband VLF data registered these multiple solar flares. The electron density variations are estimated and modeled with Long Wave Propagation Capability model and compared with quiet day. It is interesting

to note there is a sharp increase in electron density due to sudden increase in ionization as effect of solar flare (fig. 10.12).

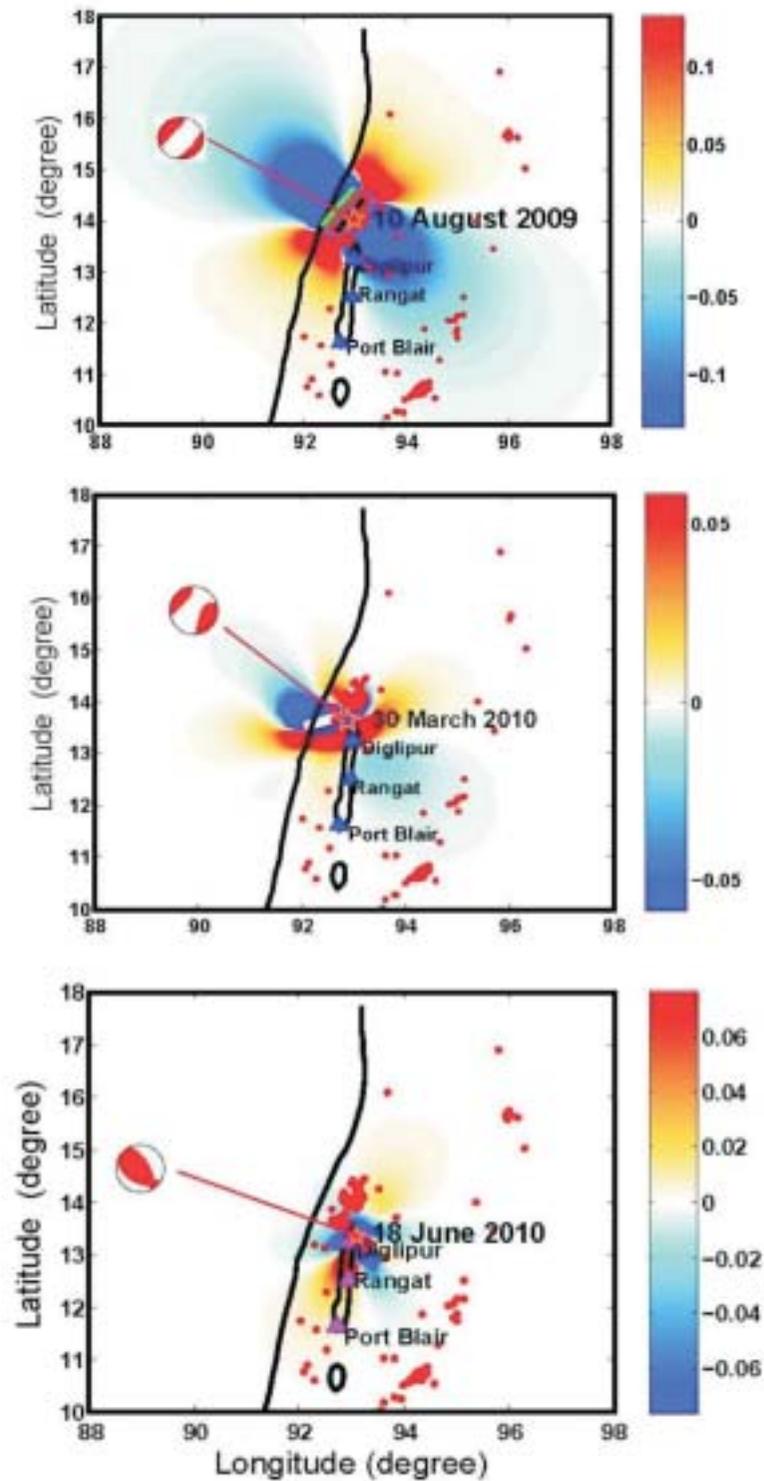


Fig. 10.11: Coulomb stress change for the three earthquakes that occurred on August 10, 2009 (top), March 30, 2010 (middle), and June 18, 2010 (bottom), and indicated by stars. The aftershocks are shown by red solid circles. Beach balls indicate fault plane solutions for each earthquake. The black line indicates subduction zone.

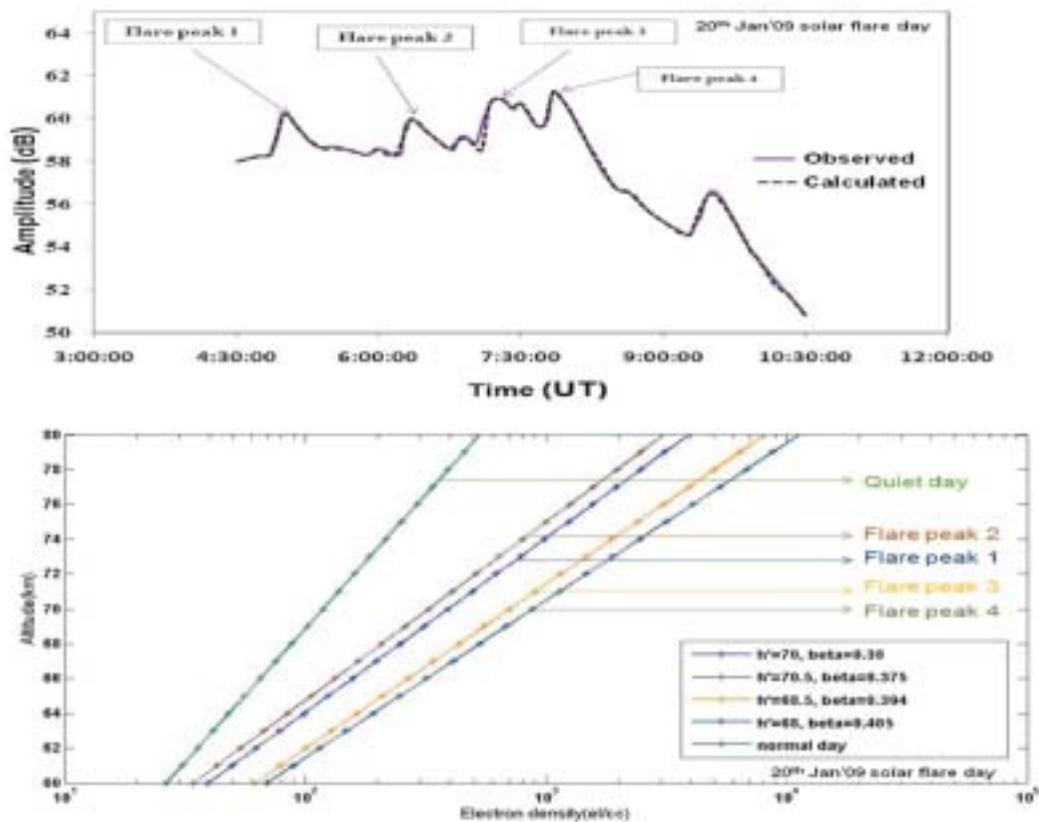


Fig. 10.12. The upper panel shows the signatures of solar flare on NWC signal which received at Allahabad. The corresponding electron density variations due to solar flare effect are shown as compared with quiet day in lower panel of the figure.

Major and Unique National Facilities created : Environmental magnetic lab augmented

IMPORTANT COLLABORATIONS (NATIONAL & GLOBAL) ESTABLISHED:

International

Stanford University, GFZ, Kyushu University., RISH, Air Force Research Lab, Tuebingen University, University of Adelaide and Lancaster University

National

North Maharashtra University, Assam Univ., Shivaji Univ, Saurashtra Univ., BHU, ARIES, ISRO, SPL-VSSC and NARL.

IMPORTANT OUTPUT INDICATORS (2010-11):

1.	Publications	47
3.	Designs and other intellectual Products	Upgraded PPM-version 6 with Narrow bandwidth auto tuning filter to improve signal to noise ratio.
4.	Post Graduate and Ph.D. trained	37
5.	Other products	Indian Magnetic Data Bulletins for 2007 and 2008 have been published. Final absolute values for the year 2009 obtained from International Real Time Magnetic Observatory Network (INTERMAGNET) facility at Alibag, have been deposited with Geomagnetic Information Node (GIN) at Paris for inclusion in the annual data CD ROM publication.

EMINENCE INDICATORS (2010-11)

For Academic Institutions	
Impact Factor Aggregates	65.152

OTHER ACCLAIMS

DST-SERC Training program on 'Electrodynamical coupling of Atmospheric regions' and DST-SERC School on 'Space Weather' have been organized by the Institute.

One semester course on earth sciences conducted, for the five year integrated M.Sc. students of the centre for excellence in basic sciences, deemed university formed by the Deptt of Atomic Energy-Univ of Mumbai initiative. A course for the Society of Petroleum Geophysicists conducted. One member is chairman of working groups of International Association of Geomagnetism & Aeronomy. One member received Asia Pacific Radio Science conference 2010 young scientist award. Seven papers published by scientists of other organizations/universities based on the geomagnetic data from IIG.

For Applied Research based Institutions

Level of penetration of National technology space	65.152
Number of unique expert systems developed and applied	Prime magnetic observatory at Alibag serves as a calibration center for magnetic instruments from organizations like SOI and NGRI and compasses for Indian Navy and Coast Guard.
Any other product related achievements (to be specified)	Total amount collected from supply of digital data : (i) National organisations Rs. 1,77,658/- (ii) International organisations Rs. 3,82,172/- Proton Precession Magnetometer (PPM) sold Rs. 2,25,000/- INTERMAGNET DATA USAGES: Scientists downloaded the following data files of Alibag: IAGA Day files: 32450 days & Binary files: 445 months

For Knowledge Service and Expert system organizations (TIFAC, NABL, Vigyan Prasar and the Professional Bodies)

- 1. National data bases developed :** Up gradation of the WDC website (URL: www.wdciig.res.in) is done by updating the database through appropriate user friendly software to have the visual mode graphic display of quick look plots of diurnal variations of the magnetic field for hourly and one minute digital data from the magnetic observatories.
- 2. Historical data compiled :** Archival of the old data volumes/ records and Metadata, is completed for Colaba Observatory data books for the period 1846 to 1904.
- 3. National missions led and coordinated :** One Member was leader and station commander of 29th Indian Scientific expedition to Antarctica. Coordinated programme of CAWSES –India sponsored by ISRO
- 4. Any other original Expert system devised :** About 120 users have registered at the WDC website for downloading the magnetic data for their research purpose.

VISUAL OUTPUTS :

Visual display, as magnetograms, of online near real time 1 minute data to headquarters from four observatories (Pondicherry, Alibag , Jaipur and Nagpur)

Digital images (magnetograms) displayed on the WDC website, of available magnetic data from Indian Observatories.

INDIAN NATIONAL ACADEMY OF ENGINEERING

Organization Particulars

The Indian National Academy of Engineering (INAE), New Delhi founded in 1987, comprises India's most distinguished engineers, engineer-scientists and technologists covering the entire spectrum of engineering disciplines. INAE functions as an apex body and promotes the practice of engineering & technology and the related sciences for their application to solving problems of national importance. The Academy provides a forum for futuristic planning for country's development requiring engineering and technological inputs and brings together specialists from such fields as may be necessary for comprehensive solutions to the needs of the country. It is the only engineering Academy in India. INAE is a Member of the International Council of Academies of Engineering and Technological Sciences (CAETS). The International Council of Academies of Engineering and Technological Sciences (CAETS) is an independent nonpolitical, non-governmental international organization of engineering and technological sciences academies committed to enhancing the contribution of science, technology and engineering in the world and its mission is to foster effective engineering and technological progress for the benefits of the societies of all countries.

RESEARCH PROFILE OF THE ORGANIZATION:

Research Studies

Studies on important/topical national issues are undertaken by the Academy through specially constituted study groups. The objective is to bring out 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. Separate Study Groups have been set up by the Academy to undertake Research Studies on Technologies for Healthcare Sector in India; Impact of Research on Chemical Industry – Current Status and Future Strategies; Impact of R&D on Indian Mining Industry Performance – Identifying the new priorities & strategic initiatives and Assessment of Civil Engineering Inputs for Infrastructural Development. The Research Studies on Technologies for Healthcare Sector in India and Impact of Research on Chemical Industry – Current Status and Future Strategies are under finalization.

Research Schemes

With the objective to encourage invention, investigation, research and promote high calibre of engineering-scientists, INAE has instituted four schemes, viz., INAE Chair Professorship; INAE Distinguished Professors/Technologists; Mentoring of Engineering Teachers by INAE Fellows and Mentoring of Engineering Students by INAE Fellows. Fifteen engineering teachers were selected under the scheme "Mentoring of Engineering Teachers by INAE Fellows" during the current year. Thirty six meritorious 3rd /4th year B.E./B. Tech engineering students were selected under the scheme "Mentoring of Engineering Students by INAE Fellows" during the current year.

Forum on Energy

Keeping in view the importance of energy issue, an INAE Forum on Energy has been constituted recently with Dr Baldev Raj, Distinguished Scientist & Director, Indira Gandhi Centre for Atomic Research, Kalapakkam as Chairman and Dr HS Mukunda, Advisor, Indian Institute of Science, Bangalore; Dr KV Raghavan, INAE Distinguished Professor, Indian Institute of Chemical Technology, Hyderabad; Dr RR Sonde, Executive Vice-President, Thermax Ltd, Pune and Prof SS Murthy, CEA Chair Professor, Indian Institute of Technology, Delhi as Members. This Forum has the mandate to address all issues related to energy.

Forum on Microelectronics

Microelectronics, being all pervasive, is at the core of every segment of industrial activity. The backdrop of India's growing strength and stature in IT industry has provided an implicit and additional impetus to the evolution of microelectronics design activity. An INAE Forum on Microelectronics has been constituted recently comprising Dr MJ Zarabi, as Chairman and Prof AB Bhattacharyya; Dr Alok Nath De; Prof PP Chakrabarti; Prof J Vasi; Dr G Venkatesh and Mr AS Kiran Kumar as Members in order to create a focus for this important activity. This Forum has the mandate to address all issues related to Microelectronics and to appropriately network with other agencies concerned with this area.

IMPORTANT OUTPUT INDICATORS (2010-11) :

The following important publications have been brought out during the year 2010-11.

a) Annals of INAE

The Annals of the INAE contains the text of the lectures delivered by Life Time Contribution Awardees; Professor Jai Krishna and Prof. SN Mitra Memorial Awardees, newly elected Fellows of the Academy and INAE Young Engineer Awardees.

b) Current Trends in Engineering Practice

The first volume of "Current Trends in Engineering Practice" - a compilation of papers based on the lectures delivered by industry experts in engineering colleges under this scheme was brought out in the year 2006. The second volume of this series – "Current Trends in Engineering Practice Volume II" has been brought out in the year 2010. This deals with recent developments and practices adopted in various projects in different disciplines and specializations. Complimentary copies of both the volumes have been distributed to AICTE, engineering colleges/institutions, concerned industry experts and government departments.

c) Report of INAE Workshop on "Making India Powerhouse for Semiconductor Design"

INAE in association with India Semiconductor Association (ISA) and supported by Department of Information Technology (DIT) and Office of the Principal Scientific Advisor to the Government of India, organized a workshop on the theme of 'Making India Powerhouse for Semiconductor Design' on 31 Oct—01 Nov., 2009 at India International Centre, New Delhi. Dr. M.J. Zarabi, Vice-President, INAE, Prof. A.B. Bhattacharyya, Former Professor, Indian Institute of Technology Delhi and Dr. Alok Nath De, Director, ST-Ericsson India were the co-Chairs of the workshop. The workshop was attended by about fifty specialists and thought leaders in the field from industry, R&D and academia.

They deliberated on issues related to India's capabilities-strengths and areas of improvement in the sphere of silicon design. A report has been brought out which captures deliberations and recommendations for giving 'semiconductor design' a collective thrust.

d) **INAE Annual Report 2010**

EMINENCE INDICATORS (2010-11)

Research Projects on Indian Engineering Heritage

India has a long tradition of outstanding engineering achievements in diverse fields such as Monuments, Bridges, Irrigation Systems, Metallurgy, Textiles etc. The documentation on these achievements is available in the libraries of Archeological Survey of India, State Museums, Professional Societies and with individuals. It is fragmented and not easily accessible. In this direction, INAE has constituted Expert Study Groups on Indian Engineering Heritage – Railways, Metallurgy and Civil Engineering to compile information and documentation of outstanding engineering achievements and create an Archives of Indian Engineering Heritage.

INDIAN NATIONAL SCIENCE ACADEMY

Hon'ble President of India, Smt Pratibha Devisingh Patil inaugurated the concluding function of the Platinum Jubilee Year of the Academy on December 7, 2009 at Saha Institute of Nuclear Physics, Kolkata.

On the occasion of concluding function, six Special Platinum Jubilee publications were released. A special Platinum Jubilee volume entitled *Science in India: Achievement and Aspirations* was later released by Hon'ble Minister of State for Science & Technology and Earth Sciences Shri Prithviraj Chavan.

A Platinum Jubilee Chair for Promotion and Service to Science has been instituted by the Academy.

The Academy elected Thirty Indian scientists and five overseas scientists to its Fellowship.

Twenty-eight young researchers were selected by the Academy for the INSA Medal for Young Scientist which were presented to the awardees during the Anniversary Meeting at Kolkata.

Eighteen awards (three general medals/ lectures and fifteen subjectwise awards were announced by the Academy. Sixteen lectures were delivered under the aegis of the different local chapters of the Academy.

Under its Science Promotion Programme, the Academy has supported fifty-four Senior Scientists, sixty-five Honorary Scientists, twelve Research Projects by Young Scientists awardees besides having financially supported ninety-two International/National Seminars/Symposia/Conferences which were held in different parts of India.

The Academy supported ninety Indian scientists to work in overseas academic and R&D institutions and facilitated seventy-seven foreign scientists to work in India under various exchange programmes.

Under the Inter Academy programme on Science Education, six hundred forty students and seventy two teachers availed the Summer Research Fellowship. Eleven Refresher Courses and thirty Lecture Workshops were also held under the programme..

Under its History of Science Programme, the Academy has supported thirty-four research projects during the year.

Inter-Academy Council (IAC) Board and Inter-Academy Panel (IAP) on International Issues have elected the Academy as its member, owing to its continued lead role and activities.

The Academy under its Science and Society programme organized several symposia and workshops on subjects such as Nutrition Security and Identification of Giftedness.

The Centre for International Cooperation in Science (CICS), formerly known as CCSTDS, continued its programmes on Science Promotion and capacity building.

INDIAN SCIENCE CONGRESS ASSOCIATION

The Indian Science Congress Association (ISCA) is a premier scientific organization of the country established in 1914 in Kolkata. 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 following objectives :

- (i) To advance and promote the cause of Science in India;
- (ii) To hold an Annual Congress at a suitable place in India;
- (iii) To publish proceedings, journals, transactions, etc.;
- (iv) To popularise Science.

ISCA CHAPTERS

The Association started organizing popular science lectures in different centers in India from 1962-63. This scheme envisaged constructive work for the popularisation and advancement of science throughout the year. Till 1985-86 these lectures were delivered at seventeen centers spread over the country. These activities were restructured with the formation of Regional Chapters.

One of the major objectives of the ISCA is to inculcate scientific temper among people and to encourage young scientists to develop steadily by involving them in the programmes relevant to fundamental, experimental and operational activities. To further these objectives ISCA started Chapters from 1986-87 in different places in India. In 2009-2010, there were 21 ISCA Chapters at Allahabad, Amravati, Banasthali, Bangalore, Baroda, Bhopal, Bhubaneswar, Chennai, Coimbatore, Delhi, Guwahati, Hyderabad, Jaipur, Jammu, Kanpur, Karnal, Kolkata, Mumbai, Nagpur, Shillong, Tirupati and Visakhapatnam.

PUBLICATIONS

Proceedings of the Ninetyseventh Annual Session of the Indian Science Congress Association were published. The bi-monthly journal Everyman's Science (Vol.XLV) is brought out.

Other publications brought out were: ISCA Directory : 2010-2011, Annual Report : 2009-2010, List of Office-Bearers & Sectional Committees for 2010-2011, Honorary Member, Donor & Life Members for 2010-2011, Members (With Voting Right) for 2010-2011, Synopsis of the Presentations of ISCA Young Scientist Awardees for 20110, proceeding (containing Presidential Address), abstracts of Platinum Jubilee Lecture, Awards Lecture papers presented and invited lectures of different sections etc for 98th ISC is under publication

ISCA REPRESENTATION IN OTHER ORGANIZATIONS DURING 2010-2011

Indian National Science Academy, New Delhi :

Dr.Ganesh Pandey, Head & Scientist - G, Division of Organic Chemistry, National Chemical Laboratory, Pune-411 008, Maharashtra (from January 1, 2009 to December 31, 2009)

Prof. S.S. Katiyar, former General President, Former Vice-Chancellor, Chhatrapati Shahu Ji Maharaj University, Kanpur, 7/111, Swaroop Nagar, Kanpur-208 002(from January 2010 to December 31, 2011)

Post Graduate Institute of Medical Education and Research, Chandigarh:

Prof.B.P.Chatterjee, former General Secretary (Headquarters), ISCA, Emeritus Fellow, AICTE and Emeritus Professor, West Bengal University of Technology, Sector - I, BF - Block, Salt Lake, Kolkata-700 064

Indian National Academy of Engineers, New Delhi:

Dr.P.Rama Rao, Past General President, ISCA, Chairman, Governing Council, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Balapur P.O., Hyderabad-500 005

JIPMER, Puducherry

Prof.Avijit Banerji, General Secretary (Hqrs.), ISCA, Programme Coordinator, Centre of Advanced Studies, Department of Chemistry, University Colleges of Science and Technology, 92, Acharya Prafulla Chandra Road, Kolkata-700 009.

All India Institute of Medical Sciences, New Delhi:

Prof K.C.Pandey, General President (Elected), Department of Zoology, Lucknow University, B1-240-A, Sector G, Jankipuram, Lucknow, (from January, to December 31, 2010).

Young Scientist's Award Programme

Indian Science Congress Association introduced the programme for Young Scientists from the 68th Session of the Indian Science Congress in 1981. The Programme enables Young scientists to present their research work with opportunities to exchange ideas in the relevant scientific problems with their counterparts and specialists. The ISCA Young Scientist Awards are given to candidates for making the best presentations. Fourteen such awards are given at present. The values of these awards have been enhanced from Rs. 5,000/- to Rs. 25,000/- from 93rd session. Each award carries a cash amount of Rs.25, 000/- and a Certificate of Merit. The list of awardees for 2010-2011 is given below:

S. No.	Area	Name of Awardee
1.	Agriculture and Forestry Sciences	Dr.Sharmistha Pal, Division of Soil Science and Agricultural Chemistry, Indian Agricultural Research Institute, New Delhi-110012.
2.	Animal, Veterinary & Fishery Sciences	Chinmoyee Maharana Cellular and Molecular Neuroscience Division National Brain Research Centre, Maneswar-122050, Haryana.
3.	Anthropological and Behavioural Sciences (including Archaeology and Psychology & Educational Sciences and Military Sciences)	Mithun Sikdar Assistant Anthropologist (Physical) Anthropological Survey of India, Western Regional Centre, Pratap Nagar, Udaipur-313001
4.	Chemical Sciences	Mr. Moorthy Suresh, Analytical Science Discipline Central Salt and Marine Research Institute (CSIR), Bhavnagar -364002
5.	Earth System Sciences	Vikram Vishal Department of Earth Sciences, Indian Institute of Technology, Bombay, Powai, Mumbai- 400076
6.	Engineering Sciences	C.Prabhavathy Department of Chemical Engineering, Indian Institute of Technology, Kharagpur-721302
7.	Environmental Sciences	Linshy V.N. Senior Research Fellow, Micropaleontology Laboratory National Institute of Oceanography, Dona Paula,Goa-403004
8.	Information and Communication	Science & Technology (including Computer Sciences) Prasun Ghosal Assistant Professor Department of IT, Bengal Engineering and Science University, W.B. Howrah-711103
9.	Materials Science	Ms.Tirtha Som Glass Science and Technology Section, Glass Division,Central Glass and Ceramic Research Institute,196,Raja S.C.Mullick Road, Kolkata-700032.

10.	Mathematical Sciences (including Statistics)	Ms. A.Sathya, Department of Mathematics, Gandhigram Rural University,.Tamilnadu
11.	Medical Sciences (including Physiology)	Dr.Smrati Bhaduria ScientistDivision of Toxicology, Central Drug Research Institute, Lucknow-226001
12.	New Biology (including Biochemistry, Biophysics & Molecular Biology and Biotechnology)	Bhalchandra K.Vaidya, Chemical Engineering & Process Development Division, National Chemical Laboratory, Pune-411008
13.	Plant Sciences	H.Sood Department of Biotechnology and Bioinformatics, Jaypee University of Information Technology, Waknaghat,Solan-173215
14.	Physical Sciences	Thakur Prasad Yadav, Centre of Advanced Studies Department of Physics, Banaras Hindu University, Varanasi-221005

98th INDIAN SCIENCE CONGRESS

The 98th Indian Science Congress will be held at Chennai under the auspices of the SRM University from January 3-7, 2011. The Focal Theme of the Congress is **Quality Education and excellence in scientific Research in Indian Universities.**

The 98th session of Indian Science Congress will address 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.

Plenary sessions

The following Nobel Laureates have agreed to deliver lectures :

1. Dr. Venkataraman Ramakrishna
2009 Nobel Laureate in Chemistry
MRC Laboratory of Molecular Biology,
Cambridge, U.K.
2. Dr. Thomas A. Steritz
2009 Nobel Laureate in Chemistry
Yale University, New Haven, CT, USA
3. Dr. Ada E. Yonath
2009 Nobel Laureate in Chemistry
Weizmann Institute of Science Rehovot,
Israel

4. Dr. Martin Chalfie
2009 Nobel Laureate in Chemistry
Columbia University, U.S.A.

Besides above the list of plenary sessions with speakers are given below:

S.No.	Tentative title of the Plenary Session	Chairman of the Session
1	International year of Chemistry” CHEMISTRY OF FUTURE”	Prof.C.N.R.Rao, F.R.S Chairman, JNCASR, Bangalore
2	Science Academies Summit	Prof. M.S. Swaminathan, FRS Chairman, MSSRFChennai
3	Enhancing Academia Industry Interactions	Dr. R. Chidambaram Principal Scientific Advisor to Government of India New Delhi
4	Science Policy-Agenda for next five years	Dr. K. Kasturirangan Member, (Science), Planning Commission New Delhi
5	Space Summit	Dr. K. Radhakrishnan Chairman, Indian Space Research Organisation Bangalore
6	Strategic Electronic Sector	Dr. V.K. Saraswat Advisor to Raksha Mantri and Director General, DRDO New Delhi
7	Addressing critical and challenging science issues of climate change	Dr. Shailesh Nayak Secretary to Govt. of India Ministry of Earth Sciences New Delhi
8	Science & Challenges in energy Security	Dr. Baldevraj Distinguished Scientist & Director, IGCAR, Kalpakkam
9	Nano materials and Nano technology	Dr. G. Sundararajan Director, International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad
10	Agriculture, Biotechnology and Food and Nutrition Security	Dr. Ajay Parida Executive Director, MSSRF, Chennai
11	Prospective of Health and Disease in Modern Society	Dr. V.M.Katoch DG, ICMR, New Delhi
12	Cancer : Development of Novel Drugs for Therapy and Prevention	Dr. Shrikant Anant University of Kansas Medical Center, Kansas City, U.S.A
13	Environmental Technology: Issues relating to waste Minimization and Management	Prof. R. Ramamurthi Former General President, ISCAISRO Scientist, S.V. University, Tirupati
14	Biodiversity - Focus on fragile coastal ecosystems	Dr. P.L. Gautam Chairman, National Biodiversity Authority, Chennai
15	Medical Science: Recent Advances in Asthma Research	Dr. S.S. Parmar Connecticut, USA

Besides the above, there will be 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); 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 will be organised.

Awardees

The Indian Science Congress Association has instituted several Awards to honour and encourage scientists in India – mainly through special endowments received from individuals and groups and also from its own funds. The concept of instituting Awards was started from 1965 onwards; there are about 29 Awards that are given by ISCA. The awardees for 2010-2011 are:

S. No.	Name of Award	Recipient
1.	ASUTOSH MOOKERJEE MEMORIAL AWARD	Prof.R.Ramamurthi, Tirupati
2.	C. V. RAMAN BIRTH CENTENARY AWARD	To be decided
3.	SRINIVASA RAMANUJAN BIRTH CENTENARY AWARD	To be decided
4.	S.N.BOSE BIRTH CENTENARY AWARD	Dr.Balaram Varghava, Delhi
5.	S.K.MITRA BIRTH CENTENARY AWARD	Dr.T.Madhan Mohan, Delhi
6.	BIRBAL SAHANI BIRTH CENTENARY AWARD	To be decided
7.	S.S. BHATNAGAR MEMORIAL AWARD	To be decided
8.	VIKRAM SARABHAI MEMORIAL AWARD	Dr.V.K.Saraswat, New Delhi
9.	M.K.SINGAL MEMORIAL AWARD	Prof.Peramesharan, Chennai
10.	PROF. R.C. MEHROTRA MEMORIAL LIFE TIME ACHIEVEMENT AWARD	Prof.Asutosh Sharma, Kanpur
11.	JAWAHARLAL NEHRU BIRTH CENTENARY AWARDS	Sri Ratan Tata Dr.Naresh Trehan, Gurgaon
12.	MILLENNIUM PLAQUES OF HONOUR	Prof.N.K.Gupta, Delhi Dr.J.S. Yadav, Hyderabad
13.	G.P.CHATTERJEE MEMORIAL AWARD	To be decided
14.	B C GUHA MEMORIAL LECTURE	Prof.R.C.Mahajan, Chandigarh
15.	PROF. SUSHIL KR. MUKHERJEE COMMEMORATION LECTURE	Dr. Himangsu Pathak, Delhi
16.	PROF. S. S. KATTIYAR ENDOWMENT LECTURE	To be decided
17.	PROF. R.C. MEHROTRA COMMEMORATION LECTURE	Prof. V.Chandrasekhar, Kanpur
18.	PROF.G.K.MANNA MEMORIAL AWARD	Prof.Nirupama Agrawal, Lucknow
19.	PROF. ARCHANA SHARMA MEMORIAL AWARD	Dr.Ananda Kumar Sarkar, New Delhi
20.	JAWAHARLAL NEHRU PRIZE	Vigyan Parisad, Prayag

21.	EXCELLENCE IN SCIENCE & TECHNOLOGY AWARD	Dr.V.M.Katoch, New Delhi
22.	PROF. HIRALAL CHAKRAVARTU MEMORIAL AWARD	Dr.Manoj Prasad, New Delhi
23.	PRAN VOHRA AWARD	Dr.Supradip Saha, New Delhi
24.	DR. B. C. DEB MEMORIAL AWARD FOR SOIL/ PHYSICAL CHEMISTRY	Dr.B.Damodar Reddy, Rajamundry
25.	DR. B. C. DEB MEMORIAL AWARD FOR POPULARISATION OF SCIENCE	Mr.S.Senthilkumaran, Chennai
26.	PROF. R.C.SHAH MEMORIAL AWARD	No Award
27.	PROF. ANIMA SEN MEMORIAL LECTURE	No Award
28.	PROF. UMAKANT SINHA MEMORIAL AWARD	No Award

INTERNATIONAL ADVANCED RESEARCH CENTRE FOR POWDER METALLURGY & NEW MATERIALS

International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad was established in the Year 1997 under Research and Technology Development. Total Number of Employees 165 out of 71 is scientists. Institutes main research areas are Nanomaterials, Engineered Coatings, Ceramic Processing, Laser Processing of Materials, Sol-Gel Coatings, Non-Oxide Ceramics, Carbon Materials, Fuel Cell Technology

MAJOR RESEARCH ACCOMPLISHMENTS (2010-2011):

- Technology for producing *nanosilver suspensions for antibacterial textile applications* has been successfully transferred to Resil Chemicals Pvt Ltd, Bangalore. They have already established a production center and started exporting nanosilver suspension to companies in several countries.
- Process for production of oxide dispersion strengthened (ODS) clad tubes for fast breeder reactor, sponsored by Indira Gandhi Centre for Atomic Research (IGCAR) has been completed successfully. Under this project, *Yttria dispersed martensitic steel with 9%Cr* was investigated for developing fuel cladding tubes for liquid metal cooled fast breeder reactors. The process route involves high energy milling of pre-alloyed steel powder with nano yttria powder followed by degassing, canning, hot extrusion and cold pilgering. Technology upscaling is in progress.
- Prototype model of novel continuous coating equipment has been conceptualized, designed, fabricated and installed at ARCI for demonstration of process on aluminium foils to a prospective technology receiver. The equipment has been used to deposit thinner oxide films of 0.5 μ m - 1 μ m thickness on kilometers long thin foils of 30 μ m thickness for development of energy efficient aluminium foil transformers (AFT's). Testing is currently under progress. In view of the vast global market size and envisaged wide application spectrum, the continuous coater design and associated process know-how has been simultaneously patented in India, US, Germany, Japan, UK, France, Brazil and South Africa.
- Under the TIFAC-CAR project for auto industry on development of tailor welded blanks (TWB) and Hydroforming technology, laser welding process for fabrication of tailor welded blank (TWB) coupons for joining 0.8mm thick IF steel sheets to 1.6 mm thick SPC 440 / DP 590 / EDD steel sheets was successfully developed. The choice of steel is based on the design and performance requirement of the selected component in the project viz. Door Inner of SUV. Defect free blanks

could be consistently fabricated through appropriate choice of welding parameters and edge management using seam tracking. These TWB coupons were subjected to formability tests and formability limiting diagrams (FLDs) were generated experimentally. The formability of TWBs was found to be between the two steels used to tailor the blank. Consequently, TWBs displayed acceptable formability for the proposed application.

- Centre for Knowledge Management of Nanoscience & Technology (CKMNT) was launched on 1st April 2009 as one of ARCI's project with an objective to foster the exchange and dissemination of advanced technological knowledge and expertise to meet the needs of the researchers, industry, policy makers, financial institutions and venture capitalists in the area of nanoscience & technology. CKMNT has been partially funded by the Govt. of India's Department of Science and Technology (DST) in a project mode and would help in fulfilling the objectives of the Nano Mission of DST.

IMPORTANT HIGHLIGHTS OF MAJOR RESEARCH PROGRAMMES (2010-2011):

- **Nanomaterials**

Nanomaterials programme at ARCI has been directed at development of technologies for large scale synthesis of nanomaterials to meet the requirements of Indian companies as well as to develop and demonstrate the innovative application technologies followed by transfer to interested companies. Nanomaterials activities have made substantial progress in terms of not only establishing a vast array of synthesis, processing and characterization facilities, but also in terms of developing applications of nanosilver for drinking water disinfection and functional textile finishes, nano-ZnO for electrical varistors, etc. The strength of ARCI nanomaterials programme is in developing nanomaterial-based applications keeping in view product quality, health and environmental concerns. Other material of focus for ARCI's nanomaterials programme are Carbon Nanotubes, possessing unique nanostructures with remarkable electronic and thermo- mechanical properties, some resulting from their close relation with graphite and some due to their one dimensional aspects. Efforts are ongoing to explore potential applications of carbon nanotubes using their unique properties. ARCI has developed carbon nanotubes from various techniques such Arc Discharge, CVD and Fluidized Bed Reactor successfully. Activities have also been initiated in the areas of advanced carbon nanotube reinforced polymer as well as metal matrix composites for structural and thermal applications.

- **Engineered Coatings**

ARCI's accomplishments pertinent to the successful transfer and implementation of Detonation Spray Coating (DSC), Micro-Arc Oxidation (MAO) and Electro-Spark Coating (ESC) technologies – unique technologies in the national context - were primarily instrumental in ARCI being recognized as a Centre of Excellence in the field.

The MAO technology is actively being implemented at three locations with simultaneous development of strategic and civilian applications such as deposition on internal surfaces of the tubular parts etc. The specialized equipment designed and established at ARCI for deposition of thin oxide film on long-thin foils on a continuous scale for certain novel applications has already been demonstrated to provide electrically insulating coatings on several kilometer long foils. The patent applications on the associated know-how were filed in India and abroad.

Efforts are ongoing to develop thermal spray techniques like Cold Spray Coating (CSC) and Solution Precursor Plasma Spraying (SPPS) as well as establishment of a unique state-of-art facility in India

like Physical Vapour Deposition (PVD) technologies such as Electron Beam Physical Vapour Deposition (EB-PVD) and Cylindrical Rotating Cathodic Arc PVD coating technology for deposition of nanocomposite wear resistant coatings.

The Pulsed Electrodeposition (PED) process is being developed to impart nanostructured coatings like Nickel, NiSiC and Copper on diverse substrates. Development of hardness gradient coatings through a novel modification of grain size from micro-meter to nano-meter regime within a single coating has been a significant achievement for which a patent application was already filed.

- **Ceramic Processing**

Ceramic Processing programme at ARCI, with its mandate of developing innovative ceramic forming processes, involves activities on advanced processing techniques such as chemical vapour deposition (CVD), hot isostatic pressing (HIP), spray pyrolysis, extrusion and colloidal processing. During the period of this report, development of know how for a variety of complex shaped transparent ceramic components, refractory nozzles, nano additives for ceramic pigments and honeycomb based solid oxide fuel cells was ongoing.

Non-Oxide Ceramics programme at ARCI involves activities on engineered non-oxide ceramics and their composites for wide range of applications. Technologies for a range of products such as reaction bonded and pressureless sintered silicon carbide for mechanical seals, wear parts, optical applications and other critical components needing light weight and high stiffness were successfully developed. Large area CVD coated SiC parts for many applications due to their relatively low coefficient of thermal expansion, and extremely smooth surface - that can be achieved upon polishing- have been developed. Activities for the development of silicon nitride and SiAlON based Nitride ceramics with low dielectric constant and excellent mechanical properties are ongoing. The SiAlON based ceramics developed at ARCI have potential for cutting tool applications and their ultra high wear resistance property make them suitable for many other applications.

- **Sol-gel Coatings**

Nanocomposite coatings often exhibit very interesting properties that differ from those of analogous composites with large particle size. Amongst the available coating deposition techniques, nanocomposite coatings generated by sol-gel process have shown a lot of promise for variety of applications. Since material properties of sol-gel derived coatings can usually be changed by modification of the starting compositions or precursors on the molecular scale, coatings with novel composition-property relationships and multi-functionalities can possibly be generated. Work is ongoing with several industrial partners for development and demonstration of sol-gel based nanocomposite coatings for surface engineering of different substrates for a wide variety of applications as given below:

1. Glass-like/pigmented glass-like coatings on metals and stainless steels for improved abrasion/scratch/corrosion resistance
2. Easy-to-clean coatings on metals, glass, plastic and ceramic substrates
3. Hard coatings on plastics
4. Decorative coatings on glass
5. Anti-microbial coatings on metals, glass and plastic

6. Superhydrophilic, anti-reflective coatings on glass and plastic

In addition to technology development of sol-gel coatings for customized applications/products, basic research is also being pursued to evolve a better scientific understanding for aiding technology development and for identifying possible new avenues of application.

- **Laser based Manufacturing Processes**

Programme on laser processing of materials was initiated to promote, demonstrate and provide laser based materials processing technologies for industrial applications in the country. Processes like Laser welding, cutting, surface engineering, metal deposition, drilling, micromachining, shock peening etc., due to their unique advantages such as high productivity, localized processing, low heat input and amenability to automation, are being increasingly used in a wide variety of industrial sectors like automobile, aerospace, electronics, energy and ship building. The scope of activities includes R&D programmes oriented towards demonstrating the feasibility of laser materials processing for specific applications, research studies towards evolving a better scientific understanding to aid in process development and job works of specialized nature. ARCI is equipped with one continuous wave CO₂ laser, a pulsed Nd: YAG laser and a 6 kW fiber coupled diode laser-each of them integrated with CAD/CAM and CNC/ Robot with turn/tilt table.

- **Fuel Cell Technology**

An Improved version of grid independent fuel cell pave systems (GIPS- 1000 and GIPS-5000) with more compact power controllers have been developed. GIPS-5000 was operated intermittently for more than 200 hours generating nearly one MWhr of energy. Judicious operation of the fuel cell stack in these systems has reduced the fuel consumption from 1 to 0.8 cu.m/KWhr. One of the major cost components in fuel cell stack is the Nafion membrane. In order to make it more economical, ARCI has developed a composite membrane based on a biaxially oriented micro porous PTFE and Nafion by a novel fabrication process. Theses composite membranes formed by impregnation of the ionomer material in the active area are attractive and cost effective alternative for immediate implementation in stationary and vehicular applications as the membrane cost is reduced by nearly 70 %. The successful demonstration of fuel cell-battery hybrid powered 3 wheeler electric vehicle with an Indian automotive company using 3 kW PEM Fuel Cell stack is complete. Efforts are ongoing, to develop next generation 5 kW fuel cell battery powered vehicle with the automotive company, wherein the fuel cell power pack design and integration carried out by CFCT shall be used as range extender.

MAJOR AND UNIQUE NATIONAL FACILITIES CREATED (2010-2011):

- Cold Metal Transfer (CMT) Welding Facility
- 20 liter -High Pressure Reactor for Aerogel Synthesis
- CNC Machining Centre
- Chemical Vapor Deposition Reactor for Synthesis of CNT
- Zeta Sizer and Particle Size analyzer
- Thermo- Mechanical Analyzer
- Impulse Excitation for Elastic Modulus Measurement

- Battery Testing Unit for Li Ion batteries
- Spray Pyrolysis for Thin Film Synthesis
- Zeta Potential Measurement System
- Rheometer

IMPORTANT COLLABORATIONS (NATIONAL AND GLOBAL) ESTABLISHED (2010-2011):

Foreign		Indian	
Academic Institutes	3	Academic Institutes	11
R & D Institutes	4	R & D Institutes	3
Industry	6	Industry	14
Total	13	Indian	28

IMPORTANT OUTPUT INDICATORS

1.	Publications	84
2.	Patents/ know-hows	Indian Patent: Filed 24, Granted 15; International Patent: Filed 3, Granted 1
4.	Post Graduate and PhDs trained	PG, 49; Ph.D., 22

EMINENCE INDICATORS (2010-2011)

- Nanosilver Suspensions for Antibacterial textile finishes
- CVD Zinc Sulfide Blanks for DRDO and blanks for ISRO
- Ligh-weighted SiC substrates for satellite mirror for ISRO
- Laser Drilling of High Pressure Nozzle Guide Vane of Jet Engines for HAL, Bangalore
- Laser Welding and cladding of a number of components for PSUs and private industries.
- SiC coatings on C/C Composite Parts for ISRO

TECHNOLOGIES/IPRS RELEASED AND COMMERCIALIZED

1. Transfer of Nanosilver Suspension Technology to Textile Chemical Company

ARCI has transferred technology to manufacture nanosilver suspensions for antibacterial textile finish to Resil Chemicals Pvt Ltd, Bangalore (Resil). The suspensions made at laboratory scale (100 ml batch) were tested by Resil for antibacterial textile application and were approved for the large scale synthesis. As the scale up involves the designing of a reactor, ARCI has collaborated with a Gujarat-based company engaged in manufacture of borosilicate glass based industrial process equipments/ process plants for large scale synthesis of nano silver suspension. A reactor with a production capacity of 15 liters/batch/hour has been designed and fabricated. Nanosilver suspensions with particle size of 10-50 nm were successfully synthesized using this reactor after addressing several issues such as

stability of the suspension in contact with the plastic container and stability during transport. The samples have been stabilized to stand high speed centrifuge at 6000 rpm as confirmed by the UV – visible spectroscopy, which indicated no decrease in the absorption peak intensity and thus no settling of the nanoparticles. The stability of the suspension was tuned to stand the dilution with tap water which is common in the textile industry for the purpose of application on textile fabric using padding process. The suspensions prepared had wash-durable antibacterial activity upto 100 washes when coated on the fabric even at low concentrations of 1 wt % nanosilver suspension in the treatment bath. Trial run of large scale synthesis of 12 litres nano silver suspension was made in the reactor. The samples produced at ARCI and tested by Resil demonstrated reproducible results. After satisfactory results of lab tests of the trial batches, Resil prepared 600 litres nano silver suspension in 50 number of 12 litre batches and exported to their textile customers.



Fig. 10.13. Nanosilver suspensions pilot scale manufacturing facility at ARCI

2. Nanosilver-incorporated Ceramic Candle Filters for Drinking Water Disinfection

Technology for nanosilver-incorporated ceramic candle filters for drinking water disinfection has been developed, field tested and transferred to Indian company in Hyderabad. Another three companies are approaching for technology transfer for northern states. ARCI has also made life cycle analysis for this product in terms of silver leaching into the filtered water as a function of usage time and long term antibacterial activity. The results are well with in the limits of WHO limits for silver in drinking water standards and US EPA limits for colloidal silver intake by humans. The product is proven to be safe based on this analysis.

Level of penetration of National Technology Space

- Since ARCI technologies are targeted at niche markets, technology recipient companies have been able to make significant impact in national technology space by commercializing technologies developed by ARCI.

INSTITUTE OF ADVANCED STUDY IN SCIENCE & TECHNOLOGY

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 can not 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 has been 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.



Fig. 10.14. Virgin and polymer (polystyrene) coated items made

Synthesis of Organic-Inorganic Nanocomposite thin films by plasma based technique:

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. TiO₂/Polyaniline nanocomposite films of thickness 300 nm to 500 nm have been deposited under optimized condition with TiO₂ 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 TiO₂ / Polyaniline film has a resistivity of $\sim 10^2$ ohm-cm, which is 7 and 10 orders lower than plasma prepared Polyaniline and TiO₂ respectively. This shows strong potential of application of TiO₂ / Polyaniline nanocomposite film for different types of device fabrication e.g Solar Cell and Sensor.

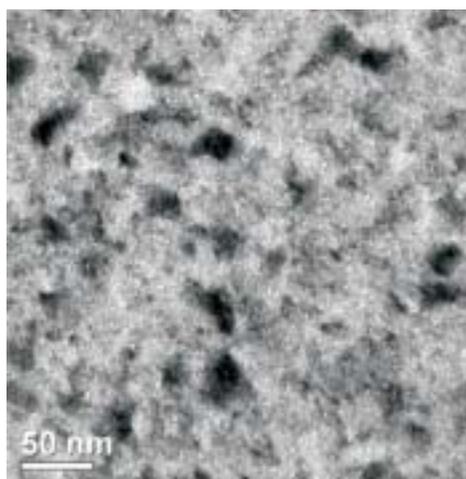


Fig. 10.15. TEM image of Polyaniline/TiO₂ nanocomposite thin film deposited by plasma polymerization and magnetron sputtering combined process.

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.

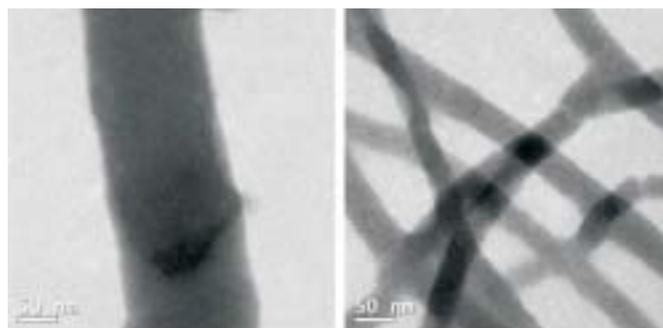


Fig. 10.16. TEM image of PANI nanowire

Mathamatical 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 relationship 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. More over we have designed optimal management for the $M / G / 1$ type of queueing system with two phases of service for unreliable server under $N - policy$.

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 $4^{\circ}C$ 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 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

We are 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 an herbal formulation has been developed and its pre-clinical toxicity has been assessed against various animal models during this period. Antioxidant activities of cer 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.

Publications-Total No in referred journals: 33

Awards/recognition:

1. Best Poster Awarded to Ms. S. K. Sharma at the International Conference on the Frontiers of Plasma Physics and Technology, Kathmandu 6-10 April, 2009.
2. Dr. Devasish Choudhury was awarded “Indo-US Science and Technology Forum (IUSSTF) Research Grant” to undertake advanced research in University of Illinois at Urbana-Champaign, October 2009-April 2010.
3. Prof. Joyanti Chutia was awarded the honour of “Women Physicist” by the Mother Teresa Womens’ University, Kodaikanal, on 28th February, 2010.
4. Mr. Nirab Chandra Adhikary has been awarded the Postdoctoral fellowship by Yokohama University, Japan in 2010.

Talks/ Lectures delivered:

- i. Prof. Joyanti Chutia delivered a Plenary Talk PLASMA-2009 held at the National Institute of Technology (NIT), Hamirpur.
- ii. Dr. H. Bailung delivered lectures on plasma diagnostics in Three day school on foundations of plasma physics and technology for young researchers of North-East India held at Dibrugarh University during October 30- November 1, 2009.
- iii. Dr. A. R. Pal delivered an Invited Talk PLASMA-2009 held at the National Institute of Technology (NIT), Hamirpur during 08-11 December, 2009.
- iv. Dr. A. R. Pal delivered a Talk in *Regional Conference on the Recent Trends in Chemistry* held at Dharmanagar College, Dharmanagar, Tripura during 12-13, September 2009.
- v. Neelotpal Sen Sarma delivered a talk on “Synthesis of liquid crystalline polymer and co-polymer of cholesteryl acrylate with 1-hexene, their characterization”, in the 55 Annual Technical Session of Assam Science Society held at Gauhati University, Guwahati on 15th February 2009.
- vi. Samiul Hoque delivered a talk on “*Synthesis and Characterization of poly-cholesteryl 4-pentenoate Liquid Crystalline Polymer and Determination of its Conducting Behaviour*”, in the *National*

Seminar on Emerging Trends in Polymer Science and Technology (Poly-2009), held at Saurashtra University, Rajkot during October 8-10, 2009.

- vii. Samiul Hoque delivered a talk on “*Synthesis and Characterization of Polymer Liquid Crystal: Cholesteryl acrylate co-polymer*” in the *National Seminar on Emerging Trends in Polymer Science and Technology (Poly-2009)*, held at Saurashtra University, Rajkot during October 8-10, 2009.
- viii. Dr. Joyanti Chutia delivered a talk on “Experimental observation of Sheath Phenomena in dusty plasmas” at the annual PSSI Conference, Hamirpur, HP during December’2009.
- ix. Dr. G. Choudhury delivered an invited talk in the *International Symposium on Probability Theory and Stochastic Processes* held in honour of *Professor S. R. S. Varadhan FRS*, held at Department of Mathematics, Cochin University of Science & Technology, Cochin , India during February 6–9, 2009.
- x. Dr. Sabitry Choudhury Bordoloi delivered a talk entitled ‘Conservation of amphibian in relation to habitat characteristics’ on 16.11.2009 in Department of Science and Technology, Science and Engineering Research Council sponsored 3rd school in herpetology (2-17 november,2009) held at Donbosco Auditorium, Guwahati.
- xi. On 22nd January, 2010 Sabitry Choudhury Bordoloi delivered Key note address in the U.G.C. sponsored National seminar on “Degradation of wetland ecosystem : its impact on the quality of life of the dependant community and on socioeconomic life of fisherman; An environmental impact assessment study in Assam.”organized by Kamrup College, Chamata on 22nd And 23rd January’2010.
- xii. Dr. Sabitry Choudhury Bordoloi delivered a talk on waste management in the seminar entitled “Waste Management Mechanism- The Role of Corporate Sectors” on 8th January, 2010 at 2:30 pm. Organized by Assam Institute of Management ,Guwahati, Assam.
- xiii. Dr. Dipali Devi has attended the Annual Day of the Mahendra Mohan Balika Vidyalaya and delivered a speech as chief guest on 10/10/09.
- xiv. Dr. Dipali Devi has attended the workshop at Indian Institute of Entrepreneur Development organized by CSB as resource person and delivered a lecture on development of seed technology of muga silkworm on 20/05/09.
- xv. Dr. Dipali Devi Lecture delivered at IASST on development of Seericulture in Assam on the occasion of visitor visited the seri biotech lab from SHRISTI , NGO of Dibrugarh on 25th February, 2010

Ongoing Projects-Title and funding agency:

- i. “Investigation of collective processes in laboratory dusty plasma” funded by ISRO, GoI.
- ii. “Basic experiments in multicomponent plasma with negative ions” funded by DST, GoI.
- 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” funded by DAE, GoI.
- iv. “Studies on the discharge characteristics of pulsed plasma system for synthesis of conducting polymer films” 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, Govt. of India 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” Funded 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”,Funded by DST(GoI).
- viii. “Nutritional Status of the pregnant women in the low socio economic areas in Kamrup District” 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” funded by NBFGR, Lucknow, U.P.
- x. “Study of Aquatic biodiversity in selected watersheds of Arunachal Pradesh, India” funded by DST, GoI.
- 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 Health care 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”, DST, Govt. of India.
- xiv. “Evaluation of antioxidant property of some selected fruits of North East India - a biochemical approach”, 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”, ICMR GoI.
- xvi. “Development of a package for seed production of muga silkworm”, NABARD.
- xvii. “Assessment of Impact of intake of aratificial colours through foodstaffs available in the North Eastern Region including Sikkim”, North Eastern Council, Govt. of India.
- xviii. “A systematic study on phisico chemical properties of muga silk (*Antheraea assama*) fiber produced in India”, DST, Govt. of India.
- xix. “Development of Grainage of muga silkworm using indoor rearing technique”, ASTEC, Govt. of Assam.
- xx. “Rehabilitation of degraded soil of Upper Assam due to excessive mining of Coal”, 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”, Ministry of Environment & Forest, Govt. of India.

Total Number of Ph.D. awarded: 3

Total Number of Research Students: 31

Visit by Scientists and talk delivered:

- i. Prof. T. K. Dey, IIT, Kharagpur has delivered a talk on “Activities of Cryogenic Centre, IIT, Kharagpur” on November 24, 2009.
- ii. Prof. Sibaji Raha, Director, Bose Institute, Kolkata has delivered a talk on “Searching for the Mysteries of the Universe – Science of LHC at CERN” on February 22, 2010.
- iii. Dr. P. K. Shukla, Scientist, CDRI visited IASST and delivered a Talk on Antidermatophytic Drug.
- iv. Prof. K.P. Gopinathan , Emeritus Prof. of IISc , Bangalore has visited the Institute during 2-4th November 2009 and delivered a lecturer on Perspective of Human cloning –Ethical issues.
- v. Prof. R.K.agarwala , Center for cell and molecular Biology, Hyderabad delivered a talk on “A brief overview of different DNA marker techniques: tools for detecting genetic variation”.
- vi. Prof. Y. Nakamura from Yokohama University, Japan visited the institute for collaborative research work on plasma during June,2009.

Workshop, Seminar etc organized:

- i. Training program for M.Sc. students of Gauhati University.
- ii. Hindi Divas was celebrated on 14th September 2009.
- iii. Foundation day of the institute was celebrated on 3rd November 2009 and Prof. J. Medhi the eminent statistician and emeritus professor of G.U. was felicitated on this occasion.

Any other activities:

- i. Dr. N. S. Sarma chaired the session–III for the oral presentation from A-1 to A-8 in the National Seminar on Emerging Trends in Polymer Science and Technology (Poly-2009), held at Saurashtra University, Rajkot during October.
- ii. Chaired the session–II in the U.G.C. sponsored National seminar on “Degradation Of Wetlands: Its Impact on Ecology, Biodiversity and Socio-Economic Condition of Fisherman Community” held at Kamrup College, Chamata On 22nd And 23rd January’2010.
- iii. Dr. J. Kotoky and K.K. Sarma participated & presented a paper in the 55th Annual Technical session, Assam science society, held at Gauhati University on Feb 15, 2010.
- iv. T. Mudoj, R Devi and D C Deka has presented a paper entitled “Estimation of metal contents in a few native fruits of N E India”. in the 55th Annual Technical session, Assam science society, held at Gauhati University on Feb 15, 2010.

JAWAHARLAL NEHRU CENTRE FOR ADVANCED SCIENTIFIC RESEARCH

THE OBJECTIVES OF THE CENTRE ARE:

- ◆ To carry out front-line research in selected areas of science and engineering;

- ◆ To promote collaborative research with scientists at the Indian Institute of Science and other institutions in the country;
- ◆ To promote a national and international forum for in-depth discussions on important scientific topics in areas of vital interest to scientists of the Centre and in the country at large;
- ◆ To organize periodic winter and summer schools in certain areas, where young talented scholars would be associated;
- ◆ To provide opportunities for talented young students to carry out research projects;
- ◆ To provide facilities to visiting scholars and faculty from all over India and abroad to work for extended periods with the faculty of the Centre;
- ◆ To publish monographs and reports on frontier and futuristic areas of science as well as monographs of educational value.

MAJOR PROGRAMMES FOR THE ELEVENTH FIVE YEAR PLAN:

Chemistry and Physics of Materials Unit will expand its research activities to the following areas: Multifunctional materials such as beferroirs, Atomic layer by layer synthesis of materials, Synthesis, characterization and application of nanomaterials, Plastics electronics, Bio-inspired materials, Inorganic-organic hybrid materials, Computer simulation and modelling of systems and phenomena of academic interest as well as practical utility which will help to promote an international centre for material science for hosting important workshops, visitors programmes and collaborative efforts. The dedicated nano laboratory will be fully functional for investigating new nanomaterials as well as nano technological problems.

Engineering Mechanics Unit plans to expand its activities into modern bio/geo/nano areas. Depending on the space, equipments/facilities and faculty strength, the following are projected : turbulent shear flow dynamics, monsoon predictions through a theory of unsteady convective boundary layers for the tropics, formulation of new wavelet techniques to investigate monsoon rainfall characteristics, computation of unsteady flows in compressors and turbines, unsteady aerodynamics of insect flight and its adoption into the design of micro air vehicles, rheology and dynamics of granular materials and suspensions, role of micro-scale inertia in disperse multiphase flows; flow of, and particle motion in, non-Newtonian and complex fluids; and small scale flows, free surface flows and density stratified flows.

Evolutionary and Organismal Biology Unit will continue to pursue their unique long term investigation on the evolutionary genetics of circadian rhythms, the generality of life-history tradeoffs, and metapopulation dynamics. Core areas of research like chronobiology, evolutionary genetics and population ecology will continue to dominate. Allied areas like neurobiology, developmental biology, community ecology will be expanded with faculties added in these areas. Major equipments required for the above mentioned expansion are: High throughput DNA sequencing set up, confocal microscope for immunocytochemistry, SABLE respirometry system for metabolic rate measurements, fine balances to weigh single flies or larvae, ovaries etc., and high end computing facilities for simulation studies of molecular loops and population dynamics.

Geodynamics Unit will have a new dimension in the form of Earth Science Centre to be established as per the recommendation of the Scientific Advisory Committee to the Prime Minister.

Molecular Biology and Genetics Unit, while consolidating the present strength of research work, will develop newer programmes in areas of bio-medical relevance. Emerging proteomics technology will be effectively utilized to understand the signal transduction system of malarial parasite; a lot more samples of HIV strains from across the country will be monitored for the changing subtype distribution across India which will help optimization in vaccine development by engineering T-helper epitope; new areas like nanobiology to understand chromatin dynamics at a single molecular level will be initiated; basic structural organization of chromatin in human brain as well as chromatin structure of meiotic recombination hotspots will be studied in great detail; human cardiovascular and hematopoietic development will be studied with the aim of identifying potential therapeutic molecules and targets; in the area of genetics of epilepsy and hearing, state-of-the-art genomics, cell biology and statistical methodology will be used to identify novel genes and gene interaction. 'Mouse genetics' and 'centromere biology' will be investigated in detail to address many biomedical problems.

Theoretical Sciences Unit will have research programmes in the following fields: Computational materials design, multiscale modelling of condensed-matter systems, computational nanoscience, glassy systems in condensed-matter systems, quantum phase transitions, biomolecular simulations and other biologically motivated problems in condensed-matter and statistical physics. The unit expects to increase its Faculty strength to 12, its students strength to 50 and visitors strength to 6 per year.

Chemical Biology Unit would like to start a few new initiatives e.g. design of biosensors, functional supramolecular systems, drug design etc. It also plan to establish its infrastructure at JNCASR with some young faculty.

Condensed Matter Theory Unit will pursue research in the following areas: theory for doped manganites, Arrays of quantum dots, multiferroics, growth kinetics of nanoparticles, Luttinger liquids and quantum wires and highly frustrated quantum spin systems. In soft condensed matter and non-equilibrium statistical physics, some newer areas will be investigated.

MODERNIZATION OF FACILITIES INCLUDING OFFICE AUTOMATION:

In order to achieve the academic and research goals in the 11th Plan, the Centre would like to develop various infrastructural facilities. The growing demand from the researchers and the students has to be addressed to and the necessary support system needs to be built. In view of this the following new facilities will be added during the 11th Plan:

1. A laboratory for chemical biology research
2. Extension of the animal facility for the mouse genetics
3. Faculty and staff housing
4. Augmentation of the captive power supply
5. Extension of the lab facilities for Molecular Biology and Genetics Unit
6. Upgrading the existing facilities of the networking and communications.

SIGNIFICANT SCIENTIFIC & TECHNICAL ACHIEVEMENTS DURING 2009-10:

Chemistry and Physics of Materials Unit (CPMU): With regard to new nanomaterials, single, bi and few layer graphene samples have been produced mainly based on chemical approaches. Several new

results have been obtained for graphene functionalisation. Graphene based nanocomposites have been made and their electrical and mechanical properties have been examined. Graphene Analogues of BN and BCN have been synthesised and their properties have been examined. Air sensitive copper nanoparticles have been stabilized using a water soluble aminoclay matrix. Several new methods have been developed for patterning nanomaterials on given substrates. Development of polymer field effect transistors (FET). Bilayer structures consisting of donor and acceptor type molecules were used for fabricating (FETs), Development of Polymer Photovoltaics - Bulk polymer heterostructures were used to fabricate solar cells. After the discovery of surface ferromagnetism in otherwise nonmagnetic inorganic nanoparticles, the research group is exploring the origin of such ferromagnetism by using various experiments. During the past one year, there is much progress in exploring the different functional aspects of metal-organic frameworks (MOFs), viz. gas storage, selective guest accommodation, anion exchange, magnetism etc. During the year, the research group is also interested in assembling the same linker with a metal ion in different way by changing the reaction parameters. The effort resulted in the construction of four Cu-1,4-ndc (1,4-ndc = 1,4-naphthalene dicarboxylate) frameworks by varying solvent and temperature. The group's effort to synthesize magnetic frameworks resulted in the construction of a $S=1/2$ kagomé compound which has been found to show very interesting temperature dependent magnetic property.

Light Scattering Laboratory has been involved in performing various experiments using the Brillouin Spectroscopy, Raman Spectroscopy and High Pressure Research. Further, Brillouin Spectroscopy measurements have been carried out on pyrochlores. Light Scattering group has been strongly involved in the study of biological system with surface enhances Raman Spectroscopy (SERS). During this period two patents associated with antibacterial activities of nanoparticle cellulose composites and SERS based DNA/ RNA detection without PCR amplification reached National Phase stages. An experimental soft matter research facility is established. A confocal microscope and rheometer were installed in the first week of January 2010.

As part of *molecular dynamics simulation*, the complex dynamics of a room temperature ionic liquid, 1-nbutyl-3-methylimidazolium hexafluorophosphate ([bmim][PF₆]) has been studied using equilibrium classical molecular dynamics simulations in the temperature range of 250K-450K. A correlation between dynamic heterogeneity and intermolecular structure has been established. III-nitride growth by Molecular beam Epitaxy: A sophisticated Molecular Beam Epitaxy system dedicated for the growth of III-nitride thin films is installed and optimized.

Metal Nanostructure and Surface Phases on Si surfaces: The research group studied the formation of surface phases and self assembled nanostructures using Silicon surface orientation and surface reconstruction patterns as templates for nanostructure growth.

Substrate search for epitaxial GaN growth: Silicon and gallium arsenide substrates have been successfully modified by ion beams into SiC, Silicon nitride and Gallium nitride at room temperature, in an effort to search for substrates compatible for epitaxial Gallium Nitride growth. High Pressure Synchrotron Beam Line in Photon Factory, Japan: Under the DST-Japan joint initiative an Indian Beam Line is being setup for doing synchrotron experiments at Photon Factory. In line with this, there is an interest to develop an High Pressure Beam line for the Indian scientist. This is being done by Light Scattering Laboratory and would be functional in the early part of the next academic year.

New Chemistry Unit (NCU): Currently the Unit is involved in three different research projects which are interdependent and complementary. Synthesized chiral unnatural amino acids with metal binding

properties (metal binding ligands). The underlying theme of the group's research is the interface between synthetic efforts on small molecules or polymers and macroscopic properties at the materials level, leading to a macro-organic/supramolecular approach to functional materials.

The Unit is involved in setting up a research program that will provide a platform to integrate organic chemistry and material science with biology to combat infectious diseases in a multi-pronged approach namely diagnosis, prevention and treatment. Researchers have contributed extensively to the microscopic understanding of optical, magnetic, opto-electronics and transport phenomena of materials ranging from atoms, molecules to extended systems including biomaterials. A large number of new models are developed by identifying and optimizing parameters responsible for linear and non-linear optical polarizations and electron and hole mobilities in a large class of organic molecular crystals and supramolecular systems.

International Centre for Material Sciences (ICMS): Being a first centre of this kind everything is being done to make sure that the centre not only fulfils its objectives but also creates new traditions in carrying out research, extension activities and international collaborations. The centre has ongoing research programmes on Solid-State Lighting, Surface Physics, Polymers, High-Resolution Electron Microscopy, Soft Condensed Matter and Chemistry for Materials. ICMS has established major scientific user facilities to serve both in-house researchers and researchers from other universities. This facility houses specialized instrumentation maintained and run by experts. The centre has many collaborative agreements and programmes with various universities, like Cambridge University, Northwestern University, Mesa+ at the University of Twente, National Institute of Materials Science in Tsukuba, Japan and with the Nano Institute in University of Waterloo, Canada. Several young scientists from other countries as well as from India have carried out short term research activities in the centre.

The Centre for Computational Materials Science (CCMS) : Molecular dynamics simulations of a series of bis(trifluoromethylsulfonyl)amide anion based room temperature ionic liquids have been carried out in order to identify the effects of the molecular symmetry of the cation on the structure and dynamics of the liquid. Simulations of ionic liquids with imidazolium cation containing varying lengths of alkyl groups were performed. Research on modeling gel formation, protein aggregation, liquid-liquid transition and nucleation in silicon, and length scales in glass forming liquids, analysis of glass formers in different spatial dimensions have been carried out using molecular dynamics simulations, and lattice model calculations. Extensively contributed to, the microscopic understanding of optical, magnetic, optoelectronics and transport phenomena of materials: ranging from atoms, molecules to extended systems including biomaterials. In-depth analysis of the role of quantum fluctuations in controlling the geometrical frustrations in various Kagomé lattices has shed new insights to the magnetic behavior in this emerging class of materials. Studies have been carried out on bio-molecular materials like DNA, their applications in magnetic switching devices and photon up and down-conversion within protein geometry. A model for ferroelectric SrTiO₂-BaTiO₃ superlattices was developed. A review was written on Computational Simulations of Nano-structures. The origin of magnetocapacitance in BaTiO₃ at nano-scale has been explained. Under the Visitors Programme, 5 students and 1 CCMS associate member have visited for period of about a week to 8 months for research / collaborative work with CCMS members.

Education Technology Unit (ETU): The Unit is actively involved in the concept, production and development of multimedia CD-ROMs and books especially for school students and teachers in various disciplines of science. The Unit has been involved in developing and producing CD-ROMs and books in vernacular Indian languages. The C N R Rao Hall of Science and Education Technology Unit started the

Teachers/students programs/ workshops. ETU had taken up the Hindi translation and production of the **Learning Science** series (four parts) both as CD-ROMs and books. The unit collaborated with World Scientific Publishing Co. Pte. Ltd. to bring out the International Edition of the Book titled '**Understanding Chemistry**' (**International Edition**) by Prof. C.N.R. Rao. The book is being marketed by World Scientific. The book titled "**Nanoworld : An introduction to nanoscience and technology**" authored by Prof. C.N.R. Rao was completed, designed, formatted and made print-ready by ETU. In the area of science popularization, 'A Celebration of Chemistry', 'Nanoworld', 'Learning Science' and 'Vignyana Kaliyona' (a science popularization program in Kannada for the benefit of Kannada medium school children) programs were conducted. The unit has made presentations at various international fora using excerpts from the multimedia CD-ROMs **Nanoworld**, **Learning Science** and **Understanding Chemistry** and **Vignyana Kaliyona (Samputa 1,2, 3 & 4)**.

Engineering Mechanics Unit (EMU): Rotor-driven aircraft have become of great interest in recent years because of their much lower fuel consumption and lower carbon foot print, which has become a major concern because of the need to counter climate change through reduction of green-house gas emissions. On a project related to the design of wings for aircrafts driven by turbo-prop engines and propellers, novel wing plan-forms have been developed, exploiting the slip stream of the propeller for reducing the induced drag. A study using optimization techniques has given interesting and promising results.

Under *Complex Fluids and Interfacial Flows*, the volume-of-fluid method was studied in detail, and a new computer code for computing interfacial flows is nearing completion. Droplet shapes were studied and a new class of static stable shapes for pendant drops was found. In the area of *Computational Fluid Dynamics*, a DNS study of the starting plume as a model for cumulus clouds has been initiated. The results from 2D simulations have been published and 3D simulations are being carried out on a powerful computing system. A new program has been initiated on the development of meshless solver, sponsored by the Boeing Company. Another program on Lattice-Boltzmann method has been initiated by a new faculty (Dr. Ansumali). In the area of *Experimental Fluid Dynamics*, the focus was on laboratory simulation of magmaconvection, (b) Parametric study of flapping flight to identify optimal wing kinematics and the role of wing-flexibility on lift production, (c) Study of Lifted Temperature Minimum (LTM) and (d) study on designing green buildings with natural ventilation (in collaboration with Prof. JH Arakeri, ME, IISc). Two new programs have been initiated during the last year: (a) the role of aerosols on the radiation heat transfer in nocturnal surface layer (LTM), and (b) the interaction of the wake of self propelled underwater bodies with stratified medium and to characterize its surface signatures (supported by NPOL and DRDO). Under *Geophysical Fluid Dynamics*, studies on the Lifted Temperature Minimum (LTM) in the nocturnal atmospheric surface layer have resulted in a plausible explanation of the phenomenon based on vertical variation of aerosol concentration. In the area of *Granular Matter*, a Landau-type order-parameter theory has been developed for the shear-banding phenomenon and discovered the Takens-Bogdanov and a variety of other degenerate bifurcation scenario in a sheared granular fluid. This order-parameter theory is currently being extended to spatially modulate non-periodic patterns, leading to Ginzburg-Landau amplitude equations. Our linear stability theory has successfully predicted the onset of convection in a granular Rayleigh-Benard experimental set-up. From particle simulations of granular Poiseuille flow, it has been found that the slip velocity and its gradient depend crucially on the mean density, wall roughness and inelastic dissipation. An ongoing analytical investigation has helped characterize the modal response of a vortex column to external disturbances, and in particular, has led to the discovery of inviscid resonances. The complete set of eigenmodes, both regular and singular, characterizing vortex column oscillations, has been found.

Evolutionary & Organismal Biology Unit (EOBU): The faculty of the Unit continued their ongoing research in the broad areas of chronobiology, neurobiology, animal behaviour and phylogeography, life-history evolution and population dynamics. Faculty of the Unit were active in delivering invited talks at major international and national meetings and premier institutions of the country, and also participated in outreach activities aimed at students. Major research activities in the Unit during 2009-2010 include continuing studies on (a) the molecular genetic and developmental underpinnings of rapid development in fruitflies, (b) male-female coevolution and gender conflict at genomic level in fruitflies, (c) studies on the formal, molecular genetic and adaptive properties of circadian clocks in fruitflies and ants, (d) comparing the neuronal circuits controlling circadian rhythms in different species of fruitflies through neuroanatomical and behavioural approaches, (e) role of temperature sensitive ion-channels in entrainment of circadian rhythms to temperature cycles, (f) Huntingtin protein expression in clock neurons in fruitflies as a model to study neurodegeneration and the mechanisms of entrainment, and (g) genetic identification for relatedness studies and behavioural observations on elephants in Nagarhole National Park in an attempt to understand the structure of social organization in these elephants. During 2009-2010, the Unit also initiated new graduate courses, including four new laboratory courses and two new courses on neurogenetics and animal behaviour, respectively. The MS/PhD programme in Evolutionary and Organismal Biology for POBE Diploma holders was also initiated in August 2010.

Molecular Biology and Genetics Unit (MBGU): Research in MBGU laboratories spans diverse areas of biology with major emphasis on biomedical research and application. The current areas of research comprise infectious diseases, human genetic diseases, chromatin organization and transcription regulation, stem cells and cardiovascular development and molecular mechanism of chromosome segregation. Chromatin Biology Laboratory has carried out colocalization studies using GC selective DNA binding dyes chromomycin A3 and 7-amino actinomycin D and AT selective dye DAPI indicate that TP2 is preferentially localized to GC rich sequences. Interestingly, as spermatids mature, TP2 and GC rich DNA moves towards nuclear periphery and in the later stages of spermatid maturation TP2 is predominantly localized at the nuclear periphery. Another interesting observation is the mutually exclusive localization of GC and AT rich DNA in the elongating and elongated spermatids. Research in Molecular Parasitology Laboratory is focused towards understanding metabolism in the malaria parasite *Plasmodium falciparum*. Towards this end the enzymes involved in purine nucleotide metabolism in the parasite are being studied. The researchers in Vascular Biology Laboratory derived recently two new sibling human embryonic stem cell (hES) lines from discarded embryos have been derived and differentiated to cardiovascular derivatives that can be cultured to purity. These are called BJNhem19 and BJNhem20 and have been deposited in the UK Stem Cell Bank. Researchers at Molecular Parasitology Laboratory are trying to find out whether DBL domains with specific residues are responsible in cases of severe malaria in Indian patients from various geographical regions. Furthermore, the expression pattern of this and other virulent proteins are being studied. In the HIV Laboratory a large number of Indian clinical samples have been screened and identified an immunodominant B-cell epitope in the cysteine-rich domain of Tat only in the HIV infected people. This finding has a direct relevance for HIV vaccine design. Human Molecular Genetics Laboratory has discovered a novel epilepsy locus at chromosome 3q13.3-q21, was followed by a detailed analysis of genes at 3q13.3-21, leading to identification of several patient-specific mutations in the extracellular calcium sensing receptor (CaSR) gene (Annals of Neurology 2008). Transcription and Disease laboratory is focusing on understanding the role of epigenetic modifications, histone chaperones and non-histone chromatin proteins in chromatin dynamics and transcription regulation. The researchers in Molecular Mycology Laboratory have been studying structure-function analysis of centromeres in several pathogenic yeasts including *Candida*

dublinsiensis, *Candida tropicalis* and *Cryptococcus neformans*. These yeasts cause most of the deaths by fungal infection in immune-compromised patients. We identified centromeres of, *C. dublinsiensis* and compared centromere sequences with those of a closely-related yeast *C. albicans*.

Theoretical Sciences Unit (TSU): The research conducted in the TSU continued to explore new frontiers in the area of theoretical physics and chemistry techniques applied to various systems. The group of Subir Das carried out and is continuing research on critical dynamics, pattern formation, nucleation phenomena, etc. Kavita Jain and her group continued their efforts to understand the problem of evolution of sex and recombination. They studied the evolutionary dynamics of a maladapted population under mutation, selection and recombination by developing a novel analytical method to calculate the fixation time to the fittest locus. Research in the group of Shobhana Narasimhan was focused on applying density functional theory to study various materials, including magnetic surface alloys, defects in graphene, methane storage in graphene and activated carbons, nanomagnetism and catalysis. One important result was the prediction of new surface alloys composed of bulk-immiscible metals; one of these systems, viz., FeAu/Ru(0001) has subsequently been shown by their experimental collaborators to indeed form an ordered surface alloy. Swapan Pati's group has contributed extensively to the microscopic understanding of optical, magnetic, opto-electronics and transport phenomena of materials ranging from atoms, molecules to extended systems including biomaterials. They developed a large number of new models by identifying and optimizing parameters responsible for linear and non-linear optical polarizations and electron and hole mobilities in a large class of organic molecular crystals and supra-molecular systems. Srikanth Sastry's group performed research on modeling gel formation, protein aggregation, liquid-liquid transition and nucleation in silicon, and length scales in glass forming liquids. Further, analysis of glass formers in different spatial dimensions was been carried out using molecular dynamics simulations, and lattice model calculations. NS Vidhyadhiraja and his group have studied the crossover from the Kondo lattice regime to the mixed-valent regime in heavy fermion materials in terms of dynamics, transport and thermodynamics. They find several novel features in our theoretical studies that corroborate with experiment, and have hitherto been attributed to other extraneous factors such as crystal field splitting. Amongst the research achievements of Umesh Waghmare's group in the past year, they determined the structural origin of the oxygen storage capacity of Sn, Pd and Fe doped CeO₂; analyzed hydrogen storage in 3D Lanthanide organic frameworks; determined the thermodynamics of H vacancies in MgH₂ from first principles obtained electric field- temperature phase diagrams of BaTiO₃ and investigated polarization switching, developed a model for ferroelectric SrTiO₂-BaTiO₃ superlattices, and explained the origin of magnetocapacitance in BaTiO₃ at the nanoscale; he also wrote a review article on Computational Simulations of Nano-structures.

Chemical Biology Unit (CBU) and Condensed Matters Theory Unit (CMTU), two virtual units of the Centre, are located in Indian Institute of Science campus. In **CBU** total synthesis of biologically active natural products, determination of structure of peptide toxins and proteins, study of biophysical properties of enzymes, study of lipids and DNA binding agents, and exploring the chemistry of bile acid analogs had constituted the major activities. In the **CMTU** Electronic structure and properties, especially in Strongly Correlated Electronic systems: In the broad area of quantum many-body theory and hard condensed matter systems, the theory for doped manganites exhibiting colossal magneto-resistance was extended to include coulomb interactions and doping disorder were taken up.

ACADEMIC

During the year, 56 students (47 Students for MS/ Ph D, 4 Students for Integrated Ph D), 3 students for Postgraduate Diploma, and 2 students for External Registration Programme were admitted. Nine

students were awarded Ph D, 3 students MS (Engg,) one student MS (by research) and one student was awarded MS (Int. Ph D) degree.

Fellowship & Extension Programmes

Under the Summer Research Fellowships Programme, 107 fellowships were awarded. For the JNC-TWASROCOSA – Summer Research Fellowships programme, five students from different countries were selected and worked with faculty of various host institutions in the country. For the Project Oriented Chemical Education (POCE) 27 undergraduate students attended the programme. The POBE programme has successfully completed three years with 30 students from various institutions in the country undergoing interactive training and for the year 2009-10. Seven candidates have been offered Visiting Fellowships for 2009-10. Out of 8 candidates joined for DST Postdoctoral Fellowship in Nano Science and Technology programme, 7 were continuing their fellowship.

SIGNIFICANT SCIENTIFIC & TECHNICAL ACHIEVEMENTS EXPECTED DURING 2010-11:

Prof. C. N. R. Rao's group have synthesised boron nitride (BN), which structurally resembles graphene, a form of carbon that is just a single atom thick. BN, considered a graphene analogue, BN will have potential applications in nanotechnology.

They have demonstrated three chemical methods to synthesize MoS and WS analogues of graphene. Several characterization techniques were used to fully examine the materials. One of the synthetic methods involved using water to exfoliate lithium-intercalated bulk compounds, and the other two approaches involved building the sheets from the bottom up. All the methods resulted in single- or few-layered samples, confirmed by transmission electron microscopy and atomic force microscopy. A two- or three-layer-thick sample of WS had an average thickness of 1.3 nm.

The density functional theory was used to examine the bonding and phonon structure in layered MoS by the group. They found that in a triple-layered compound, molybdenum atoms are in a six-coordinate environment whereas the sulfur atoms are three-coordinate. Compared with the bulk compound, the bandgap in the layered system is larger, and the layer phonons have lower energy than those in the bulk.

Prof. C. N. R. Rao's group has also been successful to have demonstrated that an addition of a pinch of graphene makes zinc oxide emit white light. Boron doped graphene has been shown to be the best combination with zinc oxide nanoparticles. Effect of the addition of very small amount of graphene (0.01-0.05 wt %) has been shown to make photo response of zinc oxide nanoparticles faster.

Researchers have grown gold nanoparticles in nanoscale pores of mesoporous carbon nitride (MCN) functional amine groups on the pore walls that provide a platform for the generation of nanoparticles.

Inorganic analogues of carbon nanotubes and fullerenes made from molybdenum and tungsten sulfide have been known for some years. The bulk forms of these sulfides are similar to graphite in that they are layered and have a hexagonal structure. Although there have been some reports of exfoliated, single-sheet forms of these compounds, they have not been unambiguously characterized or comprehensively studied. These would mimic graphene, the single- or few-layered two-dimensional carbon material exciting much interest at present.

In the Chemistry and Physics of Materials Unit, Prof. A Sundaresan, Prof C N R Rao and co-researchers have found that nanoscale metal oxides and nitrides show room-temperature magnetism

because of surface effects. The team found that even nanoparticles of high-temperature superconductors can become ferromagnets – a surprising result since superconductivity and ferromagnetism are usually incompatible.

Dr. Subi George's group have demonstrated that two particular organic molecules - one electron-rich, the other electron-deficient - can co-assemble in solution to form a fluorescent hydrogel. This hydrogel, composed of a network of very long nanofibres, may have potential applications in the field of organic and supramolecular electronics.

A team of researchers led by Prof. Tapas Kumar Kundu of the Molecular Biology and Genetics Unit have found that curcumin, an active compound in turmeric, can be a source of a molecule capable of arresting the growth of cancer cells. The water-soluble derivative of curcumin, codenamed CTK7A, interferes with cellular processes in a cancer tissue such that the tissue undergoes a programmed death. The same team has also synthesized an inhibitor of p300/CBP from garcinol, a principal component of locally available Kokum (*Garcinia indica*) fruit. This inhibitor is nontoxic to human cells and represses the replication of HIV in infected cells.

THE PLANNED RESEARCH ACTIVITIES OF DIFFERENT UNITS AT THE CENTRE :

Chemistry & Physics of Materials Unit (CPMU):

The design and synthesis of novel metal–organic open framework materials with potential application of gas storage (H_2 , CH_4 , CO_2 etc), heterogeneous catalysis, separation and exchange processes will be carried out. Size- and shape-selective novel reactions in the porous framework will also be attempted. A project on bi-functional hybrid nanocomposite materials constructed by magnetic core and luminescent lanthanide probe has also been initiated. Other problems include drug delivery using carbon and clay based nanoparticles and the study of clay-polymer composites. The intermolecular structure, dynamics and morphology of room temperature ionic liquids will be studied using computer simulation methods.

The relationship between atomic and electronic structure of metals adsorbed on metal or semiconducting surfaces. Metals (submonolayer regime) will be adsorbed in the ultra high vacuum environment onto low and high index single crystal surfaces of silicon of various reconstructions. Kinetically controlling the adsorption and desorption properties, routes to form well-defined and self assembled nano-dimensional phases and nanostructures will be optimized.

A beam line for high pressure studies using synchrotron radiation in Photon Factory, Japan will be set up. Work on cellulose intercalated with metal nanoparticles for use as catalytic membranes will be initiated, following the approval of the PCT for antibacterial effects of the cellulose metal nanoparticle composites. Use of DNA detection in seed breeding will be explored. There will be increased activity in synthesis and characterization of new nanomaterials such as graphene adducts and nanoparticles-polymer nanocomposites. Design of magnetoelectric multiferroic materials based on appropriate combinations of $BiFeO_3$ and $BiAlO_3$ using high pressure synthesis technique is being planned. The other area is study of systems such as perovskites and spinels exhibiting negative magnetization which has a potential for magnetic recording and switching applications. Superlattices of $BaCuO_2$ and $CaCuO_2$ will be fabricated and their superconducting properties will be studied. A complex perovskite oxide system will be explored for good thermoelectric properties. A rheometer will be interfaced with the confocal microscope and a holographic optical tweezer setup will be built to study soft matter. The following problems are planned to be studied: 1) the role of grain boundaries in determining the yielding behavior of size tunable colloidal crystals and the 2) rheological response of bi-

disperse soft glasses. The following problems will be studied in the area of organic semiconductors: (i) the synthesis of patternable polymers for applications in Organic Light Emitting Diode, Field Effect Transistors, and in Solar cells. (ii) The development of novel polymeric materials that can self assemble into nanoscale domains and (iii) Synthesis of novel organic-inorganic hybrid materials.

New Chemistry Unit (NCU) : . A major focus will be on the design of self-assembled functional systems from chromophores or p -conjugated oligomers, which are the key ingredients in the integration of electronic components for nano-sized electronics. Various p -type soluble, regiosymmetric thiophene molecules that are regioregular but not coupled in a head-tail fashion, with highly planar fused-ring thienoacene spacers such as thienothiophene, dithienothiophene and pentathienoacenes will be synthesized. Another focus will be on the design of supramolecular polymeric materials/hydrogels that are capable of sensing and reversible switching in response to external stimuli (stimuli responsive polymers/gels). In addition, the Unit also target multifunctional materials, formed by the non-covalent attachment of organic molecules/polymers on graphitic nonmaterials such as graphene and CNTs for solubilization and electronic applications. Currently the researchers are involved in three different research projects which are interdependent and complementary. First the group synthesizes chiral unnatural amino acids with metal binding properties (metal binding ligands). These chiral-amino acid ligands will be used for the ‘asymmetric induction’ in metal-reagent mediated asymmetric syntheses. A new class of oligomers with metal binding ligands will be designed and synthesized. These synthetic oligomers serve as smart-building blocks for the design and synthesis of metal directed assemblies and will find applications as biomaterials. A research program that will provide a platform to integrate organic chemistry and material science with biology to combat infectious diseases in a multi-pronged approach namely diagnosis, prevention and treatment. The research will focus on a fundamental understanding of material-pathogen interaction that will provide innovative solutions in tackling infections. Initially, the focus will be on designing, preparing and exploring various biodegradable and non-toxic antimicrobial materials that can be readily applied for biomedical applications. In addition, the Unit will have research programme on calculations of energy issues and charge transfer problems connected to Photosynthesis and Respiration, development of methods which would give excited states as accurately as the ground state (e.g. combining Molecular orbital and Quantum Monte Carlo methods etc)., try to bring the field of Molecular Electronics to make Device fabrication at the Macro-scale by solving electrical interconnect problems, and charge transfer phenomena in new carbon materials.

International Centre for Materials Science (ICMS)

The Centre has ongoing research programmes on Solid-State Lighting, Surface Physics, Polymers, High-Resolution Electron Microscopy, Soft Condensed Matter and Chemistry of Materials. Under ICMS, the **Centre for Computational Material Science (CCMS)** carries out research in the broad area of computational materials science, using a variety of analytical and computational tools. The list of topics include : the electronic structure of nanomaterials, charge transport and catalysis in nanosystems, novel magnetic materials and their properties, non-linear optical materials, disordered systems, complex and molecular liquids, biomimetic systems and biomaterials. The **DST Unit on Nanoscience** pursues research activities on different aspects of Nanoscience. In order to boost research interest in nanoscience, many academic activities such as courses in nanoscience, discussion meetings and symposia are being conducted.

The planned activities of CCMS are to study structural relaxation dynamics in ionic liquids, to perform fully relativistic calculations to study effects of spin-orbit interaction, and to commence calculations on transport through devices., calculations of energy issues and charge transfer problems connected to photosynthesis and respiration, development of methods which would give excited states as accurately as

the ground state (e.g. Molecular Orbital and Quantum Monte Carlo etc), to bring the field of Molecular Electronics to make Device fabrication at the Macro-scale by solving electrical interconnect problems, modeling and simulations of shape memory alloys, development of a tool to estimate magnetic super-exchange couplings, a first-principles and continuum approach to mechanical behavior of grapheme, design of magnetoelectric superlattices.

Education Technology Unit (ETU):

The unit will be bringing out a book authored by Prof. C.N.R. Rao titled 'Chemistry Today' It will also bring out the Kannada version of the CD-ROM 'Nanoworld' called 'Nanoprancha' and also a book of the same title.

CNR Rao Hall of Science and Education Technology Unit will be organizing teachers/students workshops /programs in different subjects like Physics, Chemistry, Biology, Nanoscience and Programs in Physical Sciences and Life Sciences for teachers during January-December 2010. It is proposed to have lectures and demonstrations with different themes in a particular subject. In the entire above programs faculty from JNCASR, IISc and other institutions will participate.

ETU has plans to bring out the book titled 'Nanoworld' in other vernacular Indian languages. The unit will be organizing a large number of science popularization programs for the school children and teachers.

The Unit has plans to carry out the following projects in the forthcoming year. To translate and produce a print-ready copy of the Book titled 'NANOWORLD: An introduction to nanoscience and technology by Prof. C.N.R. Rao in Kannada and Hindi.

Education Technology Unit will take up a project in Chemistry. It is planned to develop and produce a CD-ROM title and a book.

Engineering Mechanics Unit (EMU):

The Unit will continue to do research on the rheology and dynamics of dry granular fluid, suspensions and bubbly flows, along with recent work on jamming transition and compaction of anisotropic particles. A Landau-type order-parameter theory is currently being developed to describe static and dynamic phase transitions in driven granular matter. Research on linear and nonlinear instabilities and patterns in supersonic compressible flows and high Prandtl number convective flows will continue. Developed a series of modelling tools to describe the fluid motion at mesoscale label. So far these models, known as entropic lattice Boltzmann models, have been applied to incompressible isothermal dynamics and weakly rarefied isothermal dynamics for gases. The Unit intend to generalize these methods for thermal and multiphase flows. Development of direct numerical simulation of diffuse interface framework of two phase flow. 2 DSMC methods for high Mach turbulence: Direct simulation Monte Carlo model is well established tool for understanding rarefied gas dynamics. It is proposed to begin some small experimental activity on instabilities in the flow of complex fluids. Further study on the following problems is planned, with analytical and computational component to each, and also an experimental component to the second. The interaction between density stratification and vorticity. Linear instabilities and algebraic growth, the hydraulic jump, instabilities of spatially developing flows and nterfacial flows. In addition to continue with experimental work on cloud flows, the Unit will study on experimental and computational testing of novel designs for wings of turbo-prop aircraft, direct numerical solution of Navier-Stokes equation for cloud flows, mixing layers and gas turbine blades. The research group in the Unit will also work in the following areas:

1. Unsteady aerodynamics of insect flight: Experiments and simulations for understanding in flapping flight for Micro Air Vehicle (MAV) applications.
2. Geo-fluid dynamics: (a) Natural convection at very high Rayleigh and Schmidt numbers to understand mantle convection, (b) Role of radiation and aerosols on the transport processes in the nocturnal atmospheric surface layer (c) Experiments on “Atmospheric transport and dynamics” including cloud formation, radiation interaction, land-sea contrast, gravity waves, thunderstorm etc.
3. Designing green buildings: Natural ventilation and ways to achieve lower thermal-load on Buildings.
4. The origin, dynamics and stability of the Ramdas layer. vortex stability, role of micro-scale inertia in multi-phase flow transport phenomena, Rheology, dynamics and stability of bacterial suspensions, hydrodynamics of orientable particle suspensions: application to lyotropic liquid crystals.
5. Study on Data assimilation Integration of Ensemble Kalman Filter with VARS code of NAL, prediction of flutter using TKFMG code, wing-propeller coupling for RTA-70 , accurate modelling of shock-shock interaction .

Evolutionary and Organismal Biology Unit (EOBU):

Ongoing lines of investigation in the broad areas of life-history evolution, population dynamics, sociogenetics, neurobiology and circadian rhythms will continue, with some new lines of work being initiated. Major projects expected to be actively pursued during 2010-11 in these areas are:

- Transcriptome analysis of *Drosophila melanogaster* populations selected for rapid development and early reproduction.
- Theoretical and experimental examination of factors affecting the evolution of growth rates, body size and competitive ability in *Drosophila*.
- Study of gender conflict and male-female coevolution in *Drosophila melanogaster* populations selected for rapid development and early reproduction.
- Theoretical and empirical assessment of the role of migration rate and pattern on local and global stability in metapopulations.
- Field research on Asian elephants in Nagarhole National Park to continue with obtaining physical and genetic IDs. Behavioural data will now also be collected, so that dominance relationships between females can be examined as part of an investigation into the possible role of genetic relatedness in modulating social behaviour in Asian elephants.
- Comparison of neuronal circuits that regulate circadian rhythms in Drosophilid species by behavioural, neuroanatomical and molecular studies.
- Characterisation of the neuroanatomical and molecular bases of circadian thermosensation by examining the possible roles of temperature sensitive ion channels.
- Study of progression of neurodegeneration using the *Drosophila* circadian pacemaker circuit as a model.
- Neurogenetic bases of circadian egg-laying rhythm in fruit flies.

- Characterization of circadian properties and molecular genetic analyses of *Drosophila melanogaster* populations selected for (i) early and late adult emergence, (ii) narrow window of adult emergence, (iii) faster pre-adult development, and (iv) adaptation to different types of rearing conditions such as constant darkness, constant light or varying lengths of light/dark (LD) cycles -ranging from LD 10:10 hr to LD14:14 hr.
- Connections between circadian clocks and life history traits such as pre-adult development time and adult lifespan.
- Role of social cues in the regulation of circadian rhythms in fruit flies and ants.
- Circadian rhythms under natural environments.

Geodynamics Unit (GDU) : Identification of belts where sudden and swiftly occurring geological phenomena often destabilize the natural configuration of life and threaten the balance of ecosystems, is the principal objective and the main thrust of activities.

Theoretical Sciences Unit (TSU):

The planned research activities of TSU will be Ab initio calculations on surface alloys, including structure and magnetic properties; calculations of magnetic anisotropy energies for nanosystems; calculations on the Rashba effect and its impact for spintronic materials; nanocatalysis; gas adsorption on defective and/or functionalized graphene. Research on Liquid-liquid critical point, crystal nucleation in supercooled silicon; length scales relevant to slow relaxation in glass forming liquids; study of jamming in model systems; crack propagation in model glasses; modeling protein aggregation, development of first-principles Landau Ginzburg theory of shape memory alloys, design of magnetoelectric superlattices, simulations of thermal transport and thermoelectric properties of materials, mechanical deformation of glassy oxides, structural instabilities and dynamics of crack propagation in crystalline metals, piezoelectric polymers, modeling of composites for electromagnetic absorption of microwaves. Theoretical studies of the mixed-valent regime of the periodic Anderson model and the associated valence transition, studies of the multi-orbital Hubbard model, focusing on orbital ordering, orbital selective Mott transition and crystal field effects, developing a parallel Kinetic Monte Carlo code for studying charge transport in disordered organic semiconductors, studies of shot noise in nanosystems, developing a gauge field theoretic approach to strongly correlated electronic systems. The Unit will also study phase transitions in nonequilibrium steady states; theoretical investigation of statistics of correlated random variables; mathematical modeling of problems in evolutionary biology such as evolution of sex and mutation rates, punctuated equilibrium, dynamics of multi-component fluids at criticality, Kinetics of phase separation in simple model systems in bulk and confined geometries, statics and dynamics of homogeneous and heterogeneous nucleation in binary mixtures, wetting phenomena, pattern formation, etc.

Chemical Biology Unit (CBU):

The activities of the Chemical Biology Unit during 2010-11 will follow essentially the same pattern as in the earlier years since most of our projects relate to long-term problems. Total synthesis of biologically active natural products, determination of structures of peptide toxins and proteins, study of biophysical properties of enzymes, study of lipids and DNA binding agents, and exploring the chemistry of bile acid analogs will constitute the major activity of the Unit. Additionally, the study of nano-structured soft materials derived from (the supramolecular association of) small organic molecules relevant to biological systems will also be pursued extensively.

Condensed Matter Theory Unit (CMTU): The planned activities of CMTU are : Quantum Condensed Matter, especially Strongly Correlated Systems, quantum many-body theory and hard condensed matter systems, in the area of nanoparticles and nanocrystals, studies in great detail of the growth mechanism of these systems, including metallic nanoparticles and other complex systems, effects of quenching in different topological sectors in a variety of models, charge pumping on transport through quantum dots where electrons interact with each other, and transport on surfaces of topological insulators with magnetic, potential and superconducting barriers, supersolid behaviour in He (investigations of experimental consequences of superfluidity along a network of structural defects), development of a Ginzburg-Landau theory for high-temperature superconductivity in cuprates, the formation of Mott-insulator and superfluid shells in cold-atom systems in parabolic confining potentials will be studied by using an inhomogeneous mean-field theory, Soft Condensed Matter and Nonequilibrium Statistical Physics, Comprehensive studies of the statistical properties of MHD turbulence and superfluid turbulence, and further extensions of studies of turbulence with polymer additives.

Theory of active gels coupled to cell membrane, as the fundamental description of the mechanics of cells.

Measurable performance in terms of papers published and granted, technologies transferred to industry and commercialized value of the money realized etc.

Publications: The Faculty members of the Centre have published around 250 scientific papers in reputed international journals during the year 2009-10, some of them with very high impact factor. The average impact factor is 3.75.

Patents/Know-hows: During the year 2010, the faculty filed 18 applications for 15 inventions and 3 patents were granted (India 1, USA 1, South Africa 1).

The Faculty of the Centre received many awards/distinctions: Prof C N R Rao the **August-Wilhelm-von-Hoffmann-Denkmunze Medal** (Highest International Medal in Chemistry) by German Chemical Society, invited to be the **Arthur D. Little lecturer** of Massachusetts Institute of Technology (USA), D Sc (Honoris Causa) from Punjab University and offered the KFUPM Chair Professorship by the King Fahd University of Petroleum & Minerals, Saudi Arabia. Prof M R S Rao received **Padma Shri Award** of Government of India and has been appointed as Senior Editor, American Journal of Cancer Research. Prof Swapan K Pati and Prof Umesh V Waghmare have been selected for the award of **Shanti Swarup Bhatnagar Prize 2010** (Chemical Sciences) & (Physical Sciences), Prof Swapan Pati has been elected as a Fellow of the Indian Academy of Sciences, Prof Tapas Kumar Kundu has been awarded the **J C Bose Fellowship** of DST and elected to INSA, New Delhi. Prof Meheboob Alam has been selected as **DAE-SRC Outstanding Research Investigator**, Dr Ganesh Subramanian has been chosen for the **Young Engineer award**. Dr Ranjan Datta, Dr Rajesh Ganapathy Dr Santosh Ansumali have been selected as **Associates of Indian Academy of Science** for the year 2010. In addition, many faculty members received other awards and distinctions.

Postgraduates and Ph.D.s trained : Beginning the academic year an Integrated Ph D programme in Biology has been started. With the admission of 49 students for various programmes (Ph D, MS, and Diploma), the students strength at the Centre reached **208**. During the year 2010, 30 degrees (Ph D: 17, M S (Engg.) : 4, M S (by research) : 1 and M S (Materials Science (Int. Ph D) : 8) were awarded.

Under the Fellowships and Extension Programmes, the intake under the summer research fellowship

programme and visiting scientists programme has also shown an upward trend. Under the science outreach programmes, more number of school/college children were enthused to take up science as career. The POCE and POBE programmes were successful.

MAJOR PROGRAMMES PROPOSED FOR 2011-12 AND DELIVERABLES/OUTCOME EXPECTED.

The focus of research in each of the Units is: **Chemistry and Physics of Materials Unit (CPMU)** : Study of various facets of Chemistry and Physics of Materials, with the primary goal to design and understand the structure, properties and phenomena associated with advanced inorganic, organic and hybrid materials. **New Chemistry Unit (NCU)**: The Unit works on interdisciplinary aspects of chemical science. The most important areas that are actively pursued are at the interface of chemical biology, chemical science and materials science. **Engineering Mechanics Unit (EMU)** : Research on a variety of topics where fluid mechanics and heat transfer play a critical role in providing insight into various phenomena. **Evolutionary and Organismal Biology Unit (EOBU)**: is one of the principal centres in the country for research and training in chronobiology, evolutionary genetics, population ecology, behavioural neurobiology, behavioural ecology and phylo-geography. **Geodynamics Unit (GDU)** : Identification of belts where sudden and swiftly occurring geological phenomena often destabilize the natural configuration of life and threaten the balance of ecosystems, is the principal objective and the main thrust of activities. **International Centre for Materials Science (ICMS)**: The Centre has ongoing research programmes on Solid-State Lighting, Surface Physics, Polymers, High-Resolution Electron Microscopy, Soft Condensed Matter and Chemistry of Materials. Under ICMS, the Centre for Computational Material Science (CCMS) carries out research in the broad area of computational materials science, using a variety of analytical and computational tools. The list of topics include : the electronic structure of nanomaterials, charge transport and catalysis in nanosystems, novel magnetic materials and their properties, non-linear optical materials, disordered systems, complex and molecular liquids, biomimetic systems and biomaterials. The **DST Unit on Nanoscience** pursues research activities on different aspects of Nanoscience. In order to boost research interest in nanoscience, many academic activities such as courses in nanoscience, discussion meetings and symposia are being conducted. **Molecular Biology and Genetics Unit (MBGU)** : Research spans diverse areas of biology with emphasis on biomedicine. The current areas of research are: infectious diseases; cancer genomics; chromatin organization and transcription regulation; stem cells and cardio-vascular development; molecular basis of human genetic disorders and mechanism of chromosome segregation. **Theoretical Sciences Unit(TSU)**: Study of matter and life: the search for universality, and the exploration and explanation of diversity.

Education Technology Unit and C N R Rao Hall of Science: The future plans of the Unit involve bringing out the Kannada version of the CD-ROM 'Nanoworld' called 'Nanoprancha'. **CNR Rao Hall of Science** will be organizing teachers/students workshops/programmes in different subjects like Physics, Chemistry, Biology, Nanoscience.

Chemical Biology Unit (CBU) and Condensed Matters Theory Unit (CMTU), two virtual units of the Centre, are located in Indian Institute of Science campus. In **CBU** total synthesis of biologically active natural products, determination of structure of peptide toxins and proteins, study of biophysical properties of enzymes, study of lipids and DNA binding agents, and exploring the chemistry of bile acid analogs had constituted the major activities. In the **CMTU** Electronic structure and properties, especially in Strongly Correlated Electronic systems: In the broad area of quantum many-body theory and hard condensed matter systems, the theory for doped manganites exhibiting colossal magneto-resistance was extended to include coulomb interactions and doping disorder were taken up.

While the academic and research activities have been progressing well, the Centre has been actively engaged in new pursuits.

Budget requirement: (Rupees in lakhs)

2010-2011 (as per RE) 5, 260

2011-2012 (as per BE) 5, 565

Copy of the Revised Estimates for the year 2010-11 and Budget Estimates for the year

2011-12 enclosed.

RAMAN RESEARCH INSTITUTE

The Raman Research Institute (RRI) was founded by Prof. C.V. Raman in the late forties in Bangalore. After his death in 1970, it was reorganised as a national institute for research in basic science. The Institute has been receiving grants from the Department of Science and Technology of the Government of India since 1972. RRI is engaged in fundamental research in the areas of **Astronomy & Astrophysics, Light & Matter Physics, Soft Condensed Matter and Theoretical Physics** as a part of the global endeavour of humanity to increase our knowledge and understanding of the world.

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. 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. A cultural function of a premier research institute is the upholding and promotion of academic traditions and this activity includes the conduct of specialized seminars on technical topics targeted at specialized audiences as well as colloquia in a wider range of topics that are delivered in a style that strives to make current advances accessible to a wider community. Additionally, outreach activities include writings intended for a lay and discerning audience as well as the delivery of motivational talks at educational institutions.

Visiting Student Programme introduced in the year 2007 is aimed at offering research experience to highly motivated students who are pursuing their undergraduate or master's studies. The duration of the working ranges from few weeks to several months. It has progressively increased through the years and during the last year alone there were a total of 101 students from different parts of the country. The Institute has also introduced **Summer Student Programme**, which is similar to the visiting student programme, and it runs only between May 1st and June 30th of each year with the participation of about twenty selected candidates. During the period of the visit in both these programmes, the student works closely with at least one staff member of the Institute on a suitable project, or on part of a project, as appropriate. The student's work and the interaction with the staff and the graduate students are expected to provide a flavour of the research at the Institute, in general, and a first-hand experience of research, in particular.

Research work carried out by each of the scientific groups at the Institute is sampled in the following paragraphs. Naturally, the description is understandably brief and those who are interested in more details are cordially invited visit the Institute's website at www.rri.res.in.

Astronomy & Astrophysics:

This group's interests cover the area of theoretical astrophysics, observational astronomy, astronomical instrumentation and signal processing. During the year, astrophysics research included (a) development of models for cosmological Epoch of Reionization (EOR), (b) drawing up of comprehensive theoretical formulations of Magnetohydrodynamic (MHD) turbulence, (c) constructing a Dynamo theory to understand the origin of magnetic fields in cosmic objects and the processes that sustain them, (d) building gravitational dynamical models to describe the evolution of orbits of cosmic bodies around black holes, and (e) developing a theory on X-ray emissions from radio galaxies.

Observational Astronomy research included (a) study of gas distributions and winds from galaxies, (b) comparing the existing models that explain the origin of Halo and Relic radio sources with observational data from the Giant Meterwave Radio Telescope (GMRT) (c) study of evolution and life cycles of Active Galactic Nuclei (AGNs) and radio galaxies, (d) understanding the formation and structure of HI regions in the Milky Way interstellar medium using various radio telescopes in India and overseas, (e) Pulsars.

Signal processing activity focused on (a) continued analysis of data from a 150 MHz radio frequency survey of the southern sky using the Mauritius Radio Telescope, (b) developmental effort towards fabrication and installation of 50 MHz receivers on GMRT antennas to carry out an all sky survey at that frequency with unprecedented sensitivity and resolution, (c) carrying out observations using wideband receivers, built by RRI, and installed on the US Green Bank Telescope and interpretation of data obtained, (d) analysing pulsar data collected from the E-W wing of the Decameter Wave Radio Telescope at Gauribidanur, (d) the Murchison Wide-field Array (MWA) - a collaboration between US and Australian partners and the Raman Research Institute, (e) designing and constructing new broadband receivers for the Ooty Radio Telescope, (f) development of low-cost robust 15m parabolic dish antennas, (g) hardware design and development for a 3m submm wavelength radio telescope, (h) development of an X-ray polarimeter in collaboration with the Indian Space Research Organisation (ISRO) and (i) participation in the Large Area X-ray proportional counter (LAXPC) for the ASTROSAT – a satellite mission of ISRO for multi-wavelength astronomy.

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. As was reported earlier, 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 to conduct envisaged experiments of intricate and complex nature in Quantum Optics, Light Propagation in Random Media, Non-linear Optics, and Laser induced Plasma. In Quantum Optics, the experimental work concentrated on (a) Laser Cooling and Trapping to precisely probe atomic behaviour at low kinetic temperatures; developmental work to study quantum mechanical effects in cold atoms/ions/molecules, (b) progress towards construction of a 2 dimensional Magneto Optical Trap (MOT) (c) designing a Lattice of Ion Traps, (d) carrying out experiments using the recently built Ion-Atom system and attempting the synthesis of ultra cold molecules from ultra cold atoms, (e) understanding electromagnetically induced transparency (EIT) phenomena and (f) investigation of quantum walks of light in frequency space. In Light Propagation in Random Media, earlier research work on imaging in turbid media was extended for possible commercial applications. In addition, efforts were made to experimentally study localization of light. In Non-linear Optics, the group carried out investigations on the non-linear properties of various types of

materials, with an emphasis on nanoparticles and nanocomposites and studies of the temporal behaviour of nonlinearities using femtosecond pump-probe spectroscopy. In the area of Laser Induced Plasma studies, the group conducted a large number of experiments to study the time evolution and spectral characteristics of laser induced plasma.

Soft Condensed Matter

This group was for long called the Liquid Crystals Group with its research activities concentrated in the area of liquid crystal synthesis, characterization and analysis of their physical properties, and has made important contributions to the field of Liquid Crystals. Research of this group had gradually expanded into related soft condensed matter and biophysics areas. Today, the major areas of research of this group are: (a) Liquid Crystal Synthesis, (b) Physical Measurements, (c) Liquid Crystal Displays, (d) Rheology and Light Scattering Studies, (e) Electrochemistry and Surface Science, (f) Biophysics, (g) Phase Behaviour of Surfactants and (h) Liquid Crystal Theory.

The chemistry lab continued in synthesis of liquid crystals, leading to synthesis and characterization of numerous new novel mesogens. In the Physical Measurements Lab studies were carried out on mixtures of compounds made of rod-like and bent-core molecules. Detailed investigations were also carried out on dielectric properties of bent-core liquid crystals that exhibit DC phase and a glass transition at lower temperatures. This lab is also carrying out investigations in an international collaborative project on further understanding of tunable optical metamaterials. The lab also focused on understanding the physical properties of liquid-crystal-nano-particle composites, diamagnetic properties of lyotropic liquid crystals and high magnetic field composites. The Liquid Crystal Display Lab continued work on the development of new addressing techniques to reduce power dissipation and hardware complexity in drive electronics in passive matrix LCDs. Research in X-ray diffraction studies resulted in development of a phenomenological theory of phase transitions in lipid bilayers, and in a collaborative work between this lab and an Institute in France a systematic study of structural changes induced in lipid bilayers by bound toxins was initiated. Work in this lab in collaboration with an Austrian group resulted in a new method which avoids the drawbacks that were faced to determine EDP in lipid bilayers. The Biophysics Lab in collaboration with groups in the country and outside developed new flow techniques for probing the mechanical properties of axions. The Lab is also currently investigating stem cell differentiation in externally imposed chemical and substrate stiffness gradients. The Electrochemistry and Surface Science Lab examined the behaviour of classical reversible redox systems on a surface coated with Au nanoparticles, and designed an instrument to measure the photoconductivity of liquid crystals. In the Rheology and Light Scattering Lab, work was carried out on stress relaxation of aging colloidal glasses. This lab also worked on the rheology of concentrated cornstarch suspensions, light scattering from polystyrene beads dispersed in aging Laponite suspensions and the effects of base roughness on the motion of vibrated granular beads. On the theoretical front, international collaboration were continued looking at the morphologies of polymer crystallites. This resulted in formulation of phenomenological theory to explain the observed morphologies in giant unilamellar vesicles.

Theoretical Physics

The research areas of this group fall into two main distinct areas of research – gravity and statistical mechanics. Research under statistical mechanics includes mesoscopic physics, non-equilibrium physics, soft condensed matter physics and biophysics. Research under gravity covers gravitational waves and quantum gravity. Research under statistical mechanics was focused on the development of a theory of heat and electron transport, which included analytical and numerical treatment of the Fourier's Law of heat

conduction in disharmonic and anharmonic crystals. The other area was development of an algorithm for finding probabilities of rare events and its application to non-equilibrium processes. Work was also carried out on an algorithm for finding approximate ground states of a spin glass of classical continuous spin. In the field of Biological and soft condensed matter physics, analogy between the cosmological constant of the universe and the surface tension of fluid membranes was pursued. Work in this area also resulted in proposing a polarized interferometer experiment which measures the nonlocal Pancharatnam phase acquired by a pair of Hanbury Brown-Twiss photons. The problem of light transmission through a slow wave medium was tackled. Collaboration with the National Centre for Biological Sciences (NCBS) involved studies in cell biology, the mechanical response, pattern formation, symmetry breaking and hydrodynamic instabilities in both in-vivo and in-vitro reconstituted systems. The quantum dynamics in the Loop Quantum Gravity (LQG) model was analysed indicating that the definition of the magnetic field operator in LQG must be sensitive to the electric flux carried by the LQG quantum states. Extensive work was also carried out on quantum measure theory. Another area in which work was carried out was a study of geometric phases in the formalism of two flavour neutrino oscillations.

S.N. BOSE NATIONAL CENTRE FOR BASIC SCIENCES

The S. N. Bose National Centre for Basic Sciences was established in June 1986 as a registered society functioning under the umbrella of the Department of Science and Technology, Government of India.

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.

11TH PLAN PERIOD THE MAJOR RESEARCH AREAS

- 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

BRIEF SUMMARY OF SIGNIFICANT SCIENTIFIC & TECHNICAL ACHIEVEMENTS:

a) Physics of nanomaterials and application specific materials development

It has been shown that a cheap and environmentally important material like ZnO can be used as efficient light harvesting material for solar cell applications. In addition, new applications have been

developed to functionalize magnetic nanoparticles of manganites for biological applications using spectroscopic tools.

For application specific materials magnetic shape memory alloys are important materials. Significant progress has been made in investigation of shape memory alloys that include the martensitic transition in them. frequency dependence of magnetic susceptibility across structural transitions, magnetic field induced strain and magnetotransport and magneto-caloric properties. An advanced characterization tool- time-resolved magneto-optical Kerr effect microscope with 60 fs time resolution with sub-micrometer spatial resolution has been developed and ultrafast magnetization dynamics in novel magnetic systems have been investigated.

b) Advanced computational materials science

Science of Graphene is topic of considerable current interest and this year the noble prize in physics was given to scientist working in this area. A group worked on the absence of rippling of graphene on a substrate observed recently in experiments for graphene on mica. As graphene on a substrate is inevitably strained, they show that the substrate strain brings about a hardening of the phonon dispersion. Another group worked on magnetic phase diagrams of ternary alloys, catalytic properties of clusters, magnetic properties of clusters and their tuning by doping and co-doping and the effect of disorder on superconductivity. Important achievement has been obtained in understanding the origin of insulating behaviour in ferromagnets (like FeCr_2S_4). Work is currently going on to understand electronic properties of impoeratnt materials like Carbon and Boron Nitride based materials with plane wave pseudo-potential method.

c) Interface of biology and condensed matter physics

High precision calorimetry of a novel type was used to study energy fluctuations in DNA during thermal denaturation. This is for the first time such a fluctuation has been seen.

d) Theoretical work on black holes and its cosmological consequences. And Astrochemistry

Research work was carried out on relativistic astrophysics around black holes, spectral properties of emitted radiations from the accretion disks, study of the QPOs in persistent and outbursts sources.

A formalism for estimating quantum fluctuations of the background temperature in the early universe using a Lagrangian for k-essence fields. New results have been obtained on the constituents of the dark matter, emergence of the dark energy and primordial black holes.

Work has been initiated to start an Astrochemistry laboratory to mimic Interstellar space. Work was also done in theoretical work on the formation of grain-mantle in frigid condition.

OTHER ACHIEVEMENTS:

Important work was initiated on five topics. These are, Quantum field theory, Gravity and black holes, Mathematical physics,

Statistical physics and finally, Nonlinear physics. Both perturbative and non-perturbative aspects of filed theory were studied.

The role of noncommutativity was investigated and its consequences in gravity and black hole thermodynamics were examined. Differential geometry of fibre bundles and statistical physics of complex

systems were studied. Nonlinear dynamical problems involving convective instability were studied. Finally, several complex networks were designed. A group activity around the area of Quantum Information has been formed.

Publications

Upto October 31, 2010 a total of 110 publications have been made in refereed journals.

MAJOR NEW CONSTRUCTION ACTIVITIES (PHYSICAL INFRASTRUCTURE)

- a) The centre started building the integrated hostel complex with rooms for students, transit apartments, and other amenities from October 2009 for accommodating 70 students. The G+3 structure is now nearly complete and the roof has been cast topmost floor. The Centre has recently got the approval from Governing Body to construct additional two floors above G+3 so that another 50 students can be accommodated.
- b) Civil work for TEM lab has been completed.
- c) The Centre has opened a crèche named ‘Kishlay’ inside its premise to take care of the children of its staff members.
- d) The Centre is under the process of adding a Seminar hall, a lecture hall and two discussion rooms to its existing infrastructure.
- e) The centre has also opened a meeting room accommodating 30 persons at the guest house.

ADVANCED MANPOWER TRAINING AND VISITOR PROGRAMME

PhD programme

Currently the centre has 125 Ph.D. students on roll. In addition to conventional post M.Sc. Ph.D. programme, the centre is also running a post B.Sc. integrated Ph.D. programme. The post M.Sc. programme has obtained affiliation of two major universities (Calcutta University and Jadavpur University) under the new UGC guide line along with full recognition for its advanced course structure. The B.Sc. integrated Ph.D. programme has affiliation of the Calcutta University under new guide lines. The following table notes the important progress in admission process and the degree granting process till October 30, 2010.

Sl.		
1	No. of Post B.Sc Integrated Ph.D students admitted in August 2010	05
2	No. of Post M.Sc Ph.D Programme students admitted in August 2010	15
3	PhD thesis submitted	04
4	PhD degree awarded by the Universities	06

Conferences held during the year 2010-2011

Sl.	Title of the Conference	Date
1	Mesosopic Physics and Spectroscopy	November 22-24, 2010
2	75 Years of Quantum Entanglement – Foundations and Information theoretic applications	January 6-10, 2011
3	STATPHYS – Kolkata VII	November 26-30, 2010
4	MAGMA 2011[Magnetic Materials and Applications 2011]	January 24-25, 2011

Visitors and Seminar/Colloquium till October 2010

Sl.		
1	No. of Seminars held including Bose Colloquium	29
2	No. Visitors under different programmes	16
3	No. of Associates on roll	12
4	No of student visitors/summer students	27

SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES AND TECHNOLOGY

The Government of India had declared the Institute as an Institute of National Importance under the administrative control of the Department of Science & Technology by an Act of Parliament in 1980 in Trivandrum. The mandate of the Institute is to develop appropriate technologies to meet the health care 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 sciences studies for research and training in public health. A summary of the important achievements in the last one year are given below:

BIOMEDICAL TECHNOLOGY DEVELOPMENT:

Technology Transfer & related activities

M/s. IFGL, Kolkatta has officially released two bone graft products “**Biograft HA-New**” and “**Biograft HABG Active**”, based on the technology transferred from the Institute. The launching of these products were done at 3rd National Conference of the Indian Society of Prosthodontics, Restorative and Periodontics, held at Mysore, during 30th and 31st July 2010. Training of the Company personnel from M/S IFGL Bioceramics Ltd as part of the technology transfer of HAP and bioactive ceramic composites is complete and monitoring of the production process and product quality control was also carried out.

Technology on “**polyurethane resin compound for the fabrication of orthopedic casting tapes**” was transferred to Makim Med-Aids, Vadodara. Demonstration of the resin system was also organized.

IIIrd phase of training to industry personnel with regard to **Glass Ionomer** technology transfer was organised during 24th April – 9th May 2010.

Collaboration- Agreements Signed

Important collaborations (national & global) established:

International	Worked on	National	Worked on
Queensland University (QUT) of Australia, Brisbane	For cooperation in academic matters of mutual interest.	Central Electrochemical Research Institute (CECRI), Karaikkudi	Area of physical vapour deposited coatings for biomedical applications

International	Worked on	National	Worked on
		Vinvish Technologies Pvt. Ltd., Thejaswing Building, Technopark, Trivandrum	Medical Lasers and other opto-electronic devices for medical applications
		Reliances Life Sciences	Use of polymeric scaffolds developed at the lab for their research activities.
		NIPER-Ahmedabad	For collaboration in academic, scientific research and technical fields in the medical devices sector
		National Institute of Technology, Trichy	For collaboration in academic, scientific research and technical fields.
1. Publications		60 Research papers, 02 Book Chapters	
2. Patents/ know-hows		03 (Applied)	

NEW PROJECTS INITIATED DURING THE YEAR

- ◆ “Development of Calcium Sulphate Based Injectable Bone Substitute” sanctioned by DST
- ◆ ‘Preclinical evaluation of Fluoropassivated and hydrogel sealed vascular graft” funded by TTK HealthCare Ltd, Thiruvananthapuram.
- ◆ “Dispensable and biodegradable polymeric bone cement for Minimally invasive treatment of bone diseases – product validation” was sanctioned by DST.
- ◆ “Development of nanodevices for DNA delivery and cell transfection using Elastin Like Polymers (ELPs) coupled to cell interaction motifs” sanctioned by Indo-Spain (under DST)
- ◆ “Synthesis of Iron Oxide based magnetic nanoparticles for biocompatibility studies, magnetic hyperthermia and MRI applications” was sanctioned by DST.
- ◆ “Bioengineered hybrid skin substitutes for burn wounds” by Kerala state Council for Science, Technology and Environment
- ◆ “Medical device retrieval programme” sanctioned by DBT
- ◆ Development of recommendations for setting up a mission mode programme for medical instrumentation and device development” sanctioned by DST.

The internal projects sanctioned were:

- ◆ “Tissue engineered ceramic for promoting osteointegration in osteoporotic animal models with

relevance to clinical problem in women” was sanctioned under the Women Component plan of the Institute

- ◆ “Technology development of a portable resuscitation trolley” under the Technology Development Fund
- ◆ “Evaluation of functional efficacy of recombinant TGF alpha and VEGF proteins” under the Technology Development Fund
- ◆ “A pilot project on implementation of a medical device safety network portal suitable for Indian scenario” under the Technology Development Fund

Preclinical animal evaluation of decellularised bovine pericardium as dura substitute” under the Technology development Fund.

HOSPITAL SERVICES

The hospital received more new patients in OPD for consultation during 2010, compared to last years. The average length of stay and bed turnover remains more or less the same. While the bed occupancy rate reach 87%, free and subsidized group of patients increased by 2%. In addition to free treatment to the economically weaker sections of the society, treatments were also provided to different groups such as Central Government Health Scheme, Ex-servicemen Contributory Health Scheme, Scheduled Tribe Scheme, Thalolam Scheme (a Government of Kerala Scheme). During the year, a state of art digital spiral CT is installed in the Department of Imaging Sciences and Intervention Radiology. Two additional floors are getting ready on the existing AMCHSS complex. The central Air-condition system was renovated with new AC plant. The modernization of the Electrical Substation with higher capacity of transformers were installed. The contract for constructing a new canteen building was awarded. International Tele Project discussions for the Quit Tobacco India and Oxford Health alliance project of AMCHSS are progressing well. The Anesthesiology Department has provided Anesthesia support for about 4000 cases of Cardiovascular & thoracic surgery, Neurosurgery and Neuro & cardiac radiological procedures.

Cardiology department performed more than 3000 coronary procedures including approximately 500 angioplasties and also performed more than 300 electrophysiological procedures and more than 200 permanent pacemaker implantations. The Cardiovascular and Thoracic Surgery (CVTS) Department performed around 1200 adult Cardiac surgeries and another 200 Congenital Heart surgeries out of which around 700 surgeries are open-heart nature. The Microbiology Department introduced round the clock services in Bacteriology, Viral Serology, and Molecular Biology etc. The Central Clinical Laboratory performed approximately 7 lakh tests during the year in Biochemistry, Hematology and clinical pathology.

The R.Madhavan Nayar Center for Comprehensive Epilepsy Center witnessed an increase in number of outpatient attendance, video-EEG admissions and the number of EEGs performed. By 2010, more than 1100 Epilepsy surgeries were performed. More number of extratemporal surgeries was performed. There is considerable increase in the number of out patient attendance, PSG, CPAP trials and MSLT admissions at the Center for Sleep Disorder. All aspects of Sleep disorder care are provided including psychosocial counseling. The World Sleep Day was observed on 19.03.2010 under the slogan “Sleep well, Stay Healthy”.

The Neuromuscular Disorders subsection caters to the management to the issues to the patients with disorders of muscles, nerves, plexus and anterior horn cells of the spinal cord. Besides coordinating the

investigations and treatment protocols of these patients, this subsection runs a specialty review clinic aimed at the follow up of their response to treatment. A new Stroke Service Center is being established for comprehensive stroke care program with Help line facility. In addition to the routine services, coordinating speech, physio and occupational therapy and weekly teaching/demonstration on post stroke rehabilitation and nutrition for patients and caregivers. Stroke Clinic attendance was around 1600.

The Comprehensive Care Center for Movement Disorders expanded the service to include motor physiology laboratory facility. Tremor analysis and repetitive transcranial magnetic stimulation studies are performed regularly for diagnostic and research purposes. Movement disorder Clinic attendance was around 1700.

The Department of Neurosurgery continued to maintain high standards in patient care and academic pursuits as in previous years. Thrust was given to subspecialty oriented development and the major areas of operative focus were microvascular surgery, surgery of the skull base, endoscopic surgery, epilepsy surgery, movement disorder surgery and spinal instrumentation. An emphasis was given to minimally invasive procedures with the aid of neuronavigation equipment. A total of 1350 cases were operated with an overall mortality of 2.9%, which are comparable with the best centres of the world.

During the year 2010, Pathology Department had performed histopathological analysis in 1800 surgical specimens in patients undergoing treatment for neuro and cardiac diseases. Intra-operative tissue diagnosis (frozen section) was performed in more than 600 patients. The Department of Imaging Sciences & Interventional Radiology (IS&IR) is providing Diagnostic Imaging and Interventional Radiology services in Neuro and Vascular diseases and of other system. Interventions are done for difficult cases of intracranial aneurysms, cerebral AVMs, cerebral dural fistulas, Vein of Galen aneurysms, spinal AVMs; thoracic and abdominal aortic aneurysms etc. are referred to the IS&IR Department from across the county. The Department provides currently available latest technologies in MRI, Spiral CT and colour Doppler besides CR system and PACS. This Department has done 37000 Plain X-rays, 4200 MRI Scans, 5250 CT Scans and 3400 US Scans. Around 400 invasive diagnostic procedures were also done.

ACADEMIC PROGRAMMES

The Institute offers 25 Academic courses (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. Two off-campus programmes of two-year duration started at the National Institute of Applied Epidemiology, Chennai (NIE), Master of Applied Epidemiology and Master of Public Health. A joined programme by IIT Madras-CMC Vellore-SCTIMST Trivandrum on M.Tech in Clinical Engineering and Ph.D in Bio-medical devices and technology started in the previous year is attracting students from all over India. A unique feature of the course is the clinical attachment with maximum exposure to the clinical environment. This is expected to trigger development of innovative indigenous health care and technology.

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- b. “Inorganic nanoparticles for targeted drug delivery”, in Biointegration of Medical Implant Materials: Science & Design; Paul W., Sharma C.P. Edited by Sharma CP, CRC Press, Boca Raton, 2010, 204-235.

THE NATIONAL ACADEMY OF SCIENCES

The National Academy of Sciences, India was established in the year 1930. The Institute is grouped as an academic institution DST. The total number of Employees is 15 in which total Number of Research under faculties (Post Doctoral) is 15.

RESEARCH PROFILE OF THE ORGANIZATION

Areas of Research Focus : All the branches of Science & Technology

Major Research Accomplishments (2010-11) : It was in the following areas of research

1. On Water Purification & Conservation – Studies and Awareness Programmes conducted by Prof. V.P. Sharma, M.N.Saha Distinguished Fellow of NASI
2. On Science Communication/Education – Studies and Awareness Programmes conducted by several Fellows of the Academy across the country.
3. On Biodiversity – Studies and Awareness Programmes conducted by Dr. Niraj Kumar, P.I., DBT Project at NASI,
4. On By-pass Desert Cooler – Studies and Awareness Programmes conducted by Dr. Manvendra Tripathi (under a Project of NASI)
5. Library Science & Information – The Academy maintains a very rich library for facilitating the researchers; and also organizes regular meetings/workshops to guide the students.
6. On High Temperature Super Conductivity in Cuprates; and Flow of Electron through a quantum dot or a double dot – Studies conducted by Prof. S.K. Joshi, NASI Platinum Jubilee Chair
7. On Heme-biosynthetic Pathway of the Malaria Parasite as a Drug Target; and Combination Therapy of Malaria using Curcumin and Artemisinin derivatives – Studies conducted by Prof. G. Padmanaban, NASI-Platinum Jubilee Chair
8. On Polymer - Ionic Liquid Composites – Studies conducted by Prof. Suresh Chandra, NASI Senior Scientist
9. On Orchids – Studies conducted by Prof. S.P. Viji, NASI Senior Scientist
10. On Structure and diversity of tropical dry deciduous forest – Studies conducted by Prof. J.S. Singh, NASI Senior Scientist
11. On Nano-gold Catalysts – Studies conducted by Prof. V.R. Chaoudhary, NASI Senior Scientist

12. On High Attitude Biodiversity – Studies conducted by Prof. Upendra Dhar, NASI Senior Scientist
13. On Several Aspects of Rhizobacterium – Studies conducted by Prof. K.V.B.R. Tilak, NASI Senior Scientist
14. On Water Wave Scattering Problems – Studies conducted by Prof. B.N. Mandal, NASI Senior Scientist

IMPORTANT HIGHLIGHTS OF 5 MAJOR RESEARCH PROGRAMMES (2010-11) :

- (a) **Research Programme on Water** - NASI (Hqs. Allahabad, U.P.) being a premier organization of scientists, engineers and health professionals is seriously concerned about the present situation prevailing in the country in respect of community water supply and its very critical impact on community health. Several studies were conducted under the leadership of Prof. V.P. Sharma to analyse water quality of different regions; and NASI organized brainstorming sessions with the leading scientists, technocrats and health professionals as well as key policy makers to identify the following research programmes which are to be implemented through different agencies.
 - Mapping of Water Bodies in National Capital Region (NCR) of India by Prof. S.N. Naik, Prof and Head, CRDT, IIT, Delhi.
 - Water Resources Mapping and Enhancing the Water Recharging Along with Quality Profile of Garhwal Region. By Dr. B.M. Sharma, Society of pollution and environmental conservations scientists, Dehradun
 - Development of Cost Effective Technology for Recharging in Over-exploited Ground Water Resources in Urban and Rural Areas in West Bengal. By Prof. Arunabha Majumder and Prof. Asis Mazumdar, School of Water Resources Engineering, Jadavpur University, West Bengal.
 - Assessment of Performance of Existing Rainwater Harvesting Structures in Rural Areas and Development of Methodologies for Efficient Sustainable Rainwater Harvesting System. By S.P. Sinha Ray, President, Centre for ground water studies, Kolkata.
 - Development of an integrated sample and user-friendly and cost-effective system of Water Quality Monitoring in the rural areas of the country by Dr. P.K. Jha, Sulabh International Academy of Environmental Sanitation.
- (b) **Programmes on Science Education/Communication** : Innovative methods of teaching, development of low cost experimental tools & techniques and organization of several workshops/ orientation programmes and refresher courses by NASI alongwith its 15 Chapters all across the country.
- (c) **Programme on Biodiversity** – Several programmes were organized to investigate area specific biodiversity; the Biodiversity Registers have also been prepared for a few regions.
- (d) **Maintenance of a rich Library; and Programmes on Library Science & Information** – The Academy maintains a very rich library for facilitating the researchers; and also organizes regular meetings/workshops to guide the students.

- (e) **On By-pass Desert Cooler** – Intensive research and awareness programmes were conducted to minimize mosquitogenic conditions; and reduce the menace of malaria, dengue etc. in and around Allahabad region.

Major and Unique National Facilities created (2010-11) : The Academy has created a unique facility for Water Analysis by developing a portable kit; also the Ganga-gallery construction is to be completed by the end of the year 2011.

IMPORTANT COLLABORATIONS (NATIONAL AND GLOBAL) ESTABLISHED (2010-11): The Academy has established its collaborations with the National and International Laboratories through its elected Fellows; and also with other National Science Academies of India and China..

IMPORTANT OUTPUT INDICATORS (2010-11)

1.	Publications	Published all the regular journals and Special Issues of International repute.
2.	Patents/ know-hows	The Senior Scientists patented/applied for patenting their findings.
3.	Designs and other intellectual Products	Several scientific and educational CD's were developed
4.	Post Graduate and PhDs trained	JRFs/SRFs working with the Senior Scientists are being trained in their area of research. Also the Academy is giving training to the young researchers through its Summer Research Fellowship Programme, being operated jointly by the three National Science Academies.
5.	Other products	Helping the School/College teachers in developing low cost teaching aids/tools through its Science Communication Programmes.

For Knowledge Service and Expert system organizations (TIFAC, NABL, Vigyan Prasar and the Professional Bodies)

1.	National data bases developed	Compilation of research papers through its regular publications; and maintenance of these on a defined website – http://nasi.iिता.ac.in/library
2.	Historical data compiled	Compiled the History of the Academy; and also News /Views/ Comments/Recommendations on various Science Society Issues of National Importance
3.	National missions led and coordinated	The Fellows of the Academy are actively involved in several important missions related to science and society, as several are occupying major responsible positions in the country
4.	Foresight reports and analysis if any	The analysis and reports on Water Conservation Issue, Malaria Control, Biodiversity Conservation, Nutritional Status etc. have been sent to the concerned agencies.
5.	Any other original expert system devised	The Academy has carved a niche in the area of science communication/education programmes.

WADIA INSTITUTE OF HIMALAYAN GEOLOGY

Wadia Institute of Himalayan Geology was established in the Year 1968 in Dehradun. It is grouped under Global History & Health. The total number of Employees is 204 in which research faculties is 61:56 faculty members are Post-Doctoral.

AREAS OF RESEARCH FOCUS

The Institute has acclaimed reputation of internationally known center of excellence for research in geology and geophysics, aimed to unravel the orogeny of the world's youngest and loftiest mountain system and its role in climate modulation. Its research activities are grouped into five mission mode projects that are implemented through long-term and short-term projects.

MAJOR RESEARCH ACCOMPLISHMENTS (2010-11):

The research activity of the Institute is centered around five mission mode projects (Himtransects, Climate-Tectonic interaction, Biostratigraphy and Biodiversity Environmental Linkage, Sustainable Natural Resources, and Real Time Geology for Society), and some major achievements made in these projects are given in section 3.

IMPORTANT HIGHLIGHTS OF 5 MAJOR RESEARCH PROGRAMMES (2010-11):

1. The geochemical studies of gabbroic intrusive of Miri-Buxa group in the Siang Window of Eastern Himalaya suggest their derivation from primitive mantle source similar to Komatiitic composition at moderate to higher degree of partial melting (8-20%), and intrusion in a continental rift tectonic environment.
2. The Ganga river system in NW Himalaya, during the past 40 ka aggradated in two major phases in response of the two phased deglaciation in the Higher Himalaya. The incision of the river valley took place in response to increased monsoon ~11 ka, however, in the foreland the incision took place 3-4 ka later, suggesting a time lag in the surfacial responses to particular climatic pulse.
3. The OSL dating of terraces located along Siang river, north of MCT at Tuting, NE Himalaya suggested major episodes of tectonic uplift from >21-8 ka with three phases of bedrock incision centered at <21 ka, ~11 ka and ~8 ka.
4. The representative carbon isotope analyses ($\delta^{13}\text{C}$) of Almora graphite, suggested that the graphite has crystallized from biogenic carbon during the metamorphism of the host sediments.
5. Seismic hazard analysis of NW Himalaya carried out using probabilistic technique show high hazard potential zones to be centered around Kashmir region (0.70g), Kangra region (0.50g), Garhwal region (0.50g) and Darchula region (0.50g) with intervening zones representing the low hazard zones (~0.25g) for 10 % probability of exceedance in 50 years.

Major and Unique National Facilities created (2010-11)

Stable Isotope Mass Spectrometer (Delta V+ from the Thermo Scientific, Germany) is being added to existing facilities

IMPORTANT COLLABORATIONS (NATIONAL AND GLOBAL) ESTABLISHED (2010-11):

International

Iceland, Switzerland and Norway (in Process)

National

Doon University

IMPORTANT OUTPUT INDICATORS

- | | |
|-----------------------------------|--|
| 1. Publications | SCI Journals: 40
Non-SCI Journals: 8
In Press/Accepted :24 |
| 2. Post Graduate and PhDs trained | 30 PG, 08 Ph.D. |

EMINENCE INDICATORS (2010-11)

For Academic Institutions

Impact Factor Aggregates	56 (till October 2010)
Any other acclaims (to be specified)	<ol style="list-style-type: none"> 1. Prof. Anil K Gupta has been selected for the Third World Academy of Science (TWAS) Prize, 2010 for his fundamental contribution to the study of Indian monsoon variability. 2. The Geological Society of India awarded Dr. Pradeep Srivastava with the prestigious ‘S.S. Merh Award–2010’ for his significant contributions in the field of Quaternary Geology. 3. An “outreach workshop on Earthquake Risk Reduction” will be held at Wadia Institute of Himalayan Geology, Dehradun on 14th December 2010 to disseminate information of societal importance based on scientific results from the collaborative project to local stake holders including engineers, architects, schools authorities and hospital authorities.



Laser Raman Micro Probe at WIHG Lab

Fig. 10.17. Diagram showing the range of $\delta^{13}\text{C}$ values in Almora graphite together with major graphite deposits of the world.

NATIONAL INNOVATION FOUNDATION

Set up in the year 2000, National Innovation Foundation (NIF) India, based at Ahmedabad, was provided a corpus of Rs 20 Crore by DST for its operations. Building upon the Honey Bee philosophy, NIF carried forward the mission to provide a nurturing platform to the grassroots innovators and knowledge holders of the society. NIF has scaled up the activities related to scouting, documentation, validation/value addition, IP and business development related to grassroots innovations and traditional knowledge practices manifold in the last decade. With Cabinet's approval on 10th June 2010, NIF became a grant-in aid institution of DST with a budget of Rs. 26.06 Cr during 11th five year plan.

Mandated to build a National Register of green grassroots innovations and outstanding traditional knowledge, NIF is committed to help India become an inventive and creative society by documenting, adding value, protecting intellectual property rights of the contemporary, unaided, technological grassroots innovations as well as outstanding examples of traditional knowledge on commercial as well as non-commercial basis.

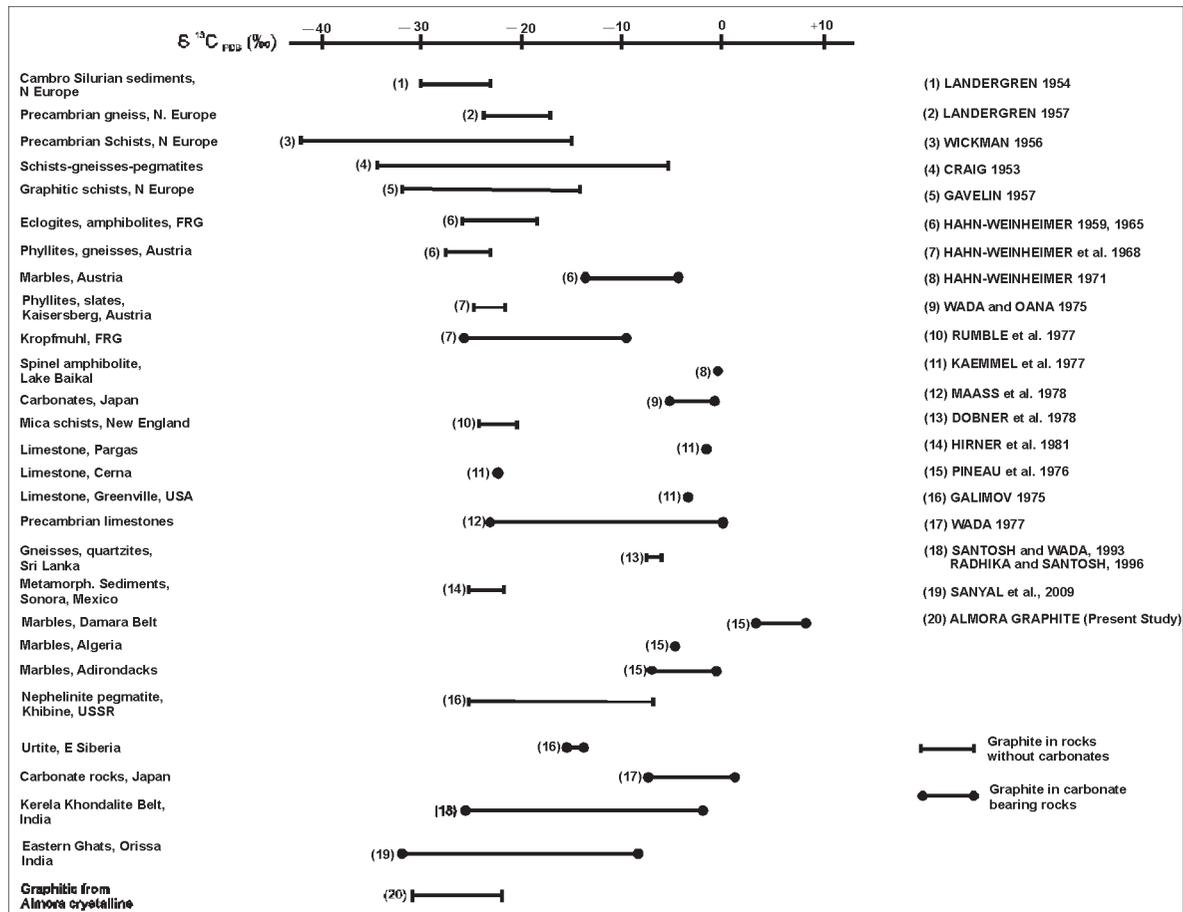


Fig. 10.18: Children's creativity and Innovation competition

The annual national competition for students' ideas and innovation - IGNITE 10 organized in association with Central Board of Secondary Education (CBSE), Society for Research and Initiatives in Sustainable Technologies and Institutions (SRISTI), Everonn Education Ltd., and other partners was able to generate 2139 entries from 161 districts from 29 states and Union Territories of India. The awards were declared

on October 15 - Dr APJ Kalam's birthday celebrated as Children's Creativity and Innovation Day by NIF. The award ceremony was held on November 8, 2010 at IIM A, where 18 creative ideas and innovations from 22 children were awarded by Dr APJ Abdul Kalam.

Scouting and Documentation:

National Biennial Campaigns

One of the major activities of NIF has been scouting ideas, innovations and traditional knowledge from different parts of the country and recognizing the outstanding innovators/traditional knowledge holders at the National level. Since its establishment about 145000 innovations, ideas and practices have been scouted (not all are unique or accepted) from about 550 districts of the country and 383 technologies have been awarded in Five National Award functions so far. The short listing of entries received during the Sixth Competition is in progress. The Seventh Biennial Competition, which began on 01 February 2009, would conclude on 31 December 2010 and till date about 16000 entries from 31 states and UTs have been received.

Shodh Yatras

The 25th Shodh Yatra (the journey of exploration on foot is organized for one week to ten days, twice a year during extreme summer and winter) was organized with the assistance of SRISTI from 15 May to 21 May 2010 in Narayanpur district of Chhatisgarh. The 26th Shodh Yatra is planned from 3 January 2011 to 9 January 2011 in Laitkynsew village, Sohra (Cherrapunji) to Smit, Shillong, Meghalaya. In these Shodh Yatras, the shodh yatris who came from different states of the country and abroad, learn from common people, honour outstanding knowledge holders at their door step, sharpen their sensitivity towards environment, respect tremendous wealth of traditional knowledge and appreciate a desire for growth and development among the local people.

Compendiums on innovations from/for different states of India

Twenty-six coffee table books based on the grassroots innovations and practices from NIF database were prepared and presented to the respective Chief Ministers of as many states by Dr Vijay L Kelkar, Chairman, Thirteenth Finance Commission and Member, Governing Board, NIF. In continuation of this, a compilation of innovations and practices from the North East states was also presented to the MPs of NE states in February 2010. In addition, a special compendium of grassroots innovations from different states of the country 'India Innovates' has also been prepared.

Workshops on Scouting and Documentation:

As a part of capacity building program of scouts, a national workshop on scouting and documentation was organized on 22-23 September 2010 at Ahmedabad. About eighty scouts and volunteers from twenty one states of the country participated in the two days program. Similar workshops involving scouts, innovators, teachers, etc., were organized from time to time in different parts of the country to give impetus to the scouting and documentation activities.

Value Addition, Research and Development:

NIF-ICMR collaboration:

Out of all the practices received at NIF, majority deal with herbal drugs for human or animal applications. To validate the unique herbal claims for human health, NIF entered into a MoU with ICMR on 23rd June

2006. The NIF-ICMR Joint Implementation Committee meeting, held at Indian Institute of Management, Ahmedabad on April 15, 2010 reviewed the progress of the cooperation. The Committee recommended that earlier presented projects may again be reviewed/ reassigned by the Subcommittee, which may decide to outsource them as well. Committee also recommended the augmentation of SRISTI laboratory facilities and establishing the herbarium and repository of non codified plants at NIF. Herbarium and plant repository dedicated for Non-codified plants will be established in coming year.

Validation of grassroots technologies:

Validation of twelve herbal technologies was accomplished in the financial year through collaboration with different laboratories, field trials and institutions such as CV Sc & AH, Jabalpur, SRISTI Sadbhav Laboratory, Ahmedabad, Oxford College, Bangalore, CAZRI, Jodhpur, IARI, New Delhi, NDUA&T, Faizabad, IIVR, Varanasi and Farmer's Field, Kheda.

The Energy and Resources Institute, New Delhi and Malaviya National Institute of Technology, Jaipur tested the Biomass gasifier developed by Raisingh Dahiya and found the design (open top biomass gasifier) to be unique with high gasification efficiency. Karnataka Antibiotics & Pharmaceuticals Ltd., Bangalore found significant curative properties of the herbal formulation developed by Ukhardiyabhai Raot against mastitis. Fracture healing formulation by Mogjibhai Damor tested at Bangalore University was found to enhance the proliferation of osteoblasts and mineralization of bone.

Support to innovator for prototype development, testing, design optimization:

Financial assistance was provided to fourteen innovators for prototype development, testing the innovation, design optimization, development of proof of concept model of technological innovations, trials, etc. Professional designers have also been involved for design optimization.

Workshop with Future Group for value addition in Grassroots Technologies:

A workshop with Future Group was organized on 26 October 2010 for identifying technological and market gap, and to develop the roadmap for making them viable products.

Micro incubator support:

Financial assistance was extended to seven innovators from different states for developing infrastructure support for augmenting their innovations/ideas. This would also enable them to extend fabrication support to ideas and innovations of other innovators of the region.

Micro venture Innovation Fund (MVIF) support to innovators:

Ten new projects were sanctioned for a total amount of Rs. 71,98,000.00 (seventy one lakh ninety eight thousand rupees only) of which Rs. 41,75,000/- (Forty one lakh seventy five thousand rupees only) were disbursed to different innovators. A sum of Rs. 2,50,000 .00 (two lakhs fifty thousand rupees) was also released as second installment for a previously sanctioned project.

Intellectual Property Right:

Patent applications

NIF applied for thirty one patents including eight provisional specifications and twenty three complete specifications of grassroots innovations in the financial year till October 2010.

Dissemination:**Collaboration with CAPART:**

NIF partnered with CAPART to assist their Technology Resource Centres (TRCs) and other potential NGOs in initiating scouting and documentation of grassroots innovations (GRIs) and traditional knowledge (tk). The aim is to assist selected member TRCs and state bodies to adopt/expand methods and systemic approaches to scout, document and promote grassroots innovation through knowledge sharing and networking. The technologies will be identified for social and commercial diffusion after validating and improvising. This is in addition to the present efforts of NIF for scouting, documentation, validation, value addition, IPR and dissemination activities of NIF.

To initiate this effort, a workshop on “Building Capacity for Scouting, Documentation, Database Development and Dissemination of Grassroots Innovations” was organized with the help of Centre for Management in Agriculture, IIMA on June 7-8, 2010 where experts from different fields gave presentations to the participants. The workshop was attended by representatives of NGOs, CAPART TRCs and members of Councils of Science and Technologies of different states.

The collaboration is being monitored and guided by expert and techno commercial committees, which were setup by CAPART in consultation with NIF under the chairmanship of Prof R. Kumar.

Exhibitions of Grassroots Technologies

NIF was invited by the Hon’ble President of India for organizing an exhibition of the grassroots technologies at the Mughal Garden, Rashtrapati Bhawan from 10-14 March 2010. Her Excellency, Hon’ble Smt Pratibha Devisingh Patil inaugurated the exhibition on March 10 and visited more than 32 stalls with more than 50 innovations primarily from the informal sector. She had declared 2010 -2020 as the decade of innovation earlier and this exhibition conveyed our commitment to that mission. Many distinguished dignitaries visited the exhibition; then Minister of Science and Technology (Independent Charge) Shri Prithviraj Chavan, Chief Minister of Delhi Mrs Sheila Dixit, Members of NIC, film director Mr James Cameron, Secretary MSME, Secretary MNRE, Secretary DSIR, Secretary DST to name a few.

NIF participated in the Army Innovation Seminar cum Exposition on 29-30 June 2010 at EME Headquarters, Delhi where it showcased different grassroots innovations like trench digger, herbal bullet proof jacket, bio mass gasification system and pollution controlling filter among many others.

Publication of Success Stories

A series of success stories of grassroots innovations and practices have been published by Yojana, The Hindu and rediff.com. The articles in The Hindu and rediff.com have generated tremendous response in terms of dissemination as well as forging linkages. Many entrepreneurs and investors wrote back expressing their interest to invest or license the profiled grassroots technologies. Articles have also been appearing in other leading national dailies like The Times of India, Indian Express, DNA, and others.