

# ANNUAL REPORT

2013 – 14



*One Hundred and Fifth Year*

**Indian Institute of Science**  
Bangalore - 560 012





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## P R E F A C E

The Indian Institute of Science (IISc, or just “The Institute”) was established in 1909 by a visionary partnership between the industrialist Jamsetji Nusserwanji Tata, the Maharaja of Mysore, and the Government of India. Over the 105 years since its establishment, IISc has become the premier institute for advanced scientific and technological research and education in India. Since its inception, the Institute has laid balanced emphasis on the pursuit of basic knowledge in science and engineering, as well as on the application of its research findings for industrial and social benefit. In the words of its founder, J. N. Tata, the objectives of the Institute are *“to provide for advanced instruction and to conduct original investigations in all branches of knowledge as are likely to promote the material and industrial welfare of India”*.

The Institute actively pursues a policy of true academic freedom in order to enable academic excellence in all areas of its activities. The Institute has taken several initiatives in promoting emerging and interdisciplinary areas, in developing active and close collaboration with research institutions worldwide, and in enabling enhanced interactions with the industry through knowledge and wealth sharing processes.

IISc is engaged in higher learning and advanced research at the cutting edge of science and technology. The Institute has a highly qualified and internationally acclaimed faculty numbering 499, and a student strength of 3398. The Institute has introduced many innovations in teaching and research. The traditional degree programmes have been the M.E., M.Tech., M. Des., M. Mgt, M.Sc. (Engg.), and Ph.D. degrees. The Integrated Ph.D program (post three year B.Sc.) in biological, physical, chemical, and mathematical science has become very popular. The four-year undergraduate (UG) program, started in August 2011, has received a good response; 107 students have been admitted in 2014, bringing the total number of UG students to 417, of which 87 are expected to graduate as the first graduating batch in 2015.

The Institute faculty continues to be very active in research and maintains a high annual publication output. The research findings cover a wide spectrum of scientific investigations. As in the past, several faculty members of the Institute have won national and international awards and honours, in recognition of their contributions to the growth of knowledge in science and engineering.

The IISc Press was begun during the centenary year, and has published several monographs and lecture notes in a co-publishing agreement with international publishers. Several lectures by distinguished scientists, including Nobel Laureates were organized under the Centenary Lectures series and some Endowed Lectures series.

The activities in the emerging second campus of the Institute at Challakere have been steadily progressing. The construction of the boundary wall has been completed; a 10 Km peripheral road has been laid and can now be used for the movement of construction material. The main gate of the campus, and an associated security complex have been completed. A state electricity board power line now reaches the campus. The Talent Development Centre has completed the training of more than 2500 science teachers, and is attracting the attention of many other states. The first research article, based on a temporary climate monitoring station on the Challakere campus, has been published. A skill development





centre has been planned, and research facilities, such as solar photovoltaics, a permanent climate monitoring station, and a geotechnical station, are planned and will soon be installed.

The Institute continues to receive major research support from national and international sources, public and private. The support for recurring expenses, and also a substantial fraction of the annual research expenses, is provided by the Ministry of Human Resource Development, Government of India. The faculty of the Institute also undertake a large number of research projects funded by different agencies, including the Department of Science and Technology (DST), the Department of Biotechnology (DBT), the Council of Scientific and Industrial Research (CSIR), the Defence Research and Development Organization (DRDO), the Ministry of Communications and Information Technology and a host of other organizations, both in the public and private sectors. Interactions between the Institute and industry are strengthened through the Centre for Scientific and Industrial Consultancy (CSIC), the Society for Innovation and Development (SID), and several centres specifically set up for interaction with the government, the society, and the industry.

A major INDO-US Energy Programme – The Solar Energy Research Institutes for India and United States (SERIUS) has been initiated. The activities of the recently established Centre for NeuroScience have received a major boost by a major grant from the Tata Trust; Mr. and Mrs. Kris Gopalakrishnan have committed Rs. 220 crores to the establishment of a Centre for Brain Research as an independent society of IISc, to be nurtured and mentored by the Institute. The Infosys Foundation has established two well endowed, international visiting chairs in Physics and Mathematics.

The Institute is continuing to take further initiatives to be globally competitive. The Institute continues to embark on new areas of research in collaboration with institutions both within and outside the country. The Office of International Relations at the Institute has facilitated discussions and agreements with several universities and R&D institutions worldwide.

I am honoured to present this Annual Report of the Institute, which basically reports the academic output and related achievements during the period 2013-14. The volume of high quality work reported here goes to the credit of the intellectual inputs of the faculty and the students, and to the support of the technical and administrative personnel. I also wish to place on record my gratitude to the Chairman and the Members of the Council of the Institute for their valuable guidance.

October 2014

**Anurag Kumar**  
Director



## Divisional Structure

|  |  |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
|--|--|---------------------|-------------------------------------|-----------|----|-------|-------------------------------|---------------------|----|------|--|--------------------|-----|-------|--|--------------------|-----|------|--------------------------------|--------------------|-----|------|--------------------------------|-----------------|-----|------|-----------------------------------|--------------|-----|-----|-------------------------|----------|-----|----|--------------------|--|--|-----|--------------------------|--|--|--------|---|--|--|
| <div><div>Division of Biological Sciences</div></div>                  | <table><tr><td>BC</td><td>Biochemistry</td><td></td><td></td></tr><tr><td>MCB</td><td>Microbiology and Cell Biology</td><td></td><td></td></tr><tr><td>MRDG</td><td>Molecular Reproduction, Development &amp; Genetics</td><td>Academics</td><td>72</td></tr><tr><td>MBU</td><td>Molecular Biophysics</td><td>Sci./Tech.Officers</td><td>12</td></tr><tr><td>CES</td><td>Ecological Sciences</td><td>Degrees Awarded</td><td>50</td></tr><tr><td>CNSc</td><td>Neuro Sciences</td><td>Publications</td><td>318</td></tr><tr><td>CIDR</td><td>Infectious Disease Research</td><td>Visitors</td><td>146</td></tr><tr><td>CAF</td><td>Central Animal Facility</td><td></td><td></td></tr></table>  | BC                  | Biochemistry                        |           |    | MCB   | Microbiology and Cell Biology |                     |    | MRDG | Molecular Reproduction, Development & Genetics | Academics          | 72  | MBU   | Molecular Biophysics                   | Sci./Tech.Officers | 12  | CES  | Ecological Sciences            | Degrees Awarded    | 50  | CNSc | Neuro Sciences                 | Publications    | 318 | CIDR | Infectious Disease Research       | Visitors     | 146 | CAF | Central Animal Facility |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| BC   | Biochemistry   |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| MCB  | Microbiology and Cell Biology  |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| MRDG   | Molecular Reproduction, Development & Genetics   | Academics           | 72                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| MBU  | Molecular Biophysics   | Sci./Tech.Officers  | 12                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CES  | Ecological Sciences  | Degrees Awarded     | 50                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CNSc   | Neuro Sciences   | Publications        | 318                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CIDR   | Infectious Disease Research  | Visitors            | 146                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CAF  | Central Animal Facility  |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
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| IPC  | Inorganic & Physical Chemistry   | Academics           | 52                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| OC   | Organic Chemistry  | Sci./Tech.Officers  | 12                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| SSCU   | Solid State & Structural Chemistry   | Degrees Awarded     | 53                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| MRC  | Materials Research Centre  | Publications        | 366                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| NMR  | NMR Research Centre  | Visitors            | 124                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| <div><div>Division of Electrical Sciences</div></div>                  | <table><tr><td>CSA</td><td>Computer Science &amp; Automation</td><td>Academics</td><td>67</td></tr><tr><td>EE</td><td>Electrical Engineering</td><td>Sci./Tech.Officers</td><td>20</td></tr><tr><td>ECE</td><td>Electrical Communication Engineering</td><td>Degrees Awarded</td><td>241</td></tr><tr><td>ESE</td><td>Electronic Systems Engineering</td><td>Publications</td><td>418</td></tr><tr><td></td><td></td><td>Visitors</td><td>61</td></tr></table>   | CSA                 | Computer Science & Automation       | Academics | 67 | EE    | Electrical Engineering        | Sci./Tech.Officers  | 20 | ECE  | Electrical Communication Engineering           | Degrees Awarded    | 241 | ESE   | Electronic Systems Engineering         | Publications       | 418 |      |                                | Visitors           | 61  |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CSA  | Computer Science & Automation  | Academics           | 67                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| EE   | Electrical Engineering   | Sci./Tech.Officers  | 20                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| ECE  | Electrical Communication Engineering   | Degrees Awarded     | 241                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| ESE  | Electronic Systems Engineering   | Publications        | 418                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
|  |  | Visitors            | 61                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| <div><div>Division of Mechanical Sciences</div></div>                  | <table><tr><td>AE</td><td>Aerospace Engineering</td><td></td><td></td></tr><tr><td>CH</td><td>Chemical Engineering</td><td></td><td></td></tr><tr><td>ME</td><td>Mechanical Engineering</td><td></td><td></td></tr><tr><td>MT</td><td>Materials Engineering</td><td>Academics</td><td>122</td></tr><tr><td>CPDM</td><td>Product Design &amp; Manufacturing</td><td>Sci./Tech.Officers</td><td>35</td></tr><tr><td>CAOS</td><td>Atmospheric &amp; Oceanic Sciences</td><td>Degrees Awarded</td><td>238</td></tr><tr><td>DCCC</td><td>Divecha Centre for Climate Change</td><td>Publications</td><td>874</td></tr><tr><td>CE</td><td>Civil Engineering</td><td>Visitors</td><td>128</td></tr><tr><td>MS</td><td>Management Studies</td><td></td><td></td></tr><tr><td>CST</td><td>Sustainable Technologies</td><td></td><td></td></tr><tr><td>CISTUP</td><td>Infrastructure, Sustainable Transportation and Urban Planning</td><td></td><td></td></tr></table> | AE                  | Aerospace Engineering               |           |    | CH    | Chemical Engineering          |                     |    | ME   | Mechanical Engineering                         |                    |     | MT    | Materials Engineering                  | Academics          | 122 | CPDM | Product Design & Manufacturing | Sci./Tech.Officers | 35  | CAOS | Atmospheric & Oceanic Sciences | Degrees Awarded | 238 | DCCC | Divecha Centre for Climate Change | Publications | 874 | CE  | Civil Engineering       | Visitors | 128 | MS | Management Studies |  |  | CST | Sustainable Technologies |  |  | CISTUP | Infrastructure, Sustainable Transportation and Urban Planning |  |  |
| AE   | Aerospace Engineering  |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CH   | Chemical Engineering   |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| ME   | Mechanical Engineering   |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| MT   | Materials Engineering  | Academics           | 122                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CPDM   | Product Design & Manufacturing   | Sci./Tech.Officers  | 35                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CAOS   | Atmospheric & Oceanic Sciences   | Degrees Awarded     | 238                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| DCCC   | Divecha Centre for Climate Change  | Publications        | 874                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CE   | Civil Engineering  | Visitors            | 128                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| MS   | Management Studies   |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CST  | Sustainable Technologies   |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CISTUP   | Infrastructure, Sustainable Transportation and Urban Planning  |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
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| IAP  | Instrumentation and Applied Physics  |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| MA   | Mathematics  | Academics           | 75                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| PHY  | Physics  | Sci./Tech.Officers  | 16                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CHEP   | High Energy Physics  | Degrees Awarded     | 55                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CCS  | Contemporary Studies   | Publications        | 326                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CCT  | Cryogenic Technology   | Visitors            | 283                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CEaS   | Earth Science  |                     |                                     |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| <div><div>Centres (under Director)</div></div>                         | <table><tr><td>SERC</td><td>Super Computer Education &amp; Research</td><td>Academics</td><td>22</td></tr><tr><td>CeNSE</td><td>Nano Science and Engineering</td><td>Sci./Tech. Officers</td><td>10</td></tr><tr><td>LIB</td><td>JRD Tata Memorial Library</td><td>Degrees Awarded</td><td>21</td></tr><tr><td>RBCPS</td><td>Robert Bosch for Cyber Physical System</td><td>Publications</td><td>114</td></tr><tr><td>APC</td><td>Archives and Publications Cell</td><td>Visitors</td><td>18</td></tr></table>   | SERC                | Super Computer Education & Research | Academics | 22 | CeNSE | Nano Science and Engineering  | Sci./Tech. Officers | 10 | LIB  | JRD Tata Memorial Library                      | Degrees Awarded    | 21  | RBCPS | Robert Bosch for Cyber Physical System | Publications       | 114 | APC  | Archives and Publications Cell | Visitors           | 18  |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| SERC   | Super Computer Education & Research  | Academics           | 22                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| CeNSE  | Nano Science and Engineering   | Sci./Tech. Officers | 10                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| LIB  | JRD Tata Memorial Library  | Degrees Awarded     | 21                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| RBCPS  | Robert Bosch for Cyber Physical System   | Publications        | 114                                 |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |
| APC  | Archives and Publications Cell   | Visitors            | 18                                  |           |    |       |                               |                     |    |      |  |                    |     |       |  |                    |     |      |                                |                    |     |      |                                |                 |     |      |                                   |              |     |     |                         |          |     |    |                    |  |  |     |                          |  |  |        |   |  |  |



# Students

## Courses Offered (994)

|                |     |
|----------------|-----|
| Level          |     |
| Under-Graduate | 21  |
| Post-Graduate  | 775 |
| Research       | 198 |

## Degrees Awarded (660)

|            |     |
|------------|-----|
| PhD        | 234 |
| MSc (Engg) | 67  |
| MS         | 9   |
| ME/MTech   | 318 |
| M Des      | 14  |
| M Mgt      | 18  |

## External Registration (186)

|                         |     |
|-------------------------|-----|
| Sponsors                |     |
| Government/Undertakings | 102 |
| Industries              | 84  |

## Admissions (793)

|             |     |
|-------------|-----|
| PhD         | 291 |
| MSc (Engg)  | 37  |
| Int. PhD    | 37  |
| ME/MTech    | 281 |
| M Des       | 16  |
| M Mgt       | 14  |
| B S         | 117 |
| (SC/ST-118) |     |

## On Roll (3398)

|             |      |
|-------------|------|
| PhD         | 1964 |
| MSc (Engg)  | 184  |
| Int. PhD    | 254  |
| ME/MTech    | 618  |
| M Des       | 39   |
| M Mgt       | 28   |
| B S         | 311  |
| (SC/ST-451) |      |

## Hostels (2685)

|           |      |
|-----------|------|
| Men       | 2013 |
| Women     | 672  |
| Messes(5) |      |

## Continuing Education (945)

|                        |     |
|------------------------|-----|
| Participants           | 50  |
| Q.I.P.                 | 20  |
| Short Term Proficiency | 875 |

## Scholarships/ Fellowships (2386)

|                  |      |
|------------------|------|
| IISc             | 1994 |
| UGC/CSIR/ Others | 392  |

IISc at a glance 2013-14



### Staff (1149)

|                       | SC/ST | OBC | GN  |
|-----------------------|-------|-----|-----|
| <b>Teaching (499)</b> |       |     |     |
| Academic              | 13    | 3   | 394 |
| Scientific            | 25    | 5   | 59  |
| Technical (56)        | 15    | 3   | 38  |
| <b>Support (594)</b>  |       |     |     |
| Officers              | 10    | 2   | 8   |
| Administrative        | 74    | 8   | 136 |
| Technical             | 34    | 4   | 66  |
| Maintenance           | 87    | 8   | 149 |
| Other                 | 3     | -   | 5   |

### Publications (2416)

|             |      |
|-------------|------|
| Science     | 1010 |
| Engineering | 1292 |
| Others      | 114  |

### Interactions

|                  |     |
|------------------|-----|
| On Campus        |     |
| Lectures         | 9   |
| Conferences      | 133 |
| Visitors         |     |
| National         | 359 |
| Overseas         | 401 |
| Delegations      | 42  |
| Staff            |     |
| Visits           | 661 |
| Conferences      | 584 |
| Thesis Examiners | 247 |

### Awards/Distinctions (Total 82)

|                           |    |
|---------------------------|----|
| <b>Fellows</b>            |    |
| National Academic         | 14 |
| Others                    | 9  |
| <b>Awards</b>             | 30 |
| Medals/Prizes             | 7  |
| Chairmanship / Membership | 23 |
| <b>Others</b>             | 27 |

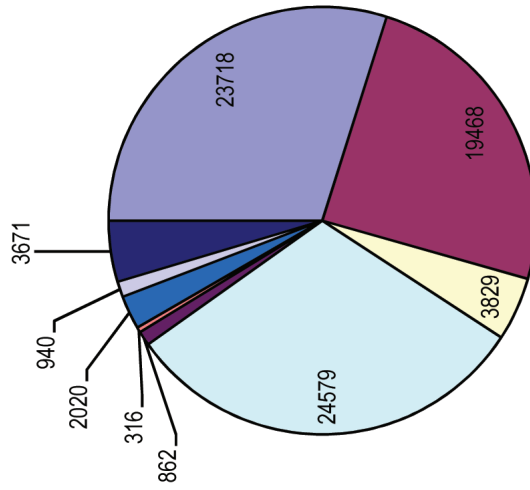
# Academia

### Divisions Departments

|                                  |    |
|----------------------------------|----|
| Biological Sciences              | 8  |
| Chemical Sciences                | 5  |
| Electrical Sciences              | 4  |
| Mechanical Sciences              | 11 |
| Physical & Mathematical Sciences | 7  |
| Centres                          | 5  |

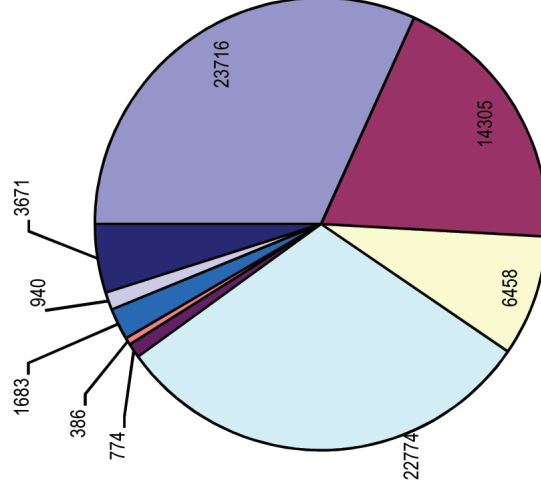
## Finance 2013-14

**Receipts**  
(₹ in lakhs)



**Total: ₹ 79,403 lakhs**

**Payments**  
(₹ in lakhs)



**Total: ₹ 74,707 lakhs**

IISc at a Glance 2013-14

# 1. The Institute

The Indian Institute of Science is an institution of higher learning and research established in 1909 under the Charitable Endowments Act 1890. With the establishment of the University Grants Commission in 1956, the Institute came under its purview as a Deemed University. The

principal authority governing the Institute is the Council, which is advised by the Court in the formulation of policies. The Director is the Chief Executive of the Institute and is assisted in its management by the Senate and the Faculties of Science and Engineering.

## 1.1 Court

The membership of the Court is drawn from different cross sections of the country such as Industry, Universities, Scientific Institutions, etc. In addition to eminent persons of science, learning and industry, it also contains the

nominees of the Government of India, the Government of Karnataka and the Tata Trusts. The Professors of the Institute and the members of the Council are also ex-officio members of the Court. The following are the members of the Court:

### **K Kasturirangan**

President of the Court  
Chairman, Governing Council  
Raman Research Institute  
Bangalore (Nom. Council)

### **Som Mittal**

Former President,  
NASSCOM, New Delhi  
(Nom. Visitor)

### **Suresh Chandra Mukul**

Former Air Marshal,  
New Delhi (Nom. Visitor)

### **Ashok Thakur**

Secretary, MHRD  
Dept. of Higher Education, GOI,  
New Delhi (Nom. GOI)

### **Apparao Mallavararupu (Rao)**

Chairman and Managing Director,  
Centum Electronics, Bangalore  
(Nom. GOI)

### **Air chief Marshal Pradeep Vasant Naik**

Former Chief of the Air Staff  
Pune (Nom. GOI)

### **B G Nandakumar**

Commissioner, Dept. of Collegiate  
Education, Bangalore (Nom. GOK)

### **R K Krishna Kumar**

Director, Tata Sons Limited,  
Mumbai (Nom. Tata Trusts)

### **Saroj K Poddar**

Chairman, Gillette India Ltd.,  
Kolkata (Rep. FICCI)

### **S N Agarwal**

Chairman  
Bhoruka Power Corporation Ltd.,  
Bangalore (Rep. All India Orgn. of  
Ind. Employers)

### **Rajinder Singh Maker**

Executive Director  
The Employers Federation of India,  
Mumbai (Rep. Employers  
Federation of India)

### **S S Mantha**

Chairman, AICTE, New Delhi  
(Rep. AICTE)

### **P S Ahuja**

Director General, CSIR, New Delhi  
(Rep. CSIR)

### **Er Har Sarup Chahal**

Vice Chancellor  
Maharshi Dayanand University  
Rohtak (Rep. Indian Universities)

### **C K Kokate**

Vice Chancellor  
K L E University, Belgaum  
(Rep. Indian Universities)

### **Lalji Singh**

Vice Chancellor, Banaras  
Hindu University, Varanasi  
(Rep. Indian Universities)

### **Harish Padh**

Vice Chancellor, Sardar Patel  
University, Vallabh Vidhyanagar  
(Rep. Indian Universities)

### **Ratan N Tata**

Former Chairman, Tata  
Sons Ltd.,  
Mumbai (Nom. Council)

### **V S Ramamurthy**

Director, National Institute of  
Advanced Studies, Bangalore  
(Nom. Council)

### **Wg. Cdr. H R Parthasarathy**

President  
IISc Alumni Association  
(Rep. Assn. of Past Students)

### **P Balaram**

Director (Ex-officio)

### **All Professors of the Institute**

(Ex-officio)

### **All Members of the Council**

(Ex-officio)

### **N Mohan Das**

Registrar (Ex-officio Secretary)

During the year, the Court met once on 3<sup>rd</sup> March 2014



## 1.2 Council

The Council is the principal governing authority of the Institute and its membership includes the Nominees of the Court, Parliament, Government of India, Government of

Karnataka, Tata Trusts, Representatives of Indian Universities, University Grants Commission and Scientific bodies. The following are the members of the Council:

### **P Rama Rao**

Chairman of the Council  
Former Vice Chancellor  
University of Hyderabad,  
Hyderabad (Nom. GOI)

### **Ashok Thakur**

Secretary, MHRD,  
Dept. of Higher Education, GOI,  
New Delhi (Nom. GOI)

### **Amita Sharma**

Addl. Secretary, MHRD,  
Dept. of Higher Education, GOI,  
New Delhi (Nom. GOI)

### **Rajaneesh Goel**

Pr. Secretary to GOK, Higher Edu.  
Dept., Bangalore (Nom. GOK)

### **I S N Prasad**

Pr. Secretary to GOK  
Dept. of Finance,  
Bangalore (Nom. GOK)

### **A N Singh**

Managing Trustee  
Sir Dorabji Tata Trust,  
Mumbai (Nom. Tata Trusts)

### **J J Irani**

Director, Tata Sons Limited,  
Mumbai (Nom. Tata Trusts)

### **S K Joshi**

Former Director General, CSIR  
Gurgaon, (Rep. UGC)

### **Ashok S Ganguly**

Member of Parliament  
(Rajya Sabha), New Delhi  
(Rep. Parliament)

### **S N Agarwal**

Chairman, Boruka Power  
Corporation Ltd., Bangalore  
(Nom. Court)

### **V S Ramamurthy**

Director, National Institute of  
Advanced Studies, Bangalore  
(Nom. Court)

### **Lalji Singh**

Vice Chancellor, Banaras Hindu  
University, Varanasi  
(Rep. Indian Universities)

### **Harish Padh**

Vice Chancellor, Sardar Patel  
University, Vallabh Vidyanagar  
(Rep. Indian Universities)

### **S S Mantha**

Chairman, AICTE, New Delhi  
(Rep. AICTE)

### **P S Ahuja**

Director General, CSIR, New Delhi  
(Rep. CSIR)

### **P Balaram**

Director (Ex-officio)

### **M R N Murthy (Ex-officio)**

Dean, Science Faculty

### **B N Raghunandan (Ex-officio)**

Dean, Engineering Faculty

### **N Mohan Das**

Registrar (Ex-officio Secretary)

The Council met quarterly on 28<sup>th</sup> Jun 2013, 21<sup>st</sup> Sep 2013, 28<sup>th</sup> Dec 2013 and 29<sup>th</sup> Mar 2014.

### Select Decisions:

- The Council congratulated Prof. C N R Rao on the conferment of "Bharat Ratna"
- Institution of CPRI Chair in the Department of Electrical Engineering
- Institution of Mrs Dharmambal and Mr B Venkatraman Memorial Travel Award for the student of the Department of Electrical Engineering
- Institution of Nikhil Memorial Award for the best M Tech student in Centre for Atmospheric and Oceanic Sciences
- Institution of Sir C V Raman Visiting Professorship in the area of spectroscopy
- Introduction of MACP Scheme at the Institute for Group B,C,D and A (Non-Teaching staff)
- Institution of Prof A Srikrishna Memorial Lecture Award in the Department of Organic Chemistry
- Institution of Prof Ramakrishna Rao Chair Professor to be conferred to a faculty in the Centre for Nanoscience and Engineering
- Institution of Prof. Ramakrishna Rao Visiting Chair Professor in the Centre for Nanoscience and Engineering





### 1.3 Finance Committee

The following are the members of the Finance Committee:

**P Rama Rao**

Former Vice Chancellor  
University of Hyderabad,  
Chairman of the Council (Ex-officio)

**H Honne Gowda**

Special Director (Technical),  
Dept. of Science & Technology  
Bangalore (Nom. GOK)

**V S Ramamurthy**

Director, National Institute of  
Advanced Studies, Bangalore  
(Nom. Council)

**Yogendra Tripathi**

Joint Secretary & Financial Adviser  
Dept. of Higher Education  
MHRD, GOI (Nom. GOI)

**R F Savaksha**

Secretary & Chief Accountant  
Sir Dorabji Tata Trust  
Mumbai (Nom. Tata Trusts)

**V Kurian**

Pr. Accountant General (A&E)  
Karnataka, Bangalore (Ex-officio)

**Amita Sharma**

Addl. Secretary, MHRD,  
Dept. of Higher Education, GOI,  
New Delhi (Nom. GOI)

**H D Malesra**

Secretary & Chief Accountant  
Sir Ratan Tata Trust  
Mumbai (Nom. Tata Trusts)

**P Balaram**

Director (Ex-officio)

**N Mohan Das**

Registrar (Ex-officio Secretary)

The Finance Committee met quarterly on 28<sup>th</sup> Jun 2013, 20<sup>th</sup> Sep 2013, 27<sup>th</sup> Dec 2013 and 28<sup>th</sup> Mar 2014

### 1.4 Senate

The Senate is one of the authorities of the Institute that consists of the Director as the Chairman, all Professors and Associate Professors, one elected representative (Assistant Professor) from each of the Faculties, the Librarian, and the Registrar (Secretary). The Senate meets at least once a term.

This principal academic body functions to (a) plan and coordinate the research activities of the Institute; (b) regulate and organize courses of instruction and study, admission of students, examinations, etc; (c) formulate conditions for the award of Degrees of the Institute; and (d) recommend names to the Council for the award of Degrees.

During the year, the Senate met on 22<sup>nd</sup> May 2013, 3<sup>rd</sup> Sep 2013, 18<sup>th</sup> Nov 2013 and 13<sup>th</sup> Feb 2014.

#### Select Decisions:

- SAP is mandatory for all PhD students and optional for M.Sc. (Engg.) students admitted for the Academic years 2011 & onwards.
- The committee on Joint Supervision with universities and Institutions be stated that the maximum period a student can be away be limited to one and half years.
- This CGPA will be computed using a basket rule. According to this rule, the best grades of all the courses that make up the minimum RTP credit requirement will be considered for computation.

The Senate recommended the award of various degrees as follows:

PhD: 234; M Sc.(Engg): 67; MS: 9;  
ME/M Tech: 318; M Des: 14; M Mgt: 18

### 1.5 Faculties

The faculties act as advisory bodies to the Senate and assist in the discharge of its duties. Each Faculty consists of the respective Dean as Chairman, all Professors, Associate Professors, Chief Research Scientists, Principal Research Scientists, Assistant Professors and Senior Scientific Officers as members and the Assistant Registrar as the Secretary. The Science Faculty met on 22<sup>nd</sup> Apr 2013 and 24<sup>th</sup> Oct 2013.

The Engineering Faculty met on 23<sup>rd</sup> Apr 2013 and 25<sup>th</sup> Oct 2013 during the year.

The Joint meetings of Faculty members were held on 23<sup>rd</sup> Aug 2013 and 8<sup>th</sup> Jan 2014. The Director chaired the Joint meetings.





## 2. Staff

### \* 2.1 Listing

#### Administration

Director  
P Balaram

Associate Director  
N Balakrishnan

#### Deans

Science : M R N Murthy  
Engineering : B N Raghunandan  
UG Programme : Chandan Dasgupta

#### Registrar

N Mohan Das PhD (Anna)

#### Deputy Registrar

K Panneer Selvam MA (Madras) LLB  
(Bangalore) PhD (Gandhigram Rural)  
Uma Chandran MA LLB (Bangalore)  
PGDPM (NIPM), GDMM (IIMM)

#### Assistant Registrar

Aparna Kandi BE (Gulbarga)  
V Nagaraja MA (Mysore)  
M J Nandeesh MSc (Mysore)  
PGDMM (IIMM)

#### Section Officer (Public Relations)

N Krishna Murthy MA (Mysore)

#### Sr. Security Officer

M R Chandrasekhar BSc (Mysore),  
LLB (Bangalore)

#### Sr. Hindi Officer

V Thilagam PhD (Bangalore)

#### Sr. Sports Officer

C P Poonacha BA (Mysore) MPEd  
(Karnataka)

#### Financial Controller

Indumati Srinivasan MA (JNU)  
MPhil (JNU) PGDPPM (IIMB)

#### Deputy Financial Controller

M Krishna Murthy MCom MBA  
(Bangalore), PGDPM & IR (Bangalore)  
PhD (Bangalore)  
P Manivannan MA (Madras)

#### Internal Auditor

P Somasekhar  
BE (Bangalore)

#### Officer-In-Charge (Health Centre)

C Sathish Rao

#### Medical Officer

R Nirmala MBBS (Madras)  
C Sathish Rao MBBS (Mysore)  
L Sharada MBBS, DGO (CMC, Vellore)

#### Authorized Medical Officer

G R Nagabhushana MBBS (Mysore)  
PGD M&CH (IGNOU)

#### Consultant

##### Dentist

P Beena BDS (Mysore)

##### Dermatologist

A L Shamprasad MBBS (Bangalore)  
MD (Bangalore)

##### ENT

Sanjay B Patil MBBS (Karnataka)  
MS (Karnataka)

##### Gynaecologist

Manonmani MBBS (Bangalore)  
MD (RGUHS, Bangalore)

##### Ophthalmologist

Malavika Krishnaswamy MBBS  
(Bangalore) MS (Bangalore)

##### Physician

S S Kumar MBBS, MD (Madras)

##### Psychiatrist

VAP Ghorpade MBBS, MD (Nimhans)

##### Radiologist

M N Srinivasan MBBS (Mysore) DMRD  
(Davangere) DNB (Bangalore)

##### Physiotherapist

V Yogesh BSc, BPT (Mangalore)

#### Project Engineer-cum-Estate Officer

M D Satyanarayana BE (Mysore)

#### Assistant Executive Engineer

G Lohithesh Kumar BE (Kuvempu)  
M Tech (Visvesvaraya)

#### Technical Officer

G Radhaswamy BE (Elec) (Mysore)  
B Sridhar MSc (Hort) (UAS, Bangalore)

#### Gymkhana

##### Hon. President

R V Ravikrishna PhD (Purdue)

#### Hostels

##### Chairman – Council of Wardens

L Umanand PhD (IISc)

##### Wardens

Abha Misra PhD (IIT-B)  
Aveek Bid PhD (IISc)  
Dipshikha Chakravorthy PhD (Pune)  
Ganesh Nagaraju PhD (IISc)  
M Shekar PhD (IISc)  
P Thilagar PhD (IIT-K)

##### Advisor (Students Affairs)

Anjali A Karande PhD (Bombay)

##### Students Counsellors

Anjula Gurtoo PhD (Ahmedabad)  
J M Chandra Kishen PhD (Colorado)  
P K Das PhD (Columbia)  
Gopalan Jagadeesh PhD (IISc)

##### Guest House (In-charge)

M Krishna Murthy MCom MBA  
(Bangalore), PGDPM & IR (Bangalore)

\*as on 31. 3. 2014



## Division of Biological Sciences

Chairman : D Narasimha Rao

### Biochemistry

#### Chairperson

H S Savithri

#### Professor

Anjali A Karande PhD (Bombay)  
Dibankar Nandi PhD (Calif, Berkeley)  
C Jayabaskaran PhD (IISc)  
K Muniyappa PhD (IISc)  
D Narasimha Rao PhD (IISc)  
Ram Rajasekharan PhD (IISc)  
P N Rangarajan PhD (IISc)  
H S Savithri PhD (IISc)  
Utpal Tatu PhD (IISc)

#### Associate Professor

Nagasuma R Chandra PhD (Bristol)  
R Manjunath PhD (IISc)  
Patrick D'Silva PhD (IIT, Bombay)  
Sathees C Raghavan PhD (BHU)  
Shikha Laloraya PhD (UW Madison)

#### Assistant Professor

Ganesh Nagaraju PhD (IISc)  
Purusharth Rajyaguru PhD (JNU)

#### Senior Scientific Officer

P G Vatsala PhD (IISc)

### Microbiology and Cell Biology

#### Chairman

Umesh Varshney

#### Professor

Balaji N Kithiganahali PhD (IISc)  
C Durga Rao PhD (IISc)  
Kumaravel Somasundaram PhD (MKU)  
V Nagaraja PhD (IISc)  
Saumitra Das PhD (Calcutta)  
Umesh Varshney PhD (Calgary)  
Usha Vijayraghavan PhD (Caltech)  
S Vijaya PhD (IISc)

#### Associate Professor

P Ajit Kumar PhD (IISc)  
Dipshikha Chakravorthy PhD (Pune)

#### Assistant Professor

Amit Singh PhD (Delhi)  
Nagalingam Ravi Sundaresan PhD  
(Indian Veterinary Research Institute)  
Saibal Chatterjee PhD (IICB)  
Subba Rao Gangi Setty PhD (JNU)  
Utpal Nath PhD (NCBS)

#### Senior Scientific Officer

Shantinath S Indi PhD (Exeter, UK)

#### Scientific Officer

William Rasican Surin PhD (JNU)

#### Technical Officer

C Rajanna MSc (Bangalore)  
Ramappa K Talawar MSc (Karnataka)

### Molecular Reproduction, Development and Genetics

#### Chairman

P Kondaiah

#### Professor

Arun Kumar PhD (BHU)  
P Kondaiah PhD (Osmania)  
S Mahadevan PhD (Tufts)  
R Medhamurthy PhD (Saskatchewan)  
Rajan R Dighe PhD (IISc)  
Sandhya S Visweswaraiah PhD (IISc)  
P B Seshagiri PhD (IISc)

#### Associate Professor

Annapoorni Rangarajan PhD (NCBS)  
Upendra Nongthomba PhD (Mysore)

#### Assistant Professor

Deepak Kumar Saini PhD (AIIMS)  
Varsha Singh PhD (IISc)

### Molecular Biophysics

#### Chairman

Dipankar Chatterji

#### Hon. Professor

A Surolia PhD (Madras)

#### Professor

P Balaram PhD (Carnegie Mellon)  
Dipankar Chatterji PhD (IISc)  
Manju Bansal PhD (IISc)  
M R N Murthy PhD (IISc)  
Raghavan Varadarajan PhD (Stanford)  
Siddhartha P Sarma PhD (Maryland)  
S K Sikdar Dr. Med. Sc (Kyushu, Japan)  
N Srinivasan PhD (IISc)  
K Suguna PhD (IISc)

#### Associate Professor

Balasubramanian Gopal PhD (IISc)

#### Assistant Professor

Jayanta Chatterjee PhD  
(Technical Univ. Munich)  
Rishikesh Narayanan PhD (IISc)

#### Technical Officer

S Raju MSc (Annamalai)

#### Scientific Assistant

Badarinarayanan AMIE  
M Govindaraja MSc (Annamalai)  
P Ramasamy MSc (Bharathidasan)

### Ecological Sciences

#### Chairman

Renee M Borges

#### Professor

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T Mathew Jacob PhD (Wisconsin)

S K Nandy PhD (IISc)

#### Associate Professor

Atanu Kumar Mohanty PhD (Polytech, NY)

Debnath Pal PhD (Jadavpur)

Sathish S Vadhiyar PhD (Tennessee)

K Sekar PhD (Madras)

Soumyendu Raha PhD (Minnesota)

#### Assistant Professor

Murugesan Venkatapathi PhD (Purdue)

Phaneendra Kumar Yalavarthy PhD

(Hanover, USA)

Sashikumaar Ganesan PhD

(Lottovon Guericke)

R Venkatesh Babu PhD (IISc)

Yogesh L Simmhan PhD (Indiana)

#### Chief Research Scientist

H Krishnamurthy ME (IISc)

#### Principal Research Scientist

R Bhakthavathsalam PhD (IISc)

Filbert Minj MTech (JNU)

J Lakshmi MTech (Andhra)

M R Muralidharan MTech (Mysore)

#### Scientific Officer

Yogendra Kumar Negi MTech (Delhi)

#### Technical Officer

K P Raghuraman MSc (Bharatidasan)

S S M Saquaf BE (Bangalore)

#### Scientific Assistant

T A Chandrappa MSc (Bangalore)

K H Gowranga MSc (Engg) (IISc)

Nalini Sreeshylan MSc (Bangalore)

### J R D Tata Memorial Library

#### Librarian-in-charge

N C Shivaprakash

#### Deputy Librarian

K S Chudamani MSc (Sheffield)

MLibSc (Mysore) PhD (Bangalore)

Puttabasavaiah BA, MLibSc (Mysore)

#### Assistant Librarian Gr.I

K Nirmala Devi BSc (Bangalore)

MLibSc (Annamalai)

#### Scientific Officer

Pitty Nagarjuna ME (Sathyabhama)

#### Technical Officer

K T Anuradha BSc (Mysore)

ADISc (ISI Bangalore)

Pushpa Srinivasan MSc (Bangalore)

S K Rout ADISc (DRTC) (ISI)

MLibSc (IGNOU)

B C Sandhya MLibSc (Mysore)

#### Scientific Assistant

Francis Jayakanth PhD (Bangalore)

V N Nagendra MA (Bangalore)

### Centre for Nano Science and Engineering (CeNSE)

#### Chairman

Rudra Pratap

#### Professor

Navakanta Bhat PhD (Stanford)

Rudra Pratap PhD (Cornell)

#### Associate Professor

Srinivasan Raghavan PhD (Penn State)

#### Assistant Professor

Akshay Naik PhD (Maryland)

Ambarish Ghosh PhD (Brown)

Manoj Varma PhD (Purdue)

Prosenjit Sen PhD (California)

Shankar Kumar Selvaraja PhD (Ghent)

### Centre for Scientific & Industrial Consultancy (CSIC)

#### Chairman

J M Chandra Kishen

#### Associate Chairman

N C Shivaprakash

### Centre for Continuing Education

#### Chairman

P Venkataram

### Centre for Sponsored Schemes and Projects

#### Advisor

R Mohan Das

### International Relations Cell

#### Chairman

G Rangarajan

### Intellectual Property Cell

#### Chairman

Jayant M Modek

### Archives and Publications Cell

#### Chairman

A G Menon

#### Co-ordinator

Sharat Ahuja

#### Technical Officer

Manu Rajan BE (BIT, Ranchi)

AISc (CSIR)

### Centre for Campus Management and Development

#### Officer-in-charge

B R Srinivasa Murthy

### Under Graduate Programme

#### Scientific Assistant

K Thulasi BLibSc (MKU)



## 2.2 Changes

### Induction

#### Professor

Tushar Kanti Chakraborty OC 1/2014

#### Associate Professor

Narendrakumar Ramanan CNSc 07/2013

#### Assistant Professor

Purusharth Rajyaguru BC 9/2013  
Nagalingam R Sundaresan MCB 1/2014  
Amit Singh MCB 1/2014  
Mrinmoy De OC 2/2014  
Govardhan P Reddy SSCU 4/2013  
Prabeer Barpanda MRC 11/2013  
Abhik N Choudhury Mat. Eng 11/2013  
Jayanta Chatterjee MBU 08/2013  
Arvind Ayyer MA 07/2013  
Soumya Das MA 07/2013  
Abhishek Banerjee MA 12/2013  
Anindya Das Phy 06/2013  
Yogesh L Simmhan SERC 11/2013  
Swetaprovo Chaudhuri AE 06/2013  
Sumanta Bagchi CES 05/2013

Narayan K Sundaram CIE 05/2013  
Deepak Kumaran Nair CNSc 10/2013  
Arnab Bhattacharyya CSA 07/2013  
Mayank Shrivastava ESE 09/2013  
Soma Biswas EE 10/2013  
Kunal Narayan Chaudhury EE 02/2014  
Shankar Kumar Selvaraja CeNSE 03/2014  
Saurabh Ray CSA 07/2013

#### Administration

P Somasekhar 09/13

#### Retirement / Voluntary Retirement / Resignation / Repatriation etc.

#### Professor

A Surolia MBU 07/2014  
Lawrence Jenkins EE 07/2014  
J Srinivasan CAOS 07/2014  
P C Pandey CIE 07/2014  
P R Mahapatra AE 07/2014  
S Kasturirengan CCT 07/2013

S A Shivashankar CeNSE 07/2013  
V Nanjundiah MRDG 07/2013

#### Associate Professor

Srinivasan G 05/2013

#### Assistant Professor

Manojit Pramanik CSA 12/2013  
Saurabh Ray CSA 12/2013

#### Principal Research Scientist

M Krishna Kumar ESE 07/2013  
R Krishna Murthy SERC 07/2013

#### Technical Officer

S Arumugam Pillai CE 07/2013  
A Gundu Rao SERC 07/2013

#### Administration

T S Vishwanath 03/2014  
S R Lakshminarasimhan 04/2013

## 2.3. Awards/Distinctions

Members of the Faculty and students have won numerous awards, both national and international, in recognition of their research and development work. Some are listed below:

#### Padmashri

Prof. A.K. Sood, PHY

#### Royal Society of Chemistry

Prof. G. Mugesh, IPC (FRCS)

#### Academy Fellowship

#### Indian National Science Academy

Prof. Sandhya S. Visweswariah, MRDG  
Prof. C. Durga Rao, MCB

#### Indian Academy of Science

Prof. B. Gopal, MBU  
Prof. B. Sundar Rajan, ECE  
Dr. Abha Misra, IAP  
Prof. B.R. Jagirdar, IPC

#### National Academy of Science

Dr. Sathees C. Raghavan, BC  
Prof. Jayant M Modak, CHE  
Prof. P.B. Seshagiri, MRDG  
Prof. B. Gopal, MBU  
Prof. Neelesh B. Mehta, ECE

#### Indian National Academy of Engineering

Prof. Joseph Mathew, AE  
Prof. Rudra Pratap, CNS  
Prof. P. Vijay Kumar, ECE

#### Other Fellowship

#### Fellows of TWAS

Prof. S.K. Satheesh, CAOS  
Prof. R. Sukumar, CES  
Prof. Anurag Kumar, ECE  
Prof. S. Bhattacharya, OC

#### J C Bose Fellowship

Prof. Rajan R Dighe, MRDG  
Prof. Sandhya S Visweswariah, MRDG

#### Institute of Electrical and Electronics Engineering

Prof. B. Sundar Rajan, ECE

#### Society of Power Engineers (India), dated 03/01/2013

Dr. Subba Reddy B, EE



## Awards

Prof. Umesh Varshney, MCB

Prof. Saumitra Das, MCB

**Ranbaxy Research Award**

Dr. Santosh Hemachandra, AE

**Best Paper Award, Turbo Expo 2012**

Prof. N. Balakrishnan, AE / SERC

**Prof. S.N. Mitra Memorial Award 2013,  
Indian National Academy of Engineering**

Dr. N. Ganesh, BC

**B.M. Birla Science Award**

Dr. Sathees C Raghavan, BC

**National Bioscience Award  
Bhatnagar Award**

Prof. H.S. Savithri, BC

**Marie Curie Mahila Vijnana Puraskara**

Prof. K. Muniyappa, BC

**Sir M. Visvesvaraya Award**

Prof. K. Muniyappa, BC

**Mysore University Golden Jubilee Award**

Prof. P.N. Rangarajan, BC

**P.S. Sarma Memorial Award**

Prof. Anindya Deb, CPDM,

**3<sup>rd</sup> National Award for Technology Innovation in Polymeric  
Products from the Min. of Chemicals & Fertilizers, Govt. of  
India**

Prof. Raghavendra Gadagkar, CES

**Sir M. Visvesvaraya Senior Scientist State Award 2011**

Prof. T.G. Sitharam, CIE

**Best Paper Award, The Indian Rock Conference (2011),  
JUIT Campus, Wagnaghat, Solan, Himachal Pradesh**

Prof. L. Sunil Chandran, CSA

**NASI-Scopus Young Scientist Award**

Prof. P. Vijay Kumar, ECE

**Best Paper Award, IEEE Transactions on Information Theory,  
Vol. 57, No. 8, August 2011.**

Dr. Manojit Pramanik, EE

**Young Scientist Research Award 2013,  
Dept. of Atomic Energy**

Dr. Muthuvel Arigovindan, EE

**SERB (DST) Young Scientist Award**

Dr. Subba Reddy B, EE

**NRDC, Societal Invention Award**

**Distinguished Alumnus Award, KLE Society's College of  
Engineering & Technology, Belgaum**

Prof. G. Narayanan, EE

**IETE Bimal Bose Award**

Prof. B.R. Jagirdar, IPC

**R.D Desai 80<sup>th</sup> Birthday Commemoration Award of the Indian  
Chemical Society**

Prof. B. Gopal, MBU

**CDRI Award (Life Sciences)**

Dr. Praveen Kumar, MTE

**Best paper award, IEEE Transactions on Components,  
Packaging and Manufacturing Technology (Journal) for the  
Year 2012**

Prof. T.A. Abinandanan, MTE

**Distinguished Educator Award, Indian Institute of Metals**

Dr. Santanu Mukherjee, OC

**NASI – Young Scientist Platinum Jubilee Award 2013**

Prof. Jayant Haritsa, SERC

**ACCS-CDAS Foundation Award 2013**

Dr. Phaneendra K Yalavarthy, SERC

**Indian National Academy of Engineering (INAE)  
Young Engineer Award – 2013**

Mr. R. Sathishkumar, SSCU

**Best Poster Presentation Award, Bragg Centennial  
Symposium (AsCA 2012 Conference), Adelaide, Australia.**

Prof. D.D. Sarma, SSCU

**H K Firodia Awards, Excellence in Science & Technology**

## Prizes / Medals

Prof. Vikram Jayaram, AE

**GD Birla Gold Medal, Indian Institute of Metals**

Prof. Debasish Roy, CIE

**ICCES Distinguished Achievement Medal**

Prof. E. Arunan, IPC

**A.V. Ramarao Foundation Prize, JNCASR**



Prof. A. Surolia, MBU  
**Dr. J.C. Ray Memorial Oration, IICB**

Prof. Raghavan Varadarajan, MBU  
**G.N. Ramachandran Gold Medal, CSIR**

Prof. Satish Patil, SSCU  
**MRSI Medal**

Prof. Satish Patil, SSCU  
**CRSI Bronze Medal**

### Chairmanship

Prof. Raghavendra Gadagkar, CCS  
**President, Indian National Science Academy, New Delhi 2014-16**

Prof. Raghavendra Gadagkar, CES  
**Chairman, Advisory Board, CSIR, India 2013-2016**

Prof. Dipankar Chatterji, MBU  
**President, Indian Academy of Sciences**

Prof. N. Jayaraman, OC  
**President, International Carbohydrate Organization (ICO), 2012**

### Membership

Prof. S.K. Satheesh, CAOS  
**Member, Sectional Committee to select INSA Fellows**  
**Member, Science Advisory Committee, Space Physics Laboratory, ISRO**  
**Member, Science Advisory Committee, NARL**  
**Member, Science Steering Group, Aerosol-Cloud-Precipitation-Climate interactions (ACPC) of International Geosphere Biosphere Program (Sweden)**

Prof. Raghavendra Gadagkar, CES  
**Member, CSIR, April 2013-March 2016**  
**Member, Board of Current Opinion in Insect Science, Elsevier (2013-2016)**

Dr. P. Anbazhagan, CIE  
**Member, American Society of Civil Engineers (ASCE)**  
**Life Member of Transportation Research Group of India**

Mr. P. Raghuveer Rao, CIE  
**Member, Panel on Urban Water Supply, Bureau of Indian Standards**

Prof. Jyant Kumar, CIE  
**Editorial Board Member, Geotechnique Letters, Institution of Civil Engineers**

Prof. Madhavi Latha, CIE  
**Nominated and selected as a Member of the Editorial Board, Geotextiles and Geomembranes, Elsevier**

Dr. Chandra Sekhar Seelamantula, EE  
**Elevated to Senior Member, IEEE Signal Processing Society**

Prof. E.D. Jemmis, IPC  
**Chemistry – An Asian Joint International Advisory Board Member**

Prof. Manju Bansal, MBU  
**Member, CSIR Society 2013-2016**

Prof. Subodh Kumar, MTE  
**Member, International Committee of International Conference on Aluminium Alloys”**

Prof. Arnab Rai Choudhuri, PHY  
**Member, Steering Committee Division E (Sun & Heliosphere) of International Astronomical Union**

Prof. Gautam R Desiraju, SSCU  
**Invited to join the JACS Editorial Advisory Board**

Prof. S. Natarajan, SSCU  
**Invited to the International Advisory Board of Chemistry – An Asian Journal**

Prof. Gautam R Desiraju, SSCU  
**Invited by the Royal Society of Chemistry to join the editorial advisory boards of Chemical Communications and Chemical Sciences**

### Others

Prof. Sathees C Raghavan, BC  
**Editor, FEBS Journal**

Dr. P. Anbazhagan, CIE  
**Treasurer, American Society of Civil Engineers, India Section from June 6, 2013 to October 16, 2014**

Prof. S.K. Satheesh, CAOS  
**Adjunct Professor, IISER, Bhopal**  
**Associate Editor, Current Science (India)**

Dr. Aninda Sinha, CHEP  
**Simons Associate ICTP, Trieste Italy**  
**Associate Faculty, ICTS, TIFR**





Prof. Rohini M Godbole, CHEP  
**Staff Associate ICTP, Trieste Italy**  
**Honoris Causa from SNDT Women's University, Mumbai**

Dr. Ashish Verma, CIE  
**Delivered Prof. SVC Aiya Memorial and World Telecommunication and Information Society Day Lecture, Institute of Electronics and Telecommunication Engineers (IETE) Bangalore Chapter**

Prof. B. Sundar Rajan, ECE  
**Associate Editor, Coding Theory for IEEE Transactions on Information Theory**

Prof. Neelesh B Mehta, ECE  
**Associate Editor, IEEE Transactions on Communications**  
**Appointed to the IEEE Trans. on Wireless Communications (New Editorial Committee)**

Prof. P. Vijay Kumar, ECE  
**Delivered a Plenary Lecture at the 2014 IEEE International Symposium, Honolulu, Hawaii**  
**Best Paper Award – Optimal Exact-Regenerating Codes for Distributed Storage at the MSR and MBR Points via a Product-Matrix Construction, IEEE Transactions on Information Theory, Vol. 57, No. 8, August 2011.**

Prof. Rajesh Sundaresan, ECE  
**Associate Editor, IEEE Transactions on Information Theory**

Dr. Chandra Sekhar Seelamantula, EE  
**Associate Editor, IEEE Signal Processing Letters**

Prof. E. Arunan, IPC  
**Associate Editor, Current Sciences**

Prof. S. Ramakrishnan, IPC  
**Associate Editor, Chemical Communications**

Prof. S. Umapathy, IPC  
**Editor, Journal "SPECTROCHIMICA ACTA"**  
**Hon. Professor, University of Nottingham, UK**

Prof. S. Vasudevan, IPC  
**Editorial Advisory Board, The Journal of Physical Chemistry**

Prof. A. Surolia, MBU  
**Doctor of Science (Hon.) Degree by Queens University, Belfast (UK)**  
**Elected to the Executive Council of IUBMB**

Prof. Raghavan Varadarajan, MBU  
**Secretary, Indian Academy of Sciences**

Dr. Suryasarathi Bose, MTE  
**Visiting Fellow, ICT (Institute of Chemical Technology), Mumbai.**

Prof. Gautam R. Desiraju, SSCU  
**Doctorate Honoris Causa by the Universidad Nacional de Cordoba, Argentina**  
**Virtual Special Issue in Crystal Growth and Design (American Chemical Society)**

Prof. Vijay Natarajan, CSA/ SERC  
**Humboldt Research Fellowship for Experienced Researchers**

### Students

### Fellowship

Rohith D. Vallam, CSA  
Swapnil Dhamal CSA  
P. Balamurugan, CSA  
**IBM PhD Fellowship**

Manisha Sinha, MBU  
Talha Bin Masood, CSA  
Kartik Nagar, CSA  
Jaya Prakash, SERC  
**Microsoft Research India PhD Fellowship**

Debarghya Ghoshdastidar, CSA  
Harikrishna Narasimhan, CSA  
**Google India PhD Fellowship**

Mr.Praveen Anand, BC  
**BMS Fellowship Award**

Prabuchandran K.J., CSA  
**TCS Ph.D Fellowship**

Chandra Bhushan Tripathi, OC  
**Bristol Myers Squibb Fellowship**

Abhijit Hazarika, SSCU  
**Malhotra Weikfield Foundation NanoScience Fellowship Award**

R. Sukumar, DCCC  
S.K. Satheesh, DCCC  
**Fellow, Third World Academy of Sciences, 2013**

Jaya Prakash, SERC  
**SPIE Optics and Photonics Education Scholarship**

Vijay Natarajan, SERC  
**Young Associate, Indian National Academy of Engineering**  
**Humboldt Research Fellowship for Experienced Researchers**



### Best Paper Award

Abhijit Kulkarni, EE

**39th Annual conference of the IEEE Industrial Electronics Society (IECON 2013) at Vienna, Austria**

Muhammed Shamveel T M, EE

**Sixth National Power Electronics Conference (NPEC-2013) held at IIT, Kanpur**

Ashish Kumar, EE

**7<sup>th</sup> in the Sixth National Power Electronics Conference 2013 (NPEC 2013), IIT, Kanpur**

K. Saichand, Akshay Kumrawat, EE

**4<sup>th</sup> in the Sixth National Power Electronics Conference (NPEC-2013) held at IIT, Kanpur**

Tukaram Moger, EE

**IEEE INDICON 2013, IIT, Bombay**

N Seetha CiE

**International Conference on Hydraulics, Water Resources, Coastal and Environmental Engineering (HYDRO 2013) at IITM**

Jagjeet Singh ME

**Sixth ISSS Conference on MEMS held in Pune, India**

G Sayantan, CiE

**Journal Indian Society of Hydraulics in 2013**

R. V. Ravikrishna ME

**XVIII National Conference on IC Engines and Combustion, Surat, India, December 2013**

Keshwani, S., CPDM

Lenau, T.A, CPDM

Ahmed-Kristensen, CPDM

S Chakrabarti, CPDM

**Reviewers Favourite' Award at ICED'13 Conference, Seoul, Korea, August 2013.**

Gokula Vijaykumar, CPDM

Annamalai Vasantha, CPDM

Srinivasan V, CPDM

Udo Lindemann, CPDM

**'Certificate of Merit' as one of the most distinguished papers in 4th International Conference on Research into Design (ICoRD13), IIT, Madras, India**

Prabir Sarkar, CPDM

B. Leelavathamma, CPDM

B.S. Nataraju, CPDM

**The paper: A Functional Representation for Aiding Biomimetic and Artificial Inspiration of New Ideas, AI EDAM, Volume 19, Issue 02, May 2005, pp 113-132, has been one of the top ten most cited articles for this journal**

Ansuman Biswas, SERC

**Best paper presentation award, 42<sup>nd</sup> National Seminar on Crystallography, New Delhi**

### Best Poster Award

Ms. Nishana, BC

**SBC(I) Best Poster Award**

Ms. R. Deepthi, BC

**AICB Best Poster Award**

Ms. Monica Pandey, BC

**IACR Best Poster Award, Feb. 2013,**

Soma Ghosh, MBU

**Best Poster award, International Conference on Biomolecular Simulations and Dynamics, 2013, IIT, Madras**

Anasuya Dighe, MBU

**Best Poster award, Recent Advances in Computational Drug Discovery (RACDD), IISc**

Mr Santanu Mondal, IPC

**Best Poster Award, 5th Annual Meeting of the Proteomics Society of India on "Medical Proteomics"**

Mr Debasish Bhowmick, IPC

**Best Poster award, Glutathione Peroxidase Activity of Amine-based Diaryl Diselenides", 12th International Conference on the Chemistry of Selenium and Tellurium (ICCST-12), Cardiff University, UK**

Mr Amit A. Vernekar, IPC

**Best Poster award, Indo-US Symposium on "Molecular Materials" at IISc, Bangalore**

**Best Poster award, , First National Conference on Mapping the "Materials Genome" at Shiv Nadar University, Dadri, Best Poster award, 15th CRSI National Symposium in Chemistry (NSC-15) at Banaras Hindu University, Varanasi**

Deya Das, MRC

**Best Poster Award in IUMRS-ICA 2013**

Gaurav Govardhan, CAOS

**Best Poster (Consolation) Prize for "Simulation of Aerosol"**





Ananya Rao, CAOS

**Best Poster Award, Fourth National Research Conference on Climate Change held at IIT, Madras**

G.R.Krishna, MT

**Best Poster Prize IUMRS ICA 2014 GaN Session**

Sreeranjini R, MT

**Best Poster Award, XXI International Conference on Bioencapsulation, Berlin, Germany**

#### Best Researchers / Thesis Award

Ms.Mrinal Srivastava, BC

**2<sup>nd</sup> Best Young Scientist Award, Biosangam 2013 A, Allahabad**

Abantika Ganguli, MBU

**Best Thesis Eli Lilly Award**

Moitrayee Bhattacharyya, MBU

**Outstanding Thesis Award by Eli Lilly Company, Asia**

Dr. Oruganty Krishnadev, MBU

**Second prize in Eli Lilly Asia award for outstanding thesis**

Ramasuri Narayanam (CSA)

**Computer Society of India's Best Ph.D Thesis Award 2012**

Mr. Saurav Pramanik, EE

**Young Researcher Award, ISH-2013, Seoul, Korea for the oral paper he presented**

Mr. Debasish Manna, IPC

Dr. Subhendu Roy, IPC

Ms. Neha Arora, IPC

**Participate in the 63rd Lindau Nobel Laureate Meeting, Lindau, Germany**

Dr. Amit. B. Pawar, OC

**Eli-Lilly Best Thesis Award 1<sup>st</sup> Prize, 2013**

Atanu Samanta, MRC

**Best young researcher award, 7<sup>th</sup> ACCMS Meeting (Thailand) 2013**

Dr. Md. Zafir alam, MT

**Prof. K P Abraham Medal for the best PhD Thesis Award**

B. Vasanthakumar, MT

**Prof R M Mallya Best PhD Thesis Award**

Ms. Upasana Das, PHY

**Best Thesis Award**

#### Travel Award

Mr.Gajendradhar Dwivedi, BC

**Carl-Storm International Diversity Program Travel Fellowship from the Organisers of Gordon Research Conference to attend the GRC on Nucleic Acids, Maine**

Ms Geetha Melangath, MCB

**Awarded a Travel grant for oral presentation at "26<sup>th</sup> International Conference on Yeast Genetics and Molecular Biology", Goethe University, Frankfurt, Germany**

Sufyan Ashhad (MBU)

**Travel grant from Initiative of Neuroinformatics/ Computational Neuroscience Education (INCNE) for attending the Neural Systems and Behavior course held at the Marine Biological Laboratory, Woods Hole, Massachusetts, USA**

Prashant Vangla, CiE

Renjitha Mary Varghese, CiE

**ISSMGE Foundation award to attend International Conference GeoCongress 2014**

#### Award / Medals

Mr.Deepesh Nagaraj, BC

**Perumal Award, 2013**

Mr. Kumar Somyajit, BC

**Ranbaxy Science Foundation Research Scholar Award**

Mr.Bhagawat Chandrasekar, BC

**Best oral presentation certificate during DBT-JRF meeting, Mumbai**

**Best Oral Presentation Award, NSCB, Hassan**

Thyageswar Chandran, MBU

**Best Oral Presentation Award, 42<sup>nd</sup> National Seminar on Crystallography (NSC42)**

N.N.R. Ranga Suri, CSA

**DRDO Young Scientist Award 2012**

Harikrishna Narasimhan (CSA)

**First Prize, Shell India Computational Talent Prize 2013**

Dilip M Thomas (CSA)

**Honorable Mention, Shell India Computational Talent Prize 2013**

Mohammad H. Hedayati, (EE)

**Iranian Golden student in India award by Govt. of Iran**

Dr. Dibyendu Mallick, (IPC)

**First prize, Eli Lilly Asia Outstanding Thesis Award 2013**





Mr. Sachin Choudhary (NMR)  
**CBMR-NMRS Gold Medal, 19th Conference of the National Magnetic Resonance Society, Mumbai**

Govindasamy Bala, DCCC  
**Norbert Gerbier-MUMM International Award**

P. Mujumdar (DCCC)  
**Von Humboldt Award, European Geophysical Union, 2013**

Ms. Abitha, CST  
**Dupont innovation prize for "Algiculture" under students innovative projects**

Srikanth Ravipati (CH)  
**Current Trends in Theoretical Chemistry prize, BARC**

Srikanth Ravipati (CH)  
**Shell India Computational Talent Prize (SICTP)-2013**

Santosh D. B. Bhargav (ME)  
**Third Prize, ASME International Design Engineering Technical Conferences, Portland, OR, USA**

Pramod Kumar (ME)  
**Academics Category of Graphical System Design Achievement Awards 2013 by National Instruments**  
**Development of a NI-PXIe controlled Solar/Waste Heat driven Adsorption Desalination and Cooling (ADC) System**

Vanessa Mary Rachel Andrade (CEaS)  
**Offered Post-doctoral Fellow at the Earthquake Research Institute of Tokyo.**

Tania Guha, CEaS  
**Offered Post-doctoral Fellow at Research Centre for Environmental Changes, Academia Sinica, Taiwan**

Mr. Lokesh Hebbani, CISTUP  
**Appointed as Advisor/Consultant to Develop Road Safety Action Plan for the State of Bihar by WORLD BANK**

Kalyanram A, SERC  
**Journal of Optical Society of America (JOSA) Publication Award**

Ashwini N Mallya, MT  
**Best student prize for the paper "Selectivity of organic nanocomposite sensor for detection of aldehydes"**



## 3. Students

### 3.1 Admissions and On Roll

**D**uring the year, 793 students (328 for research, 37 for Integrated PhD, 311 for course programmes and 117 under graduate programme) joined the Institute taking the number "On Roll" to 3398 (2148 students in research, 254 in Int. PhD, 685 in post graduate and 311 in under graduate course programme).

### 3.2 SC/ST Students

38 students belonging to SC/ST in research, 54 in the course programme and 26 in the under graduate programme joined the Institute in the current year and, in all 216 research students, 32 Int. PhD and 139 course students, 64 under graduate students were "On Roll" during the year.

#### Admissions:

**Research:** Out of 1484 applicants, 776 were called for the entrance test. A total of 656 applicants, including all those who qualified through the entrance test, GATE, UGC-CSIR NET, were called for an interview; 40 were offered admission and **36** joined.

**Integrated PhD:** Since 2013, admission is through JAM (Joint Admission Test for M.Sc), 61 of them were short-listed and called for an interview, 4 were offered admission and **2** joined.

#### Courses:

**ME/ M Tech/ M Mgt/ M Des:** Out of 974 applicants, 137 were offered admission and **54** joined.

**B S:** Out of 1111 applicants, 178 were offered admission and **26** joined.

### 3.3 Scholarships / Fellowships

The students participated in research and course programmes are granted scholarships at the Institute ranging from ₹ 8,000/- to ₹ 20,000/- depending on the programme. Those students who are granted fellowships by agencies like UGC/CSIR and other bodies are not eligible for scholarships awarded by the Institute.

### 3.4 Students Assistance Programme

Needy students have offered their services in selected Institute activities and have secured additional finances under the "earn-while-you-learn" scheme.

| Areas of Assistance         | Students | Amount        |
|-----------------------------|----------|---------------|
| Identified Projects/Schemes | 4        | ₹ 56,000/-    |
| Dept. Over head             | 1        | ₹ 12,000/-    |
| Scholarship                 | 86       | ₹ 10,31,000/- |

**Students Aid Fund:** This is a co-operative scheme (every student subscribes ₹ 100/- per annum) to assist needy and deserving students through loans, to meet tuition fees, study tour expenses, cost of books, thesis expenses and maintenance at the Institute. During the period 2013-14, 231 students availed themselves of the loan to the extent of ₹ 57,70,000/-.

### 3.5 Students Council

The Students Council (an elected body from among the student community) provides an effective channel of communication between the Director, faculty and students. Through dialogue and discussion on various student matters, problems relating to the students are resolved by initiating appropriate action. The Students' Council is also responsible for certain welfare measures initiated by the student community. The publication of 'SCAMPUS', a campus magazine and News Letter of the students is one of its main activities.

### 3.6 Hostels

The Students' Hostel consists of 10 Gents and 4 ladies Hostel Blocks. Students, Research Associates and Short Term Workers totaling 2,685 (2,013 Gents and 672 Ladies) are provided accommodation in the Hostel Blocks.

Four Dining halls (Two Vegetarian and Two Composite) provide a variety of food items in clean and hygienic conditions for all the boarders.

The Hostel and Dining halls are managed by the Council of Wardens headed by the Chairman and team.

### 3.7 Award of Medals

The Institute awards medals every year in recognition of the best thesis (both at the Doctoral and Master's levels) in various fields and for excellence in course programmes and projects. All the awards carry a cash prize of ₹ 2000 – ₹ 3000.

The following tables give the names of the medal and the recipient for the current year:

| Sl. No.   | Name of Medal   | Awardee                     | Department/Centre |
|---|---|-----------------------------|-------------------|
| <b>For the Best PhD Thesis</b>                        |   |                             |                   |
| 1.  | Prof. Chintakindi V Joga Rao Medal                      | Dr. S. Varun Kumar          | AE                |
| 2.  | Prof. B.K. Subba Rao Medal                              | Dr. Pinaki Biswas           | ME                |
| 3.  | Prof. K.P. Abraham Medal                                | Dr. Md. Zafir Alam          | MT                |
| 4.  | The Alumni Medal  | Dr. Suparna Bhattacharya    | CS                |
| 5.  | The Seshagiri Kaikini Medal                             | Dr. K. Pavan Srinath        | EC                |
| 6.  | Prof. D.J. Badkas Medal                                 | Dr. Soumitra Das            | EE                |
| 7.  | Prof. N.S. Govinda Rao Medal                            | Dr. Debarghya Chakraborty   | CE                |
| 8.  | Prof. Giri Memorial Medal                               | Dr. Nallani Vijay Kumar     | BC                |
| 9.  | Mrs. C.V. Hanumantha Rao Medal                          | Dr. Subhalaxmi Nambi        | MD                |
| 10.   | The M. Sreenivasaya Medal                               | Dr. Ghorpade Devram Sampath | MC                |
| 11.   | Prof. B.H. Iyer Medal                                   | Dr. Sanchari Bhattacharyya  | MB                |
| 12.   | Dr. J.C. Ghosh Medal                                    | Dr. Ashok Zachariah Samuel  | IP                |
| 13.   | Prof. S. Soundarajan Medal                              | Dr. S. Shanmugaraju         | IP                |
| 14.   | The Guha Research Medal                                 | Dr. Santosh Kumar Misra     | OC                |
| 15.   | The Toulouse Medal                                      | Dr. Mantu Santra            | SS                |
| 16.   | Prof. Anil Kumar Memorial Medal                         | Dr. Sunil Kumar             | PH                |
| 17.   | Kumari L.A. Meera Memorial Medal                        | Dr. Sentitemsu Imsong       | PH/HE             |
| 18.   | The Indian Economic Association Medal                   | Dr. S. Shyam                | MG                |
| <b>For the Best Integrated PhD Student (MS Level)</b> |   |                             |                   |
| 19.   | Dr. R.K. Maller Memorial Medal                          | Ms. Sneha Vishwanath        | Biological Sc.    |
| 20.   | Dr. A. Nagaraja Rao Medal                               | Ms. Dipanwita Chatterjee    | Chemical Sc.      |
| 21.   | Kumari L.A. Meera Memorial Medal                        | Mr. Kallol Sen              | Physical Sc.      |
| <b>For the Best PhD/MSc (Engg.) Student</b>           |   |                             |                   |
| 22.   | Prof. N.R. Kuloor Memorial Medal                        | Dr. Parag Deshpande         | CH                |
| 23.   | The Sudborough Medal                                    | Dr. Ritupan Sarmah          | MR                |
| 24.   | Dr. Srinivasa Rao Krishnamurthy Medal                   | Dr. Ambily Mathew           | IN                |
| 25.   | Amulya and Vimala Reddy Medal                           | Dr. Deepak P.               | ST                |
| 26.   | Tag Corporation Medal                                   | Dr. J. Srivatsava           | ED                |
| 27.   | MAA Communication Medal                                 | Dr. Ravi Kumar Gupta        | PD                |
| <b>For the Best MSc (Engg.) Thesis</b>                |   |                             |                   |
| 28.   | NASAS Medal   | Mr. K. Sandilya             | AE                |
| 29.   | ME Department Alumni Medal                              | Mr. V. Sudheer Kumar Reddy  | ME                |
| 30.   | Dr. M.N.S. Swamy Medal                                  | Mr. Prabhanjan V. Ananth    | CS                |
| 31.   | Prof. F.M. Mowdawala Medal                              | Mr. K.S. Jithin             | EC                |
| 32.   | Prof. K.N. Krishnaswamy Medal                           | Ms. Pratheebea S.           | MG                |
| 33.   | Subramanian Rajalakshmi Medal                           | Mr. A. Kalyan Ram           | SE                |
| <b>For the Best ME/MTech/MDes/MMgt Student</b>        |   |                             |                   |
| 34.   | Mrs. Sabita Chaudhuri Memorial Medal                    | Mr. Ankur Nagpal            | AE                |
| 35.   | Prof. N.R. Kuloor Memorial Medal                        | Mr. Aditya Pareek           | CH                |
| 36.   | Prof. N.S. Lakshmana Rao Medal                          | Ms. Anjana Devanand         | CE                |
| 37.   | The Computer Society of India Medal (Bangalore Chapter) | Mr. Palash Dey              | CS                |
| 38.   | The K.K. Malik Medal                                    | Mr. R. Rajesh Kumar Prusty  | MT                |
| 39.   | The Alumni Medal  | Mr. G.V. Sagar              | EC/ED             |
| 40.   | Prof. I.S.N. Murthy Medal                               | Mr. Aswath V.S.             | EC/EE             |
| 41.   | The N.R. Khambhati Memorial Medal                       | Mr. Suraj Jain              | EE                |
| 42.   | The N.R. Khambhati Memorial Medal                       | Mr. Neeraj Agarwal          | EE                |
| 43.   | Prof. S.V.C. Aiya Medal                                 | Mr. Kiran Venugopal         | EC                |
| 44.   | Motorola Medal  | Mr. Nitesh Patel            | SE                |
| 45.   | The CEDT Design Medal                                   | Mr. Alap Sharadbhai Patel   | ED                |
| 46.   | H.R. Babu Seetharam Medal                               | Ms. Aswathi R. Nair         | IN                |
| 47.   | Prof. B.G. Raghavendra Memorial Medal                   | Mr. Varun Nathan            | MG                |



### 3.8 Placement

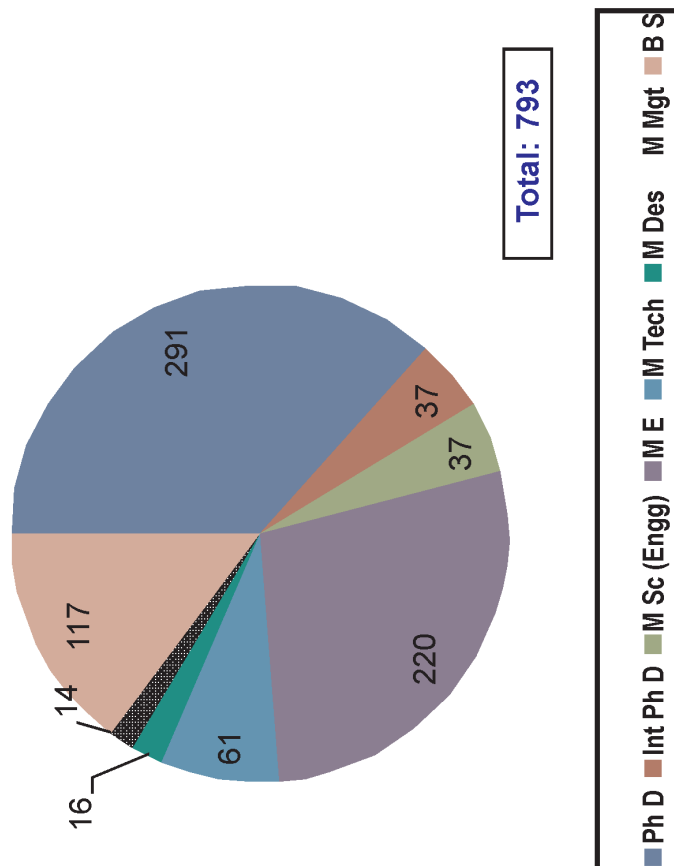
The Placement Section at the CSIC of the Institute continued to serve the purpose of bringing together the potential employers and outgoing students. The Section kept in touch with a large number of industries, National Laboratories, R&D Centres and Defence Establishments, and extended assistance in the entire recruitment process (pre-placement talks, written tests, group discussions and interviews).

During the year 2013-14, about 65 organizations conducted campus interviews. A few organizations invited students to their offices for this purpose. 300 students registered for placement, out of whom 300 participated and 185 received satisfactory placement offers. Some of the students obtained placements on their own and some decided to pursue higher studies. The placement exercise for the year 2013-14 was effective and satisfactory.



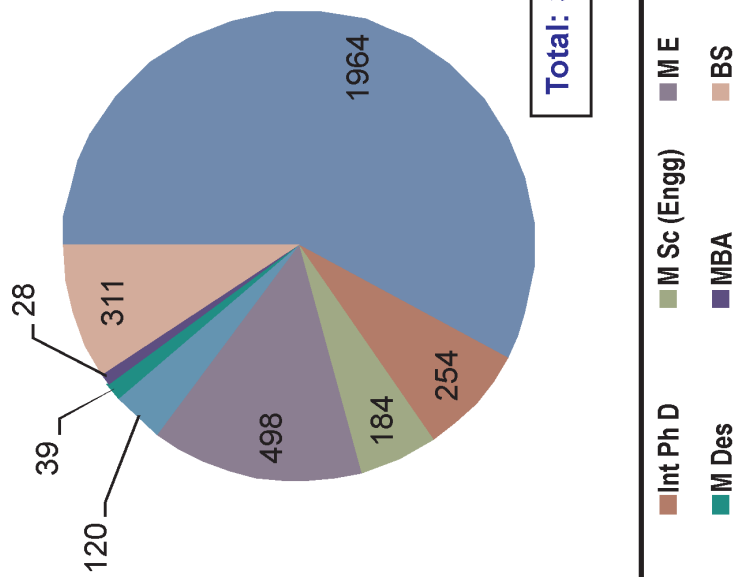
## Students 2013-14

### Admissions



Total: 793

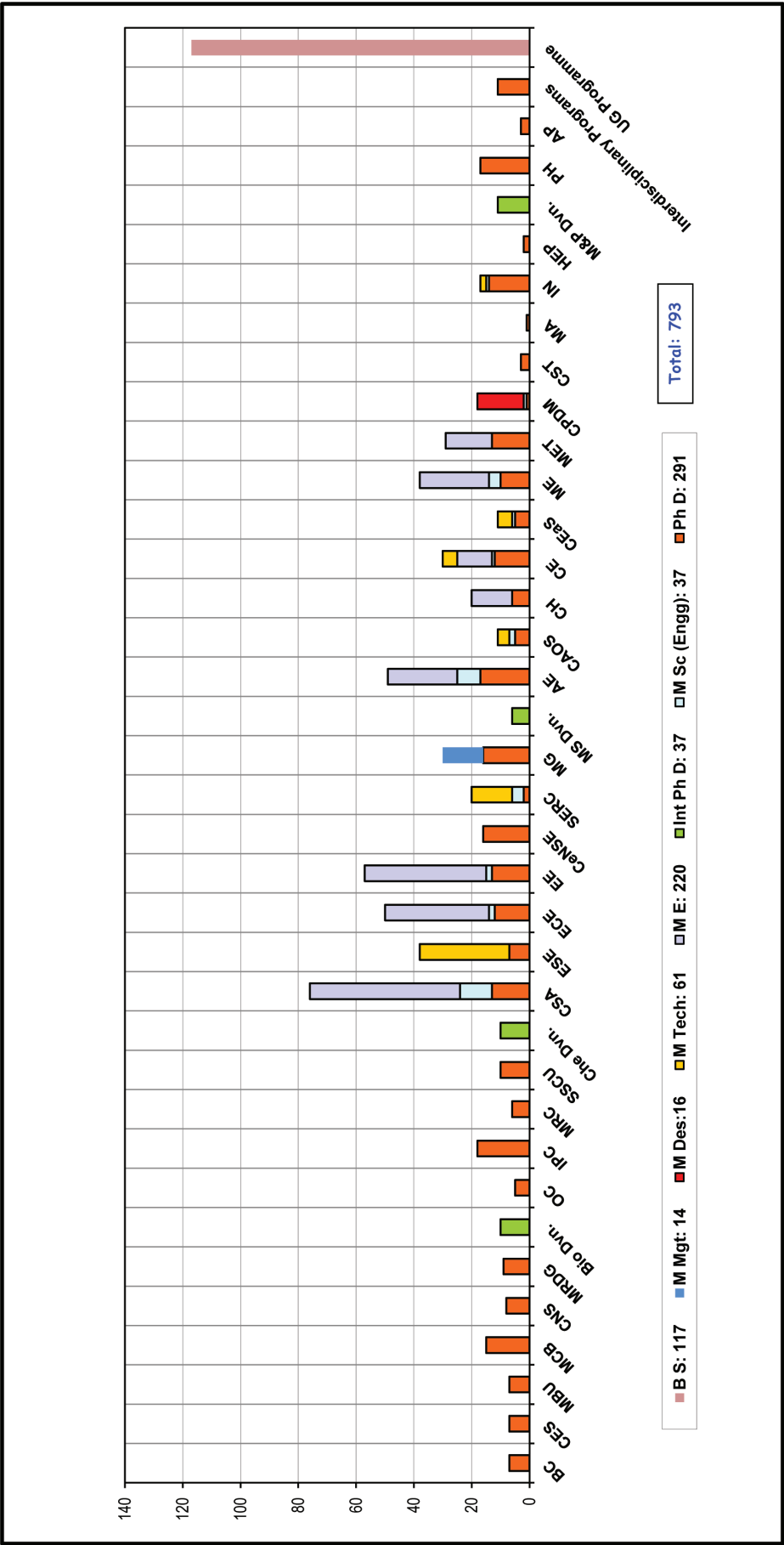
### On Roll



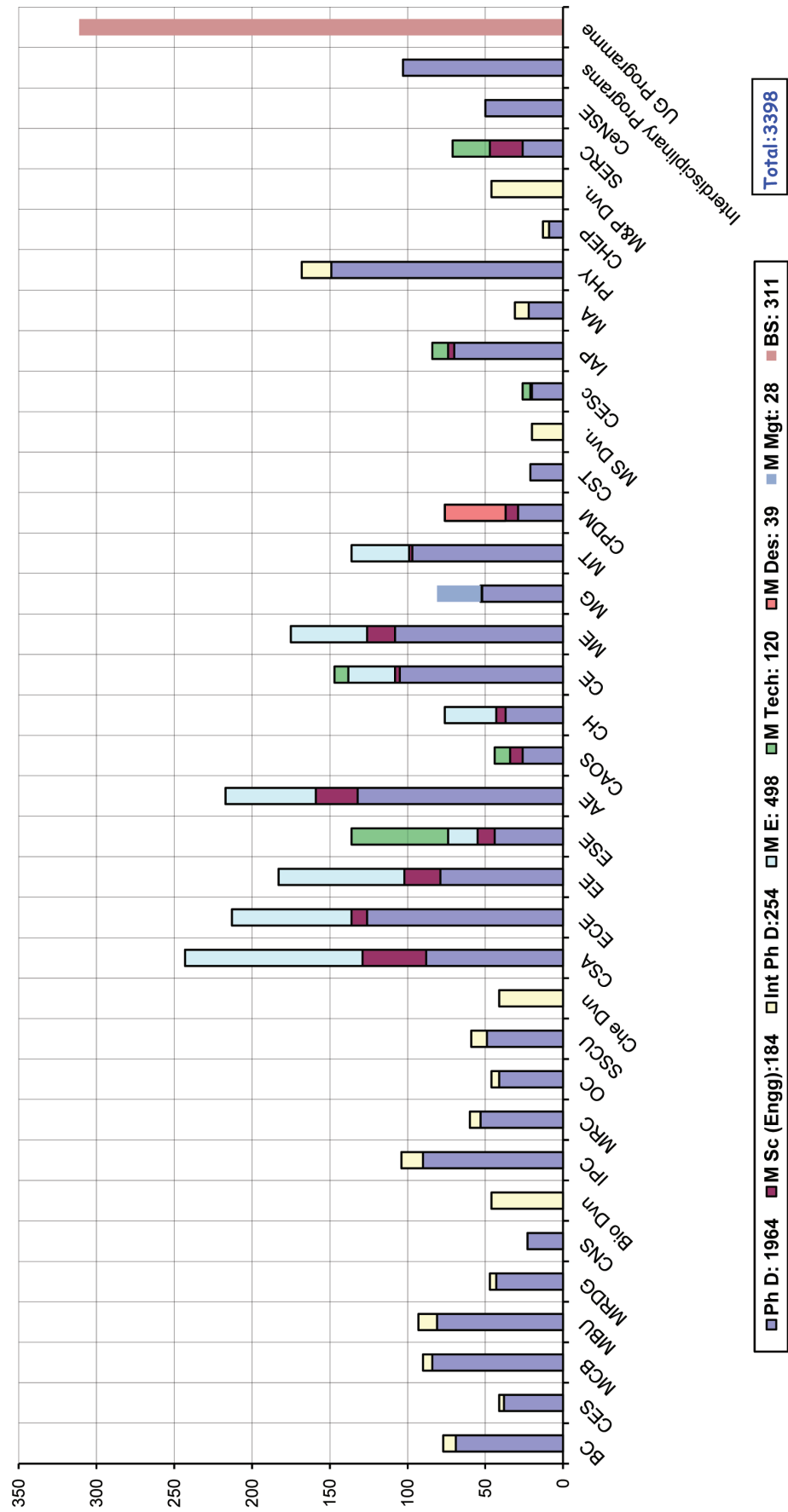
Total: 3398



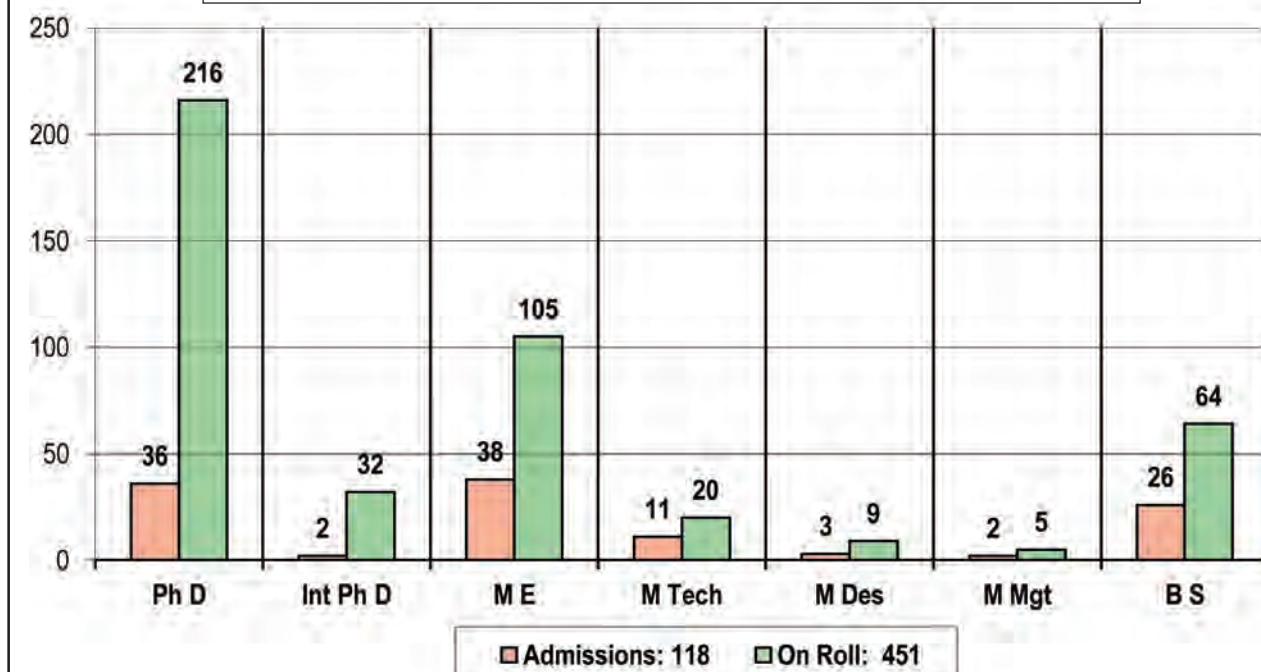
# Students Admissions 2013-14



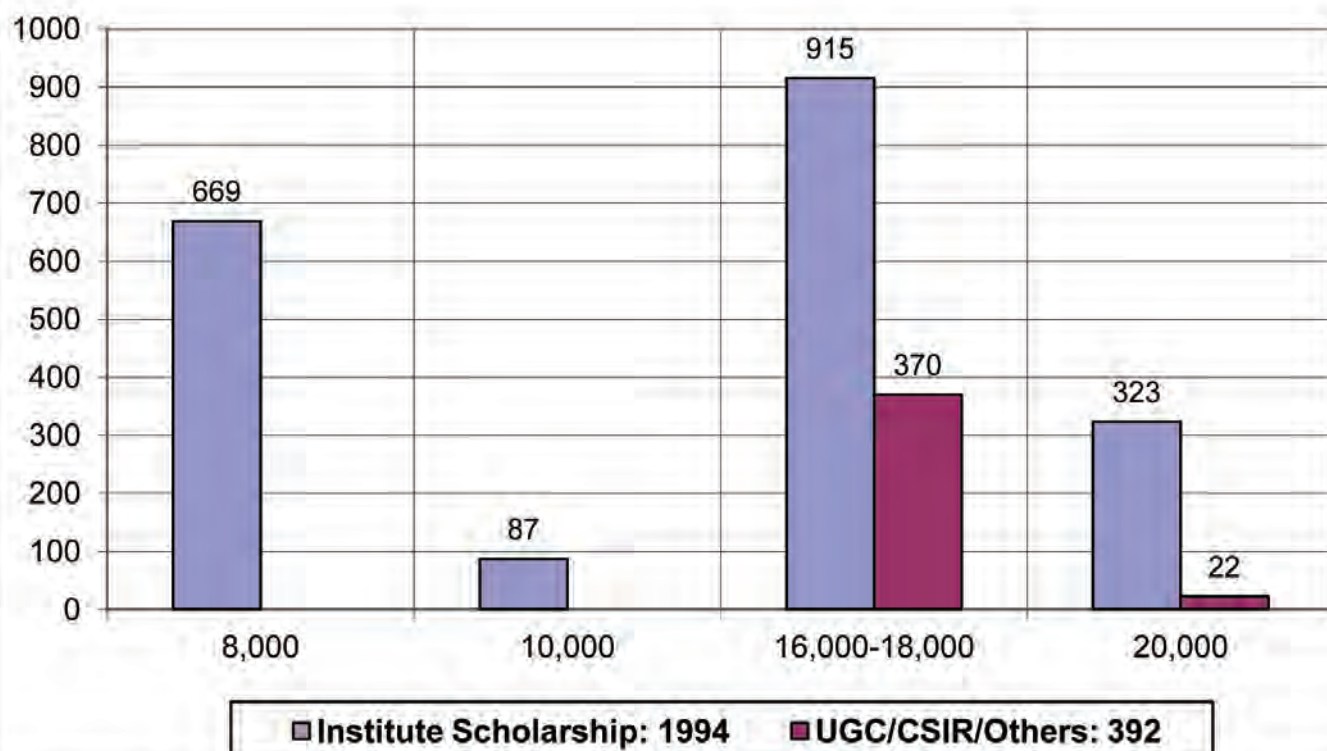
## Students On Roll 2013-14



### SC/ST Students Admissions and On Roll 2013-14



### Scholarships 2013-14





## 4. Research and Teaching

### 4.1 Research Highlights

#### 4.1.1 Division of Biological Sciences (Chairman: D. Narasimha Rao)

The Division consists of the following Departments/Centres/Units/Facilities:

- ❖ Biochemistry
- ❖ Microbiology and Cell Biology
- ❖ Molecular Reproduction, Development and Genetics
- ❖ Molecular Biophysics
- ❖ Ecological Sciences
- ❖ Neuro Sciences
- ❖ Centre for Infectious Disease Research
- ❖ Central Animal Facility

#### Biochemistry

**Staff: Academic: 15**

**Students: PhD: 69; Int PhD: 8**

**Degrees Awarded: PhD: 11**

**Publications: 59**

The Department has been focusing on the following four important areas

- Protein and metabolic engineering
- DNA repair and genomic stability
- Biology of chaperones
- Immunobiology

The progress of research in the year 2013 has been detailed below:

#### PROTEIN AND METABOLIC ENGINEERING

In the year 2013, the assembly of the *Tobacco streak virus* (TSV), an llar virus, was investigated. The N-terminal zinc finger domain of TSV coat protein was shown to be essential for the formation of virus like particles. The intrinsically disordered protein, C4, of the *Cotton leaf curl virus* was shown to exhibit ATPase and pyrophosphatase activities. The residues important for the hydrolysis of D and L isomers of diaminopropionate by Diaminopropionate

ammaonia lyase (DAPAL) were identified by site directed mutagenesis. A two base mechanism for the catalysis of the isomers was proposed.

*H. pylori* DprA (HpDprA) which facilitates the natural transformation of several bacteria, displayed dual functional interaction with *H. pylori* R–M systems by not only inhibiting the restriction enzymes but also stimulating methyltransferases. These results indicate that HpDprA could be one of the factors that modulate the R–M barrier during inter-strain natural transformation in *H. pylori*. Bioinformatic and mutational analyses indicated the presence of an additional nuclease motif (LDLK) at the N-terminus of HpMutS2. Based on DNA binding and nuclease activity analyses, a probable mechanism of suppression of HR by HpMutS2 was proposed.

The Inhibition of cancer cell proliferation and the apoptosis – inducing activity of fungal taxol and its precursor baccatin III from endophytic *Fusarium solani* were demonstrated in different cancer cell lines such as HeLa, HepG2, Jurkat, Ovc4r 3 and T47D. The cytotoxic activity exhibited by fungal taxol and baccatin III involves the same mechanism, dependent on caspase – 10 and membrane potential loss of mitochondria, with taxol having greater cytotoxic potential. Recently, diacylglycerolacyltransferase (DGAT), a member of the 10 S cytosolic TAG biosynthetic complexes (TBC) in *Rhodotorula glutinis* was identified and characterized. The work on the oleosome protein oleosin has shown that it is more than just a structural protein, and its bifunctional activity is regulated by phosphorylation by AhSTY protein kinase. In the methylotrophic yeast, *Pichia pastoris*, three zinc finger proteins (Mxr1p, Rop1p and Trm1p) were found to regulate the expression of the genes of the methanol utilization pathway. The *de novo* heme biosynthetic pathway of the malaria parasite was shown to be essential for





its survival in the mosquito and mammalian liver. In order to identify the set of proteins that are essential for the survival of an organism, a multi-level multi-scale computational methodology, based on different levels of abstraction-integrating transcriptome profiles, genome-scale metabolic networks, phyletic retention in evolutionarily-related species and topological analysis using protein-protein interaction networks was developed, which in *M.tuberculosis* has led to the prediction of 283 genes as essential. A novel formulation for mining response networks was used to identify the highest activity paths that provide mechanistic insights into pathogenesis and response to treatment.

#### DNA REPAIR AND GENOMIC STABILITY

Structure-function analyses of *Saccharomyces cerevisiae* meiosis-specific Hop1 protein revealed that the disordered N-terminal domain is dispensable for DNA binding, bridging, and synapsis of double-stranded DNA molecules but is necessary for spore formation. A role for the yeast Mre11-Rad50-Xrs2-Sae2 complex in the processing of DNA double-strand breaks and intermediates of recombination and DNA repair was uncovered. Single-molecule DNA analyses disclosed dynamics and regulation of RecA and SSB polymerization and de-polymerization. It was shown that RAD51C is indeed a new gene in the Fanconi anemia pathway of interstrand cross-link repair and it distinctly regulates DNA damage signaling and repair. More recently, it was shown that XRCC3 S225 is a novel phosphorylation target of ATM and ATR kinases. The role of *Mycobacterium tuberculosis* RecG in DNA repair and recombination was also demonstrated. Single nucleotide polymorphism genotyping assays showed distinct patterns of variation at diabetes and obesity associated loci that mirror neutral patterns of human population diversity and diabetes prevalence in India.

The functional relevance of sumoylation mediated by Mms21/Nse2, an E3 ligase associated with the Smc5/6 protein complex is being investigated. Mutants of a few Mms21 targets that were designed to have a defect in sumoylation were created. These mutants are being characterized with regard to their sensitivity to genotoxic stressors and other phenotypes.

In an important finding, a small molecule inhibitor (SCR7) that can abrogate NHEJ by interfering with the binding of Ligase IV to DNA containing a double-strand break was discovered. Studies using *in vivo* tumor models suggest that the inhibitor SCR7 can bring down the radiation dose used during radiotherapy. The existence of two G-quadruplex structures flanking the *HOX11* breakpoint region, which can explain the fragility of the *HOX11* gene during t (10; 14) translocations in T-cell acute lymphoblastic leukemia, was also shown.

#### BIOLOGY OF CHAPERONES

A novel, co-chaperone in *E.hysolytica* was identified, which is uniquely present in this diarrhea causing organism. In addition, clinical isolates of Trypanosoma, Babesia as well as Candida species from hospitals and animal populations in the field were collected and diagnostic approaches such as a specific ELISA for Trypanosomosis, and molecular diagnostic tools such as PCR for a variety of animal infections were developed. Our studies suggest that the malarial parasite has evolved novel mechanisms involving the recruitment of an exported Hsp70 homolog in the endoplasmic reticulum to cope with redox stress. The Methodology to elucidate the rapid hydrogen exchange to understand the protein folding intermediates in a multi-subunit containing proteins was developed. The role of Tim23 in the organization of pre-sequence translocase and protein import across mitochondrial inner membranes was established. The Role of chaperones in Fe/S cluster formation, especially in Friedreich's ataxia and ISCU myopathy, was investigated.

#### IMMUNOBIOLOGY

Studies on the trafficking of the toxin abrin within cells revealed that the abrin A chain, after being released into the cytosol, is sequestered into the nucleus through interaction with a cellular protein of 25 kDa, BASP1 (brain acid-soluble protein 1). Studies on the trafficking of an immune-conjugate of an antibody with an abrin toxin chain showed that the conjugate kills cells but through a pathway distinct from that of the native toxin. The regulation of two chemokines, Ccl3 and Ccl4, via Interferon-







gamma induced nitric oxide in peritoneal macrophages was shown. This study is important as Ccl3 and Ccl4 bind to Ccr5, which acts as a coreceptor for the entry of the AIDS virus. Japanese encephalitis was shown to induce HLA-F gene expression in human fibroblasts and endothelial cells. Using p65 gene knock down experiments, JEV mediated induction of the HLA-F gene, and protein expression was shown to be dependent on NFkB activation. It was also for the first time that the IL-1 treatment of normal brain endothelial cells led to a redistribution of HLA-F protein localization within cells. Novel monoclonal antibodies raised against the mycobacterial glutamate racemase enzyme are being used to study the possible interaction of this protein with other cellular proteins within the bacteria.

### Microbiology and Cell Biology

**Staff: Academic: 15; Scientific: 2; Technical: 2**  
**Students: PhD: 84; Int PhD: 6**  
**Degrees Awarded: PhD: 12**  
**Publications: 48**

The Department of MCB is a pioneer in the country in infectious disease research and cell biology. The department currently has 15 faculty members and ~100 graduate students, working on various aspects including bacterial and viral infectious diseases, cellular processes and cancer biology and gene regulation & development. The major advances made in these areas are summarized below.

Studies on bacterial diseases: The primary infectious bacteria that the department works on are mycobacteria and *Salmonella*. The major findings in this area are (1) characterization of an unusual, membrane-attached, nucleoid-associated protein from *Mycobacterium tuberculosis*; (2) elucidation of the mode of a DNA strand passage mechanism by mycobacterial topoisomerase; (3) the mechanism of inhibition of topoisomerase I by mAbs; (4) understanding transcription initiation regulation by iNTPs and pppGpp, and (5) engineering cleavage-specificity in a restriction endonuclease, (6) generation of a mutant *Mycobacterium bovis*-BCG incapable of protein mannosylation by disrupting the mannosyl transferase enzyme, (7) demonstration that mice

infected with a BCG recombinant expressing the glycoprotein Rv1860 of *Mycobacterium tuberculosis* were compromised in their ability to recruit activated dendritic cells to the spleen early after infection, suggesting a role for glycoprotein Rv1860 in virulence and pathogenicity, (8) development of an accurate method for the qualitative detection and quantification of mycobacterial promoter activity and (9) quantification of the activities of the promoter of mycobacterial cell division genes under different growth and stress conditions using this method. Regulation of the host immune genes by the pathogenic mycobacteria often determines the outcome of the infection. The department has identified different host mediators that are dependent on infection-induced signaling cascades such as Notch, Wnt and Sonic Hedgehog. Together, they act as rate-limiting steps for expression and functions of host immune genes. In *Salmonella* pathogenesis, the department has devised a better drug nano-delivery system, allowing better management of Salmonellosis. It has demonstrated that Chitosan dextran nanocapsules can be used as an efficient drug delivery system to treat intraphagosomal pathogens, especially a *Salmonella* infection. This delivery system might be used effectively for other vacuolar pathogens including *Mycobacteria*, *Brucella* and *Legionella*.

Studies on viral diseases: The department has a strong tradition of working on viral diseases of primary importance in our country. The Major findings in this area of research include (1) demonstration that non-polio enteroviruses are associated with acute and persistent diarrhea, (2) identification of multiple novel cellular interacting partners of enteroviral nonstructural proteins 2A and 3A, and rotaviral nonstructural proteins NSP2 and NSP5 by mass spectrometry, and validation of several of them by biochemical methods, (3) demonstration that the live attenuated vaccine strain SA14-14-2 of Japanese encephalitis (JE) virus stimulates robust CD8+ T cell responses in vaccines, which were missing in volunteers naturally infected with circulating field strains of JEV, (4) deciphering a regulatory mechanism of the hepatitis C virus (HCV) replication via an interaction between the viral DNA element and a host protein. It has been observed





that this interaction can be targeted to design novel anti-HCV compounds, (5) identification of specific contact points between a viral protein and its RNA component, which is important for HCV translation/replication balance, using a computational approach, (3) designing of a small peptide capable of binding to viral RNA, thereby inhibiting viral translation.

**Cellular processes and cancer biology:** In this important area of molecular research, the important findings are listed here. (1) methylations on ribosomal RNA are important for the fidelity of protein synthesis in *E. coli*; (2) *Mycobacterium tuberculosis* MutT1 and Rv1700 constitute a novel two-stage mechanism to detoxify 8-oxo-dGTP to 8-oxo-dGMP and 8-oxo-GTP to 8-oxo-GMP and protect bacteria against oxidative stress. Co-targeting of this pathway may accentuate the impact of known antibiotics; (3) generation of a conditional mutant in fission yeast SpSlu7 and its use in investigating its role in the splicing of cellular pre-mRNAs. A near universal but not obligate role for SpSlu7 has been seen. Further, multiple intronic features co-relate with an intron's dependence on SpSlu7; (4) in a study on melanin biosynthesis, an experimental result assigned a novel function to the BLOC-2 protein complex of tethering between endosomal tubules and melanosomes; (5) STX13-containing tubules are shorter in length and made fewer contacts with melanosomes in BLOC-2-deficient cells. Similar tubules were observed in Rab38-deficient cells, suggesting that Rab38 may recruit BLOC-2 on the endosomal membranes; (6) in a study on the genetics of glioma, a type of brain cancer, the department has identified a 9-gene DNA methylation signature as an independent marker in glioblastoma treatment; (7) it has also shown that miR-219-5p targets EGFR in glioma cells; (8) identified Interleukin-1 receptor-associated kinase-4 as a temozolomide-induced protein and its role in temozolomide chemosensitivity was determined; (9) studies on microRNA metabolism, especially the turnover pathway in *Caenorhabditis elegans* has been initiated. This new area of research would focus on microRNA turnover complexes - 'miRNAsomes', which have the potential to be the core constituents of the microRNA turnover pathway; (10) it has been observed that certain anti-cancer agents like vinblastin can inhibit thrombin activity and thrombin generation,

suggesting that they may attenuate thrombogenesis in clinical conditions.

**Gene regulation and development:** In this area of research, the major findings are (1) deciphering direct target genes for the rice OsMADS1, a sepallata class transcription factor, during floral development; (2) genome-wide transcript profiling developing rice panicles and axillary meristems; (3) RFL transcription factor in rice has some tissue-specific regulatory effects on downstream gene expression status; (4) identification of natural diversity in leaf growth polarity of wild plant species (2) cloning of a deubiquitinase enzyme in *Arabidopsis* that regulates plant development; (3) identification of a microRNA that regulates leaf margin architecture.

An open-to-all Electron Microscope (EM) facility has been created that consists of an existing transmission EM, a new, high-end transmission EM and an existing scanning EM. The machines are operated by a company-trained technician and are open to users throughout the country with nominal operational charges.

The department aims to expand its cutting-edge research capabilities in the area of infectious diseases and cell biology. Towards this goal, it has recruited one new faculty member to run and manage the newly established BSL3 facility at CIDR and to carry out research on highly infectious diseases such as tuberculosis. MCB has also recruited another new faculty member who will initiate work on epigenetics and heart disease.

## **Molecular Reproduction, Development and Genetics**

**Staff: Academic: 11**

**Students: PhD: 43; Int PhD: 4**

**Degrees Awarded: PhD: 12**

**Publications: 37**

The department of MRDG has been pursuing research problems that are relevant to human diseases and evolution ranging from bacterial evolution; c-elegans; developmental questions employing *Drosophila*, zebra fish and rodents; large animal physiology and the molecular and biochemical basis of human diseases. The bacterial gene *chbG* is conserved in a large





number of organisms spanning the three kingdoms of life with links to development and disease, and recent studies have confirmed the expression of the orthologs in different vertebrates including mammals. Ongoing studies are targeted at identifying the substrates for the enzyme as well as its physiological role. With respect to developmental biology, genetic pathways involved in the *Drosophila* indirect flight muscle development and organization have been found to be similar to their vertebrate counterparts. In the area of reproductive physiology, pregnancy and lactation events have been studied with respect to insulin and other hormonal actions. In the area of signal transduction, signaling in mycobacteria with respect to two component systems and the regulation of cAMP and related biochemistry is being pursued. In eukaryotes, GPCR sensors have been developed. In the area of Cancer biology, the Notch receptor structure function relations have been studied using antibodies and some regions of the Notch receptor were found to be important in their biological activity that could be abrogated using monoclonal antibodies; mechanisms that cancer cells employ to overcome stresses and a major stress signaling pathway that has been studied involves the AMP-activated protein kinase, AMPK. Recent work has identified novel mechanisms downstream of AMPK activation involved with anoikis-resistant growth and metastasis. Regulation of the tumor suppressor gene *CDC73* has been studied wherein WT1 and miRNA-155 have been found to regulate *CDC73*. Finally, the role of activins and IGFBP2 in breast cancers has been established. Activins have been identified as factors implicated in invasion and metastatic spread and IGFBP2 was found to regulate invasion through the regulation of beta-catenin. The involvement of a novel TRIM28 gene network in the prognostic prediction of breast cancers has been identified.

## Molecular Biophysics

**Staff: Academic: 12; Technical: 1**  
**Students: PhD: 81; Int PhD: 12**  
**Degrees Awarded: PhD: 12**  
**Publications: 90**

Research in the department centres around the characterization of the functional and structural properties of various biomolecules in order to

understand their exact role in life processes. A new program on the development of (i) peptide-based inhibitors of enzymes and intracellular protein-protein interactions and (ii) suitable chemical modification/s on a peptide backbone that would convey favourable pharmacokinetic properties to peptides has been initiated this year by Dr. Jayanta Chatterjee who joined the department as a faculty member.

Structural and biochemical analyses of the *M. tuberculosis* SigD/RsdA complex revealed distinct sequence-structure features that lead to the recruitment of the Cl<sub>p</sub>PI-ClpP2-Cl<sub>p</sub>X proteolytic complex and suggest a mechanism that can regulate the cellular levels of free, active sigma factors in response to an environmental stimulus. Virus-like particles useful for biological imaging and target drug delivery were produced by expressing chimeric proteins of the sesbania mosaic virus in which the disordered amino terminal ARM motif was replaced by segments of other polypeptides of similar lengths. Several protein structures that could be potential drug targets against microbial infections have been determined. Through a genomic search, sequences containing lectin domains and heparin-binding hemagglutinins were identified. The structure of snake gourd lectin, a non-toxic homologue of type II ribosome inactivating proteins revealed the structural basis for the loss of toxicity in this lectin. Putative aspartic proteinase domains have been identified in infectious mycobacterial species. The crystal structure of one of them reveals that the fold of the domain and the catalytic site architecture are like those in other pepsins.

A charge-driven interface formed by a histidine aspartate cluster at the pore interface in Dps (DNA-binding protein from starved cells) has been identified by representing the structure as a network. Mutants were generated to disrupt the charged interactions. The Kinetics of iron uptake/release and crystal structures of the wild type and various mutants show that ferroxidation and iron release kinetics were affected upon the disruption of the ionic clusters and interactions, as predicted.

The cellular concentration of c-di-GMP is maintained by two opposing activities, diguanylate cyclase (DGC) and phosphodiesterase (PDE-A). In *M. smegmatis*, a single bifunctional protein







MSDGC-1 is responsible for the cellular concentration of c-di-GMP. The promoter element present in *msdgc-1* along with the +1 transcription start site has been characterized and the sigma factors that regulate the transcription of *msdgc-1* have been identified.

The crystal structures of the peptides Boc-[Aib- $\alpha^4$ (R)Val- $\alpha^4$ (R)Val]<sub>4</sub>-OMe, Boc-Leu- $\alpha^4$ (R)Val-Val-OH and Boc-[Leu- $\alpha^4$ (R)Val-Val]<sub>2</sub>-OH suggest a high propensity of  $\alpha$ -monosubstituted  $\alpha$  residues to favor local folded conformations. NMR results on a series of ( $\alpha\alpha$ )<sub>n</sub> peptides having C12-helical conformations in the crystalline state clearly establish that longer chains result in an extension of the C12-helical fold, and successive C-terminal NH groups are involved in intramolecular hydrogen bonding. The ready incorporation of  $\alpha$ -amino acid residues at registered positions in a multi-stranded  $\alpha$ -sheet has been established by the NMR structure determination of a designed 19-residue peptide containing three facing  $\alpha$ Phe residues.

The role of aromatic-proline interactions in determining conformational preferences in contryphans and a novel cyclic disulfide peptide isolated from the venom of *Conus virgo* has been established by NMR analysis. These studies provide specific examples of the role of sequence effects in determining *cis-trans* isomerisation about Xxx-Pro bonds, within the constraints of the 23-membered cyclic disulfide moiety of the contryphans. Transcriptome analysis coupled with mass spectral analysis has been used to deconvolute a natural conus venom peptide library. b12, one of the few broadly neutralizing antibodies against HIV-1, binds to the CD4 binding site on the gp120 subunit of HIV-1 Env. Two small fragments of HIV-1 gp120, b121a and b122a, which display about 70% of the b12 epitope and include solubility-enhancing mutations, were designed, bacterially expressed and tested in rabbit immunization studies. The study showed that gp120 fragment immunogens could elicit broadly neutralizing sera in small animals.

An analysis of the relationship between promoter specific features (motifs, DNA structural features), promoter directionality (uni or bi-directional) and gene expression variability shows that several

gene expression variability measures are weakly linked to DNA structural properties, nucleosome occupancy, TATA box presence and bi-directionality of promoter regions. Interestingly, one of the gene expression variability measures, gene responsiveness is found to be intimately correlated to promoter architecture. New methods (i) for the computational design of protein-like artificial sequences to enhance the capability of remote homology detection and (ii) for the accurate prediction of residues in domain-domain interfaces have been developed. Several new evolutionary relationships involving proteins of *H. pylori* and *T. brucei* were identified using sensitive remote homology detection methods. An analysis of the repertoire of protein kinases gleaned from the genomes of fugu and zebrafish enabled recognition of organism-specific evolution and an expansion of specific subfamilies of kinases. The ongoing work of the protein-structure network has been integrated (i) with MD simulated structures, to gain insights into the functional properties such as paths of communication between distant sites from an ensemble of equilibrated structures in proteins and (ii) with extensive data of modeled protein structures to validate automated server-predictions.

Electrophysiological studies in an *in vitro* brain-slice model of epileptogenesis revealed the homeostatic activation of a feed-forward inhibitory mechanism involving the local interneurons and pyramidal neurons of the subiculum. Studies involving electrophysiological recording of synaptic transmission, Ca-imaging and vesicular release on neuronal cultures showed that corticosterone targets distinct steps of synaptic transmission via concentration specific activation of mineralocorticoid and glucocorticoid receptors. The role of voltage-gated ion channels in regulating the release of calcium from the endoplasmic reticulum and in regulating the intrinsic response dynamics of neurons is being investigated and the interactions between plasticity in voltage-gated ion channels and learning theory are being analyzed.

The solution structure of the monomeric glutamine amidotransferase (GATase) subunit of the *M. jannaschii* (Mj) guanosine monophosphate synthetase (GMPS) has been determined using high-resolution nuclear magnetic resonance





methods. The interaction studies showed that a common surface exists for metal-ion binding as well as for protein–protein interaction. The effect of this interaction on the regulation of the GATase activity of holo GMPS has been elucidated.

**New facilities created during the year:** (1) New Mass Spectrometry facility at Molecular Biophysics Unit (2) FPLC AKTA AVANT (3) Cryogenically cooled probe for the departmental 600 MHz Nuclear Magnetic Resonance instrument

## Ecological Sciences

**Staff: Academic: 11; Scientific: 2; Technical:1**  
**Students: PhD: 38; Int PhD: 3**  
**Degrees Awarded: PhD: 3**  
**Publications: 64**

CES has continued to do cutting-edge research in diverse areas of ecology, behaviour and evolutionary biology. These range from the behaviour of ants, bees, wasps and termites to the largest land mammals, the Asian elephant, including climate change. We employ diverse tools from molecular ecology to the mathematical modeling of ecosystems.

**Ecology:** Species co-occurrence patterns were studied in mixed foraging groups of birds, reef fish and rocky shore intertidal invertebrates. A network analysis was applied to heterospecific bird flocks to examine species importance. An extensive distribution database was created for frogs, snakes and lizards of the Western Ghats to study patterns of distribution and diversity, and diversification processes. The Nesting of Olive Ridley turtles was monitored in Rushikulya; the mass nesting event in March 2013 recorded ~ 140,000 turtles, the most in the last decade. Leatherback turtles were monitored and satellite tagged in Little Andaman Island, with one of the tagged turtles migrating to Western Australia.

In an important work on mathematical modelling, it was demonstrated that early warning signals of abrupt ecological transitions are broadly applicable, although with some caveats, to systems with time-delayed feedbacks. It was also shown that social baboon groups have overlapping home ranges, yet they temporally

partition the space to avoid competition with each other. In applied ecology, a valuation of ecosystem goods and services was undertaken for the Uttara Kannada District of Karnataka as well as its ecological carrying capacity.

Work on the chemical ecology of termite–fungus mutualism has demonstrated that fungal parasites can proliferate in termite mounds only in the absence of termites; hence, the nest mound conditions alone are insufficient to maintain axenic cultures of the mutualistic fungus.

**Behaviour and evolution:** An investigation in the primitively eusocial wasp *Ropalidia marginata* showed that age, body size and adult feeding rate, when considered together, were the most important factors governing ovarian development. Such flexibility and variation in the potential and timing of reproductive development may physiologically predispose females to accept worker roles and thus provide a gateway to worker ontogeny and the evolution of sociality.

In an Asian elephant population in north-east India, it was found that tusks played a relatively minor role in male-male competition. An important implication of musth and body size being stronger determinants of dominance than tusks is that it could facilitate a rapid evolution of tuskless males in the population under artificial selection against tusked individuals for ivory.

The function of vocal mimicry in the racket-tailed drongo *Dicrurus paradiseus* was elucidated. In the field cricket *Plebeiogryllus guttiventris*, playback experiments to examine female mate sampling strategies were conducted to determine how an ecological context constrains mate choice decisions by females.

Reproductive strategies and individual personalities in the dimorphic rock agama, *Psammophilus dorsalis* were investigated. The interactions between hormones and behaviour were also investigated in the same lizard species. The oviposition strategies of mosquitoes were also elucidated. The impact of invasive plants on butterfly habitat use and data on grassland dynamics were collected at a long term field site in Maharashtra.





**New facilities created during the year:** An online database on the Flora of Karnataka based on the herbarium collections of the well known botanist CJ Saldanha was launched. This herbarium is housed in CES. This data base is the first online herbarium to encompass the complete flora of any state in India. The online database holds information on 4710 flowering species and 290 non-flowering gymnosperms, ferns and allies. This online database is a unique endeavour unparalleled in the country.

With funding from DST-FIST, a new facility was added to the chemical ecology activities of the Department. The Gas-Chromatograph coupled Electro-Antennogram Detection (GC-EAD) equipment is now fully functional and can detect the response of insect antennae to volatile compounds in a blend after separation on a GC-column.

Dr Sumanta Bagchi who specialises on the interaction between soils and grazing ecosystems joined the Department as Assistant Professor in 2013. He has worked on high altitude grasslands in the Himalaya but plans to extend his work on grassland ecosystems in Peninsular India. With his expertise, the Department is poised to develop a fully functional Environmental Chemistry Lab with funding for important equipment through the DBT-IISc partnership program. CES faculty are also continuing and extending their collaboration with scientists working on ecosystems outside India. Dr Maria Thaker has an active research program on carnivores in Africa and has critically evaluated the sport hunting industry in Mozambique.

## Neuro Sciences

**Staff: Academic: 8**

**Students: Ph D: 23**

**Publications: 9**

Understanding the structure, function and development of the brain in health and disease requires studying the brain across different levels of organization using molecular, cellular, systems, cognitive and computational approaches. The Centre for Neuroscience recruits faculty across wide-ranging disciplines to establish a strong program in basic neuroscience and build links to

the existing expertise in IISc as well as with clinical centres to develop translational research.

- The unifying goal of the laboratory of **Vijayalakshmi Ravindranath** is to understand early pathogenic mechanisms underlying neurodegenerative disorders that would potentially lead to the identification of drug targets that can be used to develop rational disease-modifying therapies. To this effect, the laboratory adopts a combinatorial approach involving molecular biological, biochemical and histochemical techniques to elucidate pathogenically important cellular pathways in animal models of Parkinson's and Alzheimer's disease.
- The long term goal of **Aditya Murthy's** laboratory is to understand the nature of neural representations and brain mechanisms that control actions. In the past year, the lab used a novel triple step task to show how task performance on a previous trial can selectively influence the degree of parallel processing during the planning of sequential saccades. The causal role of the medial frontal cortex was demonstrated by means of transcranial magnetic stimulation, which could selectively abolish such proactive control. These studies suggest how executive control may selectively influence capacity sharing while planning sequential saccades.
- The laboratory of **Shyamala Mani** investigates the signaling pathways during development by which neuronal precursor cells give rise to the different kinds of terminally differentiated neurons that are present in the adult nervous system. They have been working towards establishing human cortical development models to study developmental diseases. They have cultured fibroblasts from adult skin punches and have used the cocktail of Yamanaka factors to reprogram these cells into induced pluripotent stem cells, which are being characterized.
- The laboratory of **S P Arun** investigates the neuronal basis of object recognition and its computational underpinnings using both behavioral experiments and neuro-physiological experiments. A recent study from the laboratory has shown that searches







involving a target against multiple types of distracters can be effectively understood using simpler searches involving only one distracter type. In addition, the laboratory has recently acquired (with Prof. Aditya Murthy) a Transcranial Magnetic Stimulator (TMS) system, which uses focal magnetic fields that can be used to perturb brain activity focally in humans.

- The laboratory of **Supratim Ray** investigates the neuronal mechanisms of selective attention using computational and neurophysiological techniques, with a focus on neuronal oscillations thought to play a role in cortical processing. In collaboration with Drs. Ni and Maunsell, he has found that the strength of attentional modulation depends on the tuning properties of a sensory mechanism called “normalization” and the strength of gamma oscillations (30-80 Hz) depends on normalization.
- The laboratory of **Balaji Jayaprakash** investigates the neuronal basis of learning and memory. They investigated if appetitive learning can be used to form remote memories in mice. The laboratory is currently in the process of imaging morphological changes in the neurons of the orbitofrontal cortex following memory formation. Dr. Balaji's lab is interested in understanding the role of these memories in new learning. They are testing the hypothesis that the learning of new dissimilar events can be made faster if the novelty is introduced in incremental steps. This is tested through training the mice in a set of flavor pair associations.
- The laboratory of **Naren Ramanan** is interested in understanding the molecular mechanisms regulating axon growth during development and how these mechanisms can be reactivated to promote axonal regeneration after an injury. We have identified a novel transcriptional pathway that is critical for developmental axon growth. Currently we are identifying the target genes of this pathway and aim to study the role of this pathway in axonal regeneration. In addition, we are also interested in elucidating the mechanisms regulating neural stem cells to astrocyte differentiation and how these mechanisms go

awry in gliomas, the major tumours in the brain.

- The main goal of the laboratory of **Deepak Nair** is to understand the role of the organization and recycling of synaptic molecules in transmission and plasticity. His work will utilize ultra-high resolution imaging approaches to investigate the assembly and regulation of synaptic transmission machinery. Novel imaging paradigms like nanoscale imaging and optogenetics will be used to observe the real-time organization of a chemical synapse. These non-invasive optical approaches will provide insights into the finer details on spatial heterogeneity as well as the regulation of molecular architecture involved in synaptic transmission and plasticity. Dr. Deepak Nair has received the Ramalingaswami Fellowship from the DBT.

## Centre for Infectious Disease Research

### Publications: 10

The research activities of CIDR focus on pathogens and the host response to infection. A recent study based on the generation of knockouts in the *P. berghei* heme-biosynthetic pathway revealed that the intraerythrocytic stage parasites can incorporate both the hemoglobin-heme and *de novo* heme into mitochondrial cytochromes and hemozoin. Interestingly, the *de novo* heme becomes indispensable in sexual and liver stages, where the parasites do not have access to the host hemoglobin. Presently, efforts are being made to address the functional significance of *de novo* heme biosynthesis and its potential as a drug target and vaccine candidate.

Dr. Annapuran Vyakarnum's research interests are on understanding the molecular mechanisms of host/pathogen interactions during infections caused by HIV and *Mycobacterium tuberculosis*. HIV infection is known to predispose patients to active tuberculosis by killing CD4<sup>+</sup> T lymphocytes. Understanding the roles of key immune cell types that are involved in encoding better resistance or sensitivity is an important area of research as it may lead to a better design of vaccines. Her group is involved in undertaking a system biology approach to de-convolute the complex immune





response by studying expression patterns in different cell types and relating the data to better resistance or sensitivity during infections.

In order to perform research in the area of infectious diseases, considerable efforts and funding have been invested in creating tissue culture laboratories, office spaces and a central laboratory with state of the art equipment. Importantly, the BSL3 is part of this facility where highly infectious work will be performed soon.

### Central Animal Facility

**Staff: Scientific: 2; Technical 2**

The Central Animal Facility breeds and maintains genetically pure inbred strains of different species of animals for research activities. The animal species includes New Zealand white rabbits, Wistar rats, Sprague Dawley rats and several strains of mice (Swiss albino, BALB/c, FVB/N,

CD1, C57BL/6, C3HeJ) including knockout mice (IFN $\gamma$  KO, iNOS KO, etc.). These animals are used in research activities involving oncology, neurobiology, reproductive biology, immunology, virology, microbiology, genetic engineering and biochemical studies. The facility has supplied 9500 animals during the year.

**Primate Research Laboratory:** The Primate Research Laboratory (PRL) currently has adult, sub-adult, juvenile and infant bonnet monkeys (*Macaca radiata*). Research related to the neuronal basis of object recognition, visual perception, generation of motor behaviour, application of cognitive/psychophysical, neuropsychological and physiological techniques in non-human primates are being pursued by the IISc faculty members. PRL also has a state of art surgical room equipped with a gaseous anaesthetic machine with a precision vapourizer and a multiparameter health monitoring system for conducting sterile surgeries in non-human primates.

## 4.1.2 Division of Chemical Sciences (Chairman: S Ramakrishnan)

The Division consists of the following Departments/Centres/Units:

- ❖ Inorganic and Physical Chemistry
- ❖ Organic Chemistry
- ❖ Solid State and Structural Chemistry
- ❖ Materials Research
- ❖ NMR Research Centre

### Inorganic and Physical Chemistry

**Staff: Academic: 19; Scientific: 3**  
**Students: PhD: 90; Int PhD: 14**  
**Degrees Awarded: PhD: 15; MS: 1**  
**Publications: 111**

Established in 1909, the department is currently one of the finest in the country with 20 teaching faculty, 5 emeritus faculty and 2 scientific officers in its roll. The UGC has long recognized the department as a center for Advanced Studies and

extended its support for a further period of five years in April 2012. Recently, the department entered its second phase of support from the DST under its program Funds for the Improvement of Science & Technology (FIST).

Major research achievements of the faculty members may be broadly classified under the areas of spectroscopy, theoretical chemistry, nanoscience, bioinorganic chemistry, polymer chemistry, electrochemistry, organometallic chemistry, and catalysis. A few of the important achievements of the past year are listed below:

**Spectroscopy:** A Microwave spectrum of  $(\text{CF}_3)_2\text{CH-OH-OH}_2$  has been recorded for the first time in an attempt to understand its structure. A Spatially Offset Raman Spectroscopic set-up was developed and this methodology was successfully used to analyse compounds and some hazardous chemicals that were concealed





inside non-metallic containers. In addition, a new technique has been developed to study the molecular structure of materials buried deep inside other materials, as is often the case, for example, in medical and security research.

**Sensing:** The Detection of  $F^-$  and  $CN^-$  in water has been a challenging task, particularly in the presence of interfering anions. In this context, a series of triarylborane (TAB) - containing fluorescent dyes has been synthesized and their anion sensing capabilities have been evaluated. In order to achieve a colorimetric detection of  $F^-$  in an aqueous medium, TAB-TPA dyads decorated with ammonium cations have been synthesized. The Incorporation of ammonium groups on triphenyl amine (TPA) enables the detection of  $F^-$  calorimetrically.

**Catalysis and Organometallic Chemistry:** The Synthesis of several water soluble molecular cages of Pd(II) and the use of their confined nanospace for performing catalytic organic transformations in an aqueous medium have been accomplished.

The activation of the B–H bond in borane-amine Lewis base adducts using highly electrophilic ruthenium complexes has been accomplished. Based on this study, it was possible to trap the intermediates and elucidate the complete mechanistic details of these reactions. Further, core-shell nanostructured materials, comprising two noble metals, have been synthesized by employing trimethylamine borane (TMAB) as a reducing agent. It being a weak reducing agent, TMAB is able to distinguish the smallest reduction potential window of any two metals, which renders a selective reduction of metal ions thus affording core-shell architectures of the nanoparticles.

New organometallic complexes having chiral ligands based on proline have been designed for the asymmetric reduction of aromatic aldehydes to alcohols in water. It was shown that a phenyl substituent on the proline consistently gave better enantiomeric excess in the product.

**Bioinorganic and Medicinal Chemistry:** Metal-based photo-chemotherapeutic agents showing a significant PDT effect in red light while being essentially non-toxic in the dark have been

developed. In addition, oxovanadium (IV) complexes were shown to be efficient photocytotoxic agents in cancer cells in red light by selectively targeting the mitochondria, as desired by the oncologists, instead of the nuclear DNA. Biotin-conjugated tumor-targeting photocytotoxic iron (III) complexes have also been developed showing specific activity towards Hep G2 liver cancer cells rather than over normal cells.

It was shown, for the first time, that graphene oxide (GO) can be reduced catalytically by glutathione peroxidase (GPx) mimetics. In these reactions, GO acts as a peroxide substrate, indicating that GO contains peroxide functionalities. A detailed experimental investigation on a tellurium compound indicates that the synthetic tellurol reduces GO through cleavage of the peroxide ring.

**Nanoscience and Electrochemistry:** Organic electrode materials for rechargeable lithium batteries have been developed based on natural sources. Nanostructures based on osmium have been prepared and its surface plasmon was reported for the first time. The chain-like structures have been used as substrates for surface-enhanced Raman scattering studies to detect small concentrations of analytes. Moreover, novel electrode materials based on nitrides have been developed for use in direct methanol type fuel cells.

The Electrooxidation reactions of organic molecules on the nanostructures of Pt, Pd, Au and Pd-Au deposits prepared on conducting polymers have been studied. The electrochemically deposited metal particles grow in a dendritic morphology with an enhanced electrochemically active surface area on a polymer when compared to the particles deposited in the absence of the polymer. The Electrooxidations of alcohols and glucose suggested enhanced catalytic activity of such materials.

Cyclodextrin-functionalized  $Fe_3O_4@TiO_2$ , which serve as reusable 'Capture and Destroy', magnetic nanoparticles have been synthesized, and their capability for the photocatalytic degradation of endocrine-disrupting chemicals occasionally found in water supplies was demonstrated. Cyclodextrin functionalized reduced graphene oxide is shown to be water





dispersible over a wide range of pH values. It is shown to be an excellent platform for the resonance Raman detection and the estimation of organic pollutants and dyes present in water. Further, silver nanoparticles have been successfully synthesized using a new biosynthetic approach and SERS studies of model compounds and explosives have been carried out.

**Polymer Chemistry:** Mutually immiscible segments were randomly placed on the periphery of a hyperbranched polymer (HBP) using previously developed peripherally clickable HB polyester; this approach provided a simple way to generate Janus and Tripodal entities that result from the thermodynamically driven self-segregation of these segments. A novel photo-degradable HBP was developed, which was shown to be effective in generating micron-sized patterns using a standard lithographic process; importantly, however, in the absence of any photo-catalyst.

**Theoretical Chemistry:** A novel 'carbon bond'  $X-C-Y$  was proposed to be observed in  $H_nY-CH_3X$ , where X and Y are atoms with higher electronegativity than C. The carbon bond exhibited properties similar to hydrogen bonds and appeared to contribute to the very prevalent but yet ill-defined hydrophobic interactions.

Several projects in the domain of theoretical chemical physics were pursued in 2013. A multi-electronic ( $\sim 10$ ) state potential to describe the H-atom dissociation in phenol in terms of all three disappearing coordinates was developed. Work related to boranes, boron-rich solids and boron based fullerenes are being actively continued. The structure of  $CHF_3-HCCH$  complex was elucidated computationally and experimentally.

In recent optical pump-probe experiments with a broad-band (femto-second) probe and a narrow-band (pico-second) pump, it was observed that the loss and gain intensities at Raman resonances were significantly different; this was attributed to the temperature dependence of the Stokes and anti-Stokes Raman signals. Stimulated Raman signals using full quantum mechanical treatment were analysed. The Theoretical results predicted that, within the third order susceptibility, such

temperature dependences do not exist in the relative intensities of the gain and loss signals.

The Thermodynamic properties of a quantum heat engine have been thoroughly studied. Using a prototype model for the heat engine, it is shown that the engine efficiency is significantly altered by the quantum coherences.

**New facilities created during the year:** Cell culture facility to carry out chemical biology work. X-ray single crystal diffractometer facility for the Chemical Sciences division. It is planned to build a chirped pulse Fourier transform microwave spectrometer that can help in: (1) collecting broadband microwave spectra and (2) increasing the frequency range of the pulsed-nozzle Fourier transform microwave spectrometer.

## Organic Chemistry

**Staff: Academic: 9; Scientific: 1**

**Students: PhD: 41; Int PhD: 5**

**Degrees Awarded: PhD: 14**

**Publications: 47**

The Department of Organic Chemistry is one of the oldest departments in the campus and in the country. Currently, the department has ten faculty members, one honorary professor, about 65 PhD students and about 12 project assistants and 12 research associates. Research carried out in the Department covers almost all areas of Organic Chemistry, including emerging and interfacial subjects. The department publishes around 50 papers every year. The accomplishments cover a variety of areas including design, synthesis, and structural characterization, the analysis of multi-molecular interactions and the elucidation of physical properties of small organic and macromolecules.

***Organic Synthesis/Molecular Design:*** Developing strategies for the total synthesis of natural products of therapeutic significance from abundant chiral pool compounds is of continuing interest in the area of organic synthesis. The Total synthesis and determination of the absolute configuration of a natural product, synargentolide B was accomplished from a lactic acid ester, while







an enantiospecific total synthesis of indole alkaloids (+)-eburnamonine, (–)-aspidospermidine and (–)-quberachamine was also accomplished from a lactic acid ester. An expeditious enantiospecific total synthesis of (–)-crassalactone C and (–)-bengamide E was accomplished from tartaric acid. A Synthesis of (+)-pinellic acid; an active component responsible for anti-influenza activity was also achieved. In the course of these investigations, the formation of a 14-membered macrocycle via tandem olefin cross-metathesis, and an intramolecular hetero Diels-Alder reaction was observed. The Facile synthesis of isochromanones and isoquinolones, scaffolds that are important in medicinal chemistry was accomplished by a  $\text{AuCl}_3$  catalyzed cascade triggered by an internal nucleophile. Also, the use of chiral pyridine sulfinamides as effective catalysts in the asymmetric alkylation of aldehydes with diethylzinc was also investigated.

A detailed study concerning a [3+2+1] cascade cyclization of vinylcyclopropanes (VCP) catalyzed by bromonium species ( $\text{Br}^{\delta+}-\text{X}^{\delta-}$ ) generated *in situ*, resulting in the synthesis of chiral bicyclic amidines in a tandem one-pot operation, was carried out. The formation of amidines involved the ring opening of VCPs with  $\text{Br}-\text{X}$ , followed by a Ritter-type reaction with chloramine-T and a tandem cyclization. The reaction was further extended to vinylcyclobutane systems, undergoing a [4+2+1] cascade cyclization with the same reagents. The versatility of the methodology was demonstrated by the careful choice of VCPs and VCBs to yield bicyclo [4.3.0], [4.3.1] and [4.4.0] amidines in an enantiomerically pure form. A number of novel catalysts consisting of mesoporous materials (MCMs) were developed. The Dimerization of vinylarenes with various transition metal oxides impregnated MCM catalysts was investigated. These experimental results showed that the transition metal oxides ( $\text{Fe}_2\text{O}_3$ ,  $\text{CoO}$ ) impregnated MCM-41 and MCM-48 were quite effective catalyst systems for the tail-to-tail dimerization of styrenes; such a dimerization is, generally, very rare. A generalized protocol was developed for the ring opening of a variety of doubly-activated cyclopropanes using selenolates derived from the corresponding diselenides and sodium borohydride. The methodology was shown to be effective in the synthesis of selenium

containing unnatural amino acids. A convenient synthetic protocol has been developed for introducing thiazines at any location in peptides through a base-mediated cyclo-S-alkylation of thioamides.

The first switch peptide templates have been designed and synthesized; this can bias coupled peptides to exist in dynamic equilibrium between two distinct states that are at the origin of amyloid protofibril formation in proteins – an antiparallel  $\beta$ -sheet state and an unfolded state. A Propyl linker has been used as a novel surrogate for the hydrogen bond (HBS) to stabilize tripeptides in the shortest single helical turn conformation. The first models for peptides constrained in their “natively disallowed” conformations have been designed and synthesized. The First synthetic models that mimic the transition state for the H-bond assisted *cis*→*trans* isomerization in peptidyl prolyl isomerases have been designed and synthesized.

Facial selectivities in the nucleophilic additions of two, 3-unsaturated 3-arylsulfinyl pyranosides were studied; these pyranosides undergo nucleophilic additions at C-2, with facial selectivities depending on the nucleophile and the substituent on sulfinyl sulfur. The reactions of such sugar vinyl sulfoxides led to the addition of a nucleophile preferring an axial orientation at C-2, with a concomitant formation of an allylic bond at C-3 to C-4. This trend in the addition pattern was observed for the primary amine, carbon and sulfur nucleophiles, whereas secondary amines preferred an equatorial addition at C-2.

Pd-nanoparticles made in-situ in a hydrogel have been used as recyclable catalysts for carrying out Suzuki, Heck and Sonogashira reactions in aqueous media. Several extensions of the classical Henry nitro-aldol reaction that can be carried out under environmentally mild conditions (‘green’ processes) have been developed. Thus, the Henry products derived from nitromethane and a variety of aldehydes were reduced to the corresponding nitroalkanes with  $(n\text{-Bu})_3\text{SnH}$  in water under microwave irradiation ( $80^\circ\text{C}/10\text{ min}$ ). Alternatively, they were dehydrated to the corresponding nitroalkenes with  $\text{K}_2\text{CO}_3$  in water (generally  $0\text{-}5^\circ\text{C}/20\text{ min}$ ). Both reactions are ‘one pot’ and occur in excellent yields across a range of aliphatic and aromatic (including





heteroaromatic) substrates. A method for the selective reduction of aldehydes in the presence of ketones, with  $\text{NaBH}_4$  in aqueous  $\text{Na}_2\text{CO}_3$  has been developed. The reaction occurs in high yield, likely via a carbonate-borane complex.

**Physical Organic Chemistry:** Crystallographic and theoretical studies have been carried out to understand the nature of anti-aromaticity in tetracyclone, and its perceived kinetic stability. It appears that crystal-packing features, dominated by several short contacts in the lattice, stabilize the system and lead to its formation in high yields.

A novel 5-membered ring H-bonded cyclic ( $\text{C}_5^{\text{H}}$ ) structure, involving an  $\text{n}'\text{I}\delta^*$  ( $\text{N}-\text{H}_{i-1}$ ) interaction, has been designed in short peptides and characterized. Aib has been identified as the best residue to express this weak interaction, owing to the Thorpe-Ingold effect. The  $\text{n}'\text{I}\delta^*$  interaction has been shown to constrain the C-terminal residue of model peptides: (i) in a conformation where three disallowed short range van der Waals contacts are accommodated and (ii) in a disallowed fold where one disallowed dihedral angle is accessed, in both the solution and crystal structure. A weak  $\text{N}'\text{I}\delta^*$  H-bond has been engineered in short peptides of the type Xaa-Pro-Oxa/Thi, where Oxa is 1, 3-dihydro-4H-oxazine and Thi is 1, 3-dihydro-4H-thiazine. The interaction mimics the  $\text{n}'\text{I}\delta^*$  orbital overlap that occurs in the transition state of the peptidyl prolyl isomerase-protein complexes during the cis/trans isomerization of the prolyl peptide bonds. The energy of this weak interaction has been estimated to be  $0.38 \pm 0.07$  kcal/mol, based on NMR analyses of model compounds and DFT calculations. This weak interaction has been used as a remote switch to modify the cis/trans ratios of the prolyl peptide bond in short peptides. An unusual  $\text{n}'\text{I}\delta^*$  ( $\text{N}_{\text{im}}'\text{I}\text{C}_{2\text{im}}$ ) interaction has been found in peptides containing the imidate isosteres ( $\text{N}_{\text{im}}$  is the N of the imidate). Using extensive 1D, 2D NMR, and temperature coefficient studies, it has been estimated that this interaction stabilizes the cis configuration of the preceding prolyl peptide bond by  $\sim 0.33$  kcal/mol to 1.37 kcal/mol, depending on the electronic nature of the donor and acceptor atoms in the interaction. Using this interaction, the prolyl peptide bond has been stabilized in up to 82% cis configuration in model

compounds, without introducing any modifications on the pyrrolidine ring.

**Chemistry of New Materials:** Studies of DNA complexation efficacies and gene delivery vector properties of the nitrogen-core poly(propyl ether imine) (PETIM) dendrimer with DNA were evaluated through spectral studies, emission quenching, thermal melting and gel retardation assays; the most change to the DNA structure during complexation was found to occur at a weight ratio of dendrimer-DNA  $\sim 2:1$ . The zeta potential measurements further confirmed this stoichiometry at electroneutrality. Cytotoxicity studies involving five different mammalian cell lines revealed the dendrimer toxicity profile ( $\text{IC}_{50}$ ) values of  $\sim 400\text{--}1000$   $\mu\text{g mL}^{-1}$ , depending on the cell line tested. Quantitative estimation, using a luciferase assay, showed that the gene transfection was at least 100 times higher when compared to a poly (ethylene imine) branched polymer, having a similar number of cationic sites as the dendrimer.

The Photophysical property of the poly (ether imine) (PETIM) dendritic macromolecule in the presence of aromatic compounds was studied. The inherent photoluminescent property of the dendrimer undergoes quenching in the presence of guest aromatic nitro-compounds. From a lifetime measurements study, it was inferred that the lifetimes of the luminescent species of the dendrimer are not affected with nitrophenols as guest molecules, whereas nitrobenzenes showed a marginal change in the lifetimes of the species. The Raman spectral characteristic of the macromolecular host-guest complex was conducted in order to identify the conformational change of the dendrimer; a significant change in the stretching frequencies of the methylene moieties of the dendrimer was observed for the complex with 1, 3, 5-trinitrobenzene, when compared to other complexes and free host and guest molecules.

The Efficient management of fruit fly pests using physical gels has been accomplished successfully. The Gelation of molecules processing hydrogen bond donors and acceptors has been demonstrated which induced chirality transcription in two-component photochromic







systems. A room temperature synthesis CdSe quantum dots has been developed. A methodology has been developed to incorporate such QDs in a hydrogel matrix.

The smallest self-assembling molecules that represent the optimal balance between their intermolecular interactions and interacting surfaces have been identified. The controlled homo-dimensional self-assembly of these molecules into hollow horizontal and vertical tubular forests have been achieved. The cavities of the tubes have been used as templates to encapsulate and agglomerate surface functionalized metals (gold, copper, cobalt, and magnetite) nanoparticles and polymers (polyaniline and PE-DOT) for applications as real time nanosensors in cells.

**Bioorganic Chemistry/Chemical Biology:** New cholesterol based lipids that possess differential hydration were synthesized. Membrane formation and lipoplex formation with DNA were characterized physically and biologically. A new tripeptide derived from a neurological origin showed exceptional aggregation and delivery of anticancer drugs to resistant cancer cells.

Based on solvatochromic studies of a weak  $n \rightarrow \pi^*$  ( $N \rightarrow H+1$ ) interaction in short peptides, we have hypothesized the probable origins (during protein folding) for the rare occurrences of disallowed conformations of residues in the solution and crystal structures of proteins. A method has been designed to engineer two  $n \rightarrow \pi^*$  interactions in peptides, to constrain the C-terminal residues of desired model peptides in disallowed folds for: i) the elucidation of the crystallographic origins of disallowed folds in proteins; ii) correcting the energy parameters to account for the rarely encountered “disallowed” dihedral angles of residues in the crystal structures of proteins. It has been determined that charge relay efficiency in a single microdipole of a peptide bond represents a maximum; increase in the net macrodipole through hydrogen bonding interactions cannot improve relay efficiencies; hydrogen bonds at ideal geometries are good media for charge relay; deficient hydrogen bonds attenuate the relay; and, the C-terminal ends of the hydrogen bonds in peptides are good points for charge affinity.

The first elucidation of steric interactions that govern the cis/trans isomerism in X-Pro peptides have been achieved through structure correlation studies. Through the first crystal structure and solution NMR and FT-IR evidence it has been shown that the Piv-Pro peptide bond can indeed access the *s-cis* geometrical isomer; through access to this isomer, we show that the Van der Waals clashes that were hypothesized to preclude the adoption of this isomer are easily avoided in all X-Pro peptides through simple local bond distortions. It is rather, the unavoidable distortions that occur in the peptide bond containing the Pro carbonyl, and the loss in resonance energy there of that disfavors the cis-X-Pro conformer; interactions that can compensate for such losses in resonance stabilize the cis Piv-Pro isomer in solution and in crystals. It has been shown that reverse  $n \rightarrow \pi^*$  interactions can be tailored into peptides through a modification of the backbone amide to imidate isosteres; the Burgi-Dunitz trajectory for nucleophilic addition of a N to a carbonyl is not a limiting condition for  $n \rightarrow \pi^*$  interactions in peptidomimetics; nucleophiles with increased p-character can form the  $n \rightarrow \pi^*$  interactions from longer distances and at more acute angles than suggested by the BD trajectory.

Lanthanide luminescence based assay systems for lipase,  $\alpha$ -galactosidase,  $\alpha$ -glucosidase; chymotrypsin, alkaline phosphatase and  $\alpha$ -lactanase have been developed. Kinetic parameters indicated normal enzymatic activity in the gel matrix.

### **Synthetic Methodology Development and Asymmetric Catalysis:**

A facile and convenient method to access trisubstituted thioureas by reacting in situ generated dithiocarbamate of secondary amines with aryl amines is reported. To the best of our knowledge, this is the first report of the reaction of in situ generated dithiocarbamate of secondary amines with aryl amines to accomplish trisubstituted thioureas of aryl amines. One of the salient features of this method is that it does not employ isothiocyanate. Apart from these advantages, it has been shown that the reaction is versatile and works with a variety of substrates.





A novel, mild and convenient method exists for the nitrodecarboxylation of substituted cinnamic acid derivatives to their corresponding nitroolefins catalyzed by CuCl in the presence of air. This nitrodecarboxylation reaction uses TBN as a nitrating source. Besides these advantages, the reaction provides a useful method for the synthesis of  $\alpha$ ,  $\beta$ -disubstituted nitroolefin derivatives, which are generally difficult to access from other conventional methods. Additionally, this reaction is selective as the E-isomer of acid derivatives resulted in the formation of the corresponding E-nitroolefins. In addition to these advantages, metal nitrates or  $\text{HNO}_3$  are not employed for the transformation. One more salient feature of this reaction is that the acid-sensitive functionalities or compounds, such as nitrile functionality, thiophene and furan derivatives, are well tolerated under the reaction conditions.

An unprecedented, versatile iodine-catalyzed oxidative CDC (cross-dehydrogenative coupling) reaction of C-H bonds of tetrahydroisoquinoline under aerobic conditions has been uncovered. This novel catalyst system was found to be very effective and compatible with a wide range of nucleophiles. The scope of the metal-free CDC is illustrated by synthesizing a variety of functionalized tetrahydroisoquinolines and N, N-dimethylaniline. New and useful nucleophiles, such as phenols and indole, are employed to accomplish a Friedel-Crafts reaction, and the use of ethyl-2-nitroacetate furnished the corresponding nitro compounds.

A novel Ru catalyzed versatile regioselective alkenylation strategy for indole derivatives at the C2-position has been demonstrated using the benzoyl group as a directing group; this is the first report of the C2-alkenylation of N-benzoylindoles. Although Ru catalysts are well-known catalysts for the direct alkenylation of benzamides at the ortho-position, such functionalization is not observed in the present strategy. The deprotection of the benzoyl group is also very facile, thereby making the methodology more useful. Similarly, C-H functionalization using the carbonyl oxygen of an aldehyde as a directing group has been demonstrated for synthesizing 4-substituted indoles. This strategy to accomplish 4-substituted indoles is important, as this class of privileged molecules serves as a precursor for ergot

alkaloids and related heterocyclic compounds; this is the first report of a C-4 alkenylation of indoles using a Ru catalyst and an aldehyde as a directing group.

Iodine-mediated phosphorylation reactions to synthesize phosphoramidates/phosphate esters have been developed under very mild, efficient, and environmentally benign conditions. This catalytic system was found to be effective and compatible with a wide variety of primary/secondary amines, primary/secondary/cinnamyl/allyl/propargyl alcohols, and sulfoximines. A variety of useful phosphoramidates and phosphate triesters can be synthesized using this environmentally benign procedure.

A novel Pd-catalyzed selective coupling reaction of hydrazones in the presence of t-BuOLi and benzoquinone to form the corresponding branched olefin was demonstrated. The reaction is very versatile and compatible with a variety of functional groups; it was shown to be useful for the preparation of a variety of heterocyclic molecules, which may have useful synthetic implications.

During the past few years, electrophilic halogen-induced reactions of unactivated olefins have been rapidly emerging as a very efficient and practical mode for the stereoselective functionalization of unactivated olefins. The first catalytic enantioselective iodoetherification of oximes, a ketone-derived nucleophile, has recently been developed using commercially available N-iodosuccinimide (NIS) as the electrophilic iodine source. In the presence of 10 mol% of a dihydrocinchonidine-derived thiourea,  $\alpha$ ,  $\beta$ -unsaturated oximes underwent facile iodoetherification to produce  $\Delta^2$ -isoxazolines containing a quaternary stereogenic center generally in high yield with good to excellent enantioselectivity. In most of the cases, a single recrystallization furnished essentially enantiopure products. The synthetic utility of the cyclic products was demonstrated through their conversion to compounds with various other functionalities in excellent yield and without compromising their stereochemical integrity. In addition, a catalytic enantioselective sulfa-Michael/Horner-Wadsworth-Emmons reaction cascade has been developed taking advantage of phosphonate as an electrophilic activator and a traceless binding site. With the help of 10 mol% of a simple





bifunctional urea derivative, a variety of aryl and heteroaryl substituted thiochromene derivatives was obtained in excellent yields with a high level of enantioselectivity. In the realm of vinylogous reactivity, an achiral phosphine was combined with a chiral squaramide derivative to accomplish an enantioselective addition of deconjugated butenolides to allenates. Ever since the discovery of the nucleophilic addition to the relatively electron-rich  $\alpha,\beta$  double bond of allenates (an umpolung addition), this reaction has been recognized among the few general methods available for the installation of substituents at the  $\alpha$  position of the carbonyl compounds. However, the asymmetric variants of this type of reaction always relied on the use of chiral phosphines as the catalyst. The current report, for the first time, demonstrated the possibility of combining an achiral phosphine and a chiral squaramide in a synergistic fashion to bring about this class of transformation in enantioselective manner. The densely functionalized products containing a quaternary stereogenic center were obtained in good to high yields with high enantioselectivities. This protocol also represents the first example of a catalytic enantioselective C $\alpha$ -C $\alpha$  bond formation between two different carbonyl partners.

Enantioselective desymmetrization has the potential to create functional diversity within a molecule with the generation of multiple stereocenters in a single step. Very recently, an enantioselective desymmetrization of prochiral 1, 3-dinitropropanes has been developed which proceeds via enantioselective differentiating organocatalytic allylic alkylation. Functionalized allylic carbonates were used as the allyl source. Densely functionalized products with two vicinal stereocenters were obtained generally with good to excellent diastereoselectivity and superb enantioselectivity. Besides, an efficient, robust and highly enantioselective catalytic desymmetrization of 2, 2-disubstituted cyclopentene-1, 3-diones has been developed via a direct vinylogous nucleophilic addition of deconjugated butenolides. The remarkable influence of the secondary catalyst site on the enantioselectivity points towards an intriguing mechanistic scenario, possibly by triggering a change in catalyst conformation.

**New facilities created during the year:** Tissue Culture facility created under DST-FIST Grant.

## Solid State and Structural Chemistry

**Staff: Academic: 11; Scientific: 6**  
**Students: Ph D: 49; Int Ph D: 10**  
**Degrees Awarded: PhD: 10; MS: 1**  
**Publications: 94**

The Solid State and Structural Chemistry Unit, founded at the Institute in November 1976 by Professor C. N. R. Rao, has given a major thrust to frontier areas of Chemistry. The Unit has collaborative projects with some of the best laboratories in USA, UK, France, Germany, Israel, Italy, Japan and Sweden. It is recognized as a premier research center in the areas of Solid State, Materials, Physical, Inorganic and Theoretical Chemistry.

**Research conducted over the past year:** Scientists at the Solid State and Structural Chemistry Unit, working on diverse aspects of Solid State Chemistry, Physics and Technology in the broadest sense have achieved several significant milestones and results during the past one year.

In one effort, researchers at the Unit were able to demonstrate that the emission from manganese ions, regarded as un-tunable for over a century, is actually composed of several sub-populations that emit over a wide region of the emission spectrum. Further, they were able to devise a scheme to tune the emission band of a metal ion doped into a semiconductor host by controlling the geometry of the dopant site. In another effort, researchers have developed novel optical materials with extremely low lasing thresholds. The effect of shape on the photovoltaic properties of light harvesting II-VI nanocrystals was also pursued, and it was shown that a change in shape resulted in a significant increase in efficiency. Extensive studies in organic and hybrid solar cells in the department continue to achieve new milestones. Researchers have recently observed band-like transport in an n-type organic polymer material.

Studies on inorganic framework solids shed light on phenomena, such as energy transfer, thermochromism etc. that occur in these materials. The metal-organic framework compounds and also employed as precursors for the preparation of ceramic oxides, which are







formed by low temperature decomposition of the parent MOF and in a nano-regime.

Theoretical investigations were undertaken into several condensed matter systems using statistical as well as electronic structure techniques. Using statistical-mechanical tools, scientists studied phenomena such as the anomalous behavior of supercooled water, phase transitions, protein denaturation and unfolding, biocatalyst performance, fluid confinement and transport in nanoporous solids and ionic conduction and transport in molten salts as well as electrolytes. Researchers have also developed theoretical tools to understand the phase behavior of materials during melting and freezing. Density matrix renormalization group theory was used to investigate the optical, electrical and magnetic properties of organic molecular solids.

Experimental electron density features, based on high-resolution single crystal X-ray diffraction data sets at low temperatures, have been analyzed to obtain insights into carbon bonding. This has opened up a new concept in the weak intermolecular interaction regime, a phenomenon of great importance in drug design. Research is being carried out on various aspects of experimental and computational crystal engineering with a focus on the application of the synthon concept to obtain new and unusual patterns in crystal structures. This is generally achieved using weak interactions.

**Funding status:** The unit is in the process of receiving the third installment of FIST. In addition, faculty members have received individual project support from various National Funding Agencies such as DST, BRNS, CSIR and industry. Some faculty members are involved in international collaborative research projects. The Majority of the funding towards, travel, contingencies/ consumables and instrumentation on the Indian side is supported by the DST. Two major projects on Energy, one from the Ministry of Human Resources and Development (MHRD) and the Department of Science and Technology (Intensification of Research in High Priority Areas, IRHPA) have been sanctioned with SSCU acting as the nodal department for the projects.

## Materials Research

**Staff: Academic: 9; Technical: 1**

**Students: Ph D: 53; Int Ph D: 7**

**Degrees Awarded: PhD: 12**

**Publications: 119**

To promote Materials Science activities in a coordinated manner, the Materials Research Laboratory was established way back in the year 1978. The laboratory functioning within the Division of Physical and Mathematical Sciences and run by a committee of distinguished faculty drawn from different departments was mandated to promote interdisciplinary research programmes in Materials and to provide centralized services on a few sophisticated, major instruments. A programme of direct admission of research students was initiated in the year 1985, marking a change in the charter of the Materials Research Laboratory towards a full-fledged research department. In 1987, Materials Research Laboratory was renamed Materials Research Centre (MRC). Currently, the Centre enjoys the status of a department for all academic activities, with additional responsibility for promoting interdisciplinary research in Materials Science. The Centre continues to provide critical sophisticated equipment support pertaining to materials characterization to many users within and outside the Institute. The Centre has the distinction of admitting students to the Ph.D. programme from both the Science and Engineering disciplines and administratively belongs to the Chemical Sciences Division of the Institute. Presently, the core faculty strength of the Centre is eleven including two honorary professors. On an average, the Centre has 70 students on roll enrolled for the Ph.D. programme. It also participates in the teaching programmes of the integrated Ph.D., undergraduate and bioengineering disciplines at the Institute. MRC attracts major research projects and funding both from National and International agencies, and is a leader in both fundamental and Applied Materials Science. This is reflected in the consistent publication record as well as funding, which is among the highest in the Institute.

**Research Conducted during the year:** The research at Materials Research Centre for the





past one year continued to focus on the broad area of functional materials for applications ranging from biology, electronic devices, energy and environment, encompassing both theoretical and experimental investigations. In the following, a brief summary of the work carried out by different research groups at MRC in the previous year is presented. In addition, two new faculty members have been currently involved in establishing state-of-the-art research facilities in the broad areas of magnetic materials and Li-ion batteries.

**Functional ceramics at different length scales:** The  $B_2O_3$ -added  $K_{0.5}Na_{0.5}NbO_3$  (KNN) ceramics exhibited improved dielectric and piezoelectric ( $d_{33}$ ) properties at room temperature. The remnant polarization ( $P_r$ ) and coercive field ( $E_c$ ) values were dependent on the  $B_2O_3$  content and crystallite size. The Nonlinear dielectric response of  $BaBi_4Ti_4O_{15}$  ceramics synthesized via the conventional solid-state reaction route was monitored over a wide range of electric field strengths ( $E_0 = 0.5 - 5$  kV/cm). Rayleigh relations were employed to interpret the non-linear dielectric response and the contribution of irreversible domain wall motion to the macroscopic permittivity was separated. Nanocrystalline barium sodium niobate,  $Ba_2NaNb_5O_{15}$  (BNN), synthesized via a citrate assisted sol-gel route exhibited strong visible photoluminescence (PL) at room temperature. The PL mechanism was explained by invoking the dielectric confinement effect, defect states and generation of self-trapped excitons. Monophasic  $Ba_2NaNb_5O_{15}$  crystallized at the nanometer scale (12-36 nm) in  $2BaO-0.5Na_2O-2.5Nb_2O_5-4.5B_2O_3$  glass system exhibited crystallite size dependent refractive indices. At room temperature under UV excitation (355 nm), these glass nanocrystal composites displayed a violet-blue emission that was ascribed to the defects states.

The Mechanical properties (Hardness and Young's modulus) of glasses and glass-nanocrystal (anatase  $TiO_2$ ) composites in the  $BaO-TiO_2-B_2O_3$  system fabricated by the conventional melt-quenching technique were found to be enhanced with an increasing volume fraction of nanocrystallites of  $TiO_2$  in a glass matrix. The results were correlated to the structural units and nanocrystals present in the glasses. The Dielectric and optical properties at room

temperature of the glasses in the  $x$  ( $BaO-TiO_2$ )- $B_2O_3$  ( $x = 0.25, 0.5, 0.75$ , and  $1$  mol.) system were studied. Interestingly, these glasses were found to be hydrophobic. Composites comprising poly (methyl methacrylate) (PMMA) and  $CaCu_3Ti_4O_{12}$  (CCTO) via melt mixing followed by hot pressing were fabricated. The composite, with a 38 vol % of CCTO (in PMMA), exhibited remarkably low dielectric loss at high frequencies.

Transition metal silicides for high temperature thermoelectric applications have been investigated in detail. In particular, the effect of the co-substitution of Mn and Al in the crystal lattices of  $Cr_2Si$  on thermoelectric properties is studied. The gas sensors based on oxides have been developed. The detailed structural /microstructural and dielectric properties of titanates were studied. The effects of doping on thermal stability and the optical properties of nanocrystalline  $SnO_2$  were investigated.

Theoretical and experimental studies on ultrathin metal nanowires were carried out to understand the detailed electronic structure and tunability of electronic states in the wires. By varying growth conditions, wires were placed at different distances from the substrate with intervening linker molecules of different lengths. This dramatically modified the electronic states of the wire and hence their transport behaviour.

High activity  $CeO_2/Pt$  catalysts were synthesized using the microwave method. The effect of the morphology of the ceria on catalytic efficiency was investigated in detail. The impact of the aspect ratio of ZnO nanorods on their photocatalytic activity was demonstrated. Highly active  $TiO_2/PbO$  hybrids were synthesized. A new method for the synthesis of hollow intermetallics was developed and the mechanism of formation was studied using in-situ electron microscopy.

Carbon nanostructures, ZnO and  $GeO_2$  were grown using vapor phase techniques and investigated for various energy-related device applications. New techniques for the growth of ultralong ZnO nanowires and a single step technique for the growth of branched carbon nanotubes were developed.  $Ge/GeO_2$  hybrids were synthesized and investigated for luminescence properties. Pt-free fuel cell catalysts have been developed. The green synthesis method for Au/guar-gum for ammonia





sensing has been established. Rapid synthesis methods for M@rGO (M= Au, Pt, Pd) hybrid nanostructures at room temperatures have been developed.

**Biomaterials:** The research in the areas of biomaterials focused on porous scaffold development and on understanding the interaction of electrical/magnetic fields with biological systems. Human mesenchymal stem cells were found to differentiate to neural-like cells in a conductivity dependent manner on doped polyaniline substrates under electric-field-stimulated culture conditions. A complementary theoretical analysis was carried out to determine the bioelectric stress field in the intercellular, extracellular and the cell membrane to explain the observed morphological changes. The influence of a pulse magnetic field on the inactivation of bacterial cells was established, and such an effect was found to be independent of the bacterial cell type.

**Computational Materials Science:** The Origin of enhanced thermoelectric properties of doped  $\text{CrSi}_2$  was examined - a linear relationship between thermodynamic charge state transition levels of defects and the maxima of thermopower  $T_m$ , was demonstrated in  $\text{CrSi}_2$  using first principles density functional theory. For doped  $\text{CrSi}_2$ , the peak of thermopower was found to occur at the temperature corresponding to the position of the defect transition level. This provides a unique design opportunity to modify the defect transition level or enhance thermoelectric properties. The possibility of stabilizing the planar form of silicene by Ni doping has been studied using first principles density functional theory based calculations. It is found that a planar as well as a buckled structure are stable for Ni-doped silicene, but the buckled sheet has a slightly lower total energy. Similar trends were observed in the case of Ge and Sn sheets also. Using first principles density functional calculations, the underlying principles of designing an efficient metallacarborane based hydrogen storage media were established.

**Functional Materials in Thin – film Configuration:** The thin-films and multilayer heterojunctions of different materials that include  $\text{InGaN/Si}$ ,  $\text{HgCdSe}$ ,  $\text{CZTS}$ ,  $\text{Cu}_3\text{BiS}_3$ ,  $\text{In}_2\text{O}_3/\text{p-Si}$ ,  $0.85\text{PMN}-0.15\text{PT}$ ,  $\text{La}_{0.6}\text{Sr}_{0.4}\text{MnO}_3$  were grown using a variety of state-of-the-art deposition

techniques, including molecular beam epitaxy (MBE) and pulsed layer deposition (PLD). The devices based on these thin films were investigated for their infrared detector, photovoltaic, electrocaloric and magnetic applications.

**Prototype Devices:** The following devices were realized using some of the functional materials that were synthesized at MRC.

Electro-optic light intensity modulators  
Bragg-like gratings  
Vibration sensors  
Pyroelectric sensors  
Gas sensors  
White-light emitters.

## NMR Research Centre

**Staff: Academic: 4; Scientific: 1**  
**Publications: 19**

The primary focus of the NMR Research Centre is the development of new NMR methods and their application to important and challenging chemical and biological problems. During the last year several novel methods have been developed. Some of the important recent findings/work initiated include: (i) a method for rapid characterization hydrogen exchange in proteins; (ii) characterization of the dynamics of an intrinsically disordered domain of human IGF2BP-2; (iii) A new method for testing the enantiopurity of chiral amines; (iv) Selective multiple quantum excitation and detection in a group of scalar coupled spins; (v) A new experimental technique has been designed for the selective extraction of magnitudes and signs of  $^nJ_{\text{HF}}$  from the severely overlapped  $^1\text{H}$  NMR spectra; (vi) An Experimental scheme has been proposed that by using  $^1\text{H}$  decoupled  $^1\text{H}$  spectra, it is possible to unravel the spectra of enantiomers from the severely overcrowded NMR spectra. (vii) Challenging experiments like Rotational Echo Double Resonance (REDOR) and the 2D heteronuclear correlation (HETCOR) between  $^1\text{H}$  and the quadrupolar nucleus  $^{11}\text{B}$  were developed and applied; (viii) development of frequency selective ultrafast 2D, spectroscopy in an inhomogeneous magnetic field; (ix) implementation of a double quantum experiment that provides proximity and correlation information using low *r.f.* radiation without compromising on the bandwidth; (x) new methods and new directions in metabolomics.





#### 4.1.3 Division of Electrical Sciences (Chairman: Anurag Kumar)

The Division consists of the following Departments/Centres:

- ❖ Computer Science and Automation
- ❖ Electrical Engineering
- ❖ Electrical Communication Engineering
- ❖ Electronic Systems Engineering

##### Computer Science and Automation

**Staff: Academic: 22; Scientific: 1; Technical: 1**  
**Students: PhD: 88; M Sc (Engg): 41; ME/M Tech: 114**  
**Degrees Awarded: PhD: 9; MSc (Engg): 8; ME: 59**  
**Publications: 117**

The technical activities of the department are clustered into three groups: Intelligent Systems, Theoretical Computer Science, and Computer Systems.

##### Intelligent Systems

We developed reinforcement learning algorithms for online feature tuning and proved their convergence. We developed feature based algorithms and studied their implementations in the context of energy harvesting sensors. We developed balanced simultaneous perturbation Hessian estimates and developed Newton based algorithms that incorporate these. The new estimates are seen to exhibit significantly superior performance in comparison to the previously known algorithms. We also considered a stochastic differential equation version of the Bass model for pricing and developed and implemented a parameter optimization algorithm for updating the parameters of the Bass model. This is seen to explain well the sales behaviour of products and provide guidance on when a new product should be introduced in the market.

In the area of game theory and mechanism design, we have initiated work on *multi-armed bandit mechanisms*. This work is at the interface of online learning and mechanism design and has significant application to many current problems in Internet advertising, crowdsourcing, and smart

grids. We have initiated work on *computational social choice*. In particular, we are looking into important problems such as the asymptotic manipulability of voting rules and possible winners in elections. In the context of *social networks*, we have explored important problems such as eliciting true preferences from a social network and aggregating preferences of nodes in a social network. We have formulated and solved important problems in design of incentives to make *crowdsourcing* more robust and more effective.

In the area of statistics and machine learning our research highlights include (i) developing theory of power-law kernels and study of corresponding reproducing kernel Hilbert spaces, (ii) deriving regularizers corresponding to q-Gaussian and q-Laplacian distributions, and (iii) introducing multi-point kernels based on Jensen-Shannon divergences and study of their application to spectral clustering. In many real-world applications, obtaining labeled data is usually expensive; while unlabeled data are available in abundance. In such cases, a common approach is to use semi-supervised learning methods. We proposed a novel approach to solve semi-supervised structured prediction problems. The novelty of this approach lies in an efficient and effective hill-climbing technique for solving the difficult constraint matching problem in a structured prediction framework. We also proposed a new approach for semi-supervised ordinal regression using Gaussian processes. The approach is based on the expectation-propagation approximation idea and an efficient label switching method for solving an integer programming problem.

Our research on clustering and classification included time series classification, where an algorithm was developed which calculates the fuzzy membership of a test pattern to the classes. Multilabel classification was also investigated and a fuzzy algorithm developed. Other topics include class-based feature selection, feature selection for semi-supervised learning and outlier detection and incremental learning. We have also worked



on combining classifiers on multiple relations; finding similarity between compressed data points where the compression scheme is either lossy or non-lossy; identifying outliers in categorical data and time-varying social network data. The problem of designing sparse multiclass and multilabel classifiers for large data sets is challenging. We proposed algorithms which solve primal problems directly by greedily adding the required number of basis functions into the classifier model.

We have made significant progress on two foundation areas in machine learning and initiated substantial research applied to computer graphics and computer storage. The first area we would wish to highlight is the discovery of an interesting connection between the Lovasz theta function and kernel methods. This new insight is yielding powerful algorithms for finding large dense subgraphs. The second area we would like to highlight is a new topic discovery algorithm which can recover subtle topics, beyond the scope of traditional topic models. The key idea behind this was the introduction of multiple topic vectors assumption. This assumption has now opened doors for designing powerful algorithms which can understand user generated content such as comments and their relationship to news.

### **Theoretical Computer Science**

Our cryptology research involved the analysis of probably secure cryptographic protocols, where we have made several interesting findings. We have provided a unified treatment of multiple forking. Our improved analysis leads to a significant improvement in the tightness of existing protocols and the bound seems to be optimal. We have revisited the notion of property-preserving encryption and showed that the first proposal from Eurocrypt'12 is completely insecure. We have also looked at the efficacy of fault attacks on pairing based protocols.

In the area of algorithmic algebra, our highlights are (i) establishing the Macaulay-Buchberger theorem over Noetherian rings, (ii) identifying ideal lattices via short reduced Grobner bases (concept introduced by us), and (iii) on going work on Border bases over rings.

One of our graph theory research results related the cubicity of a graph with bandwidth. We also

studied the SIG dimension of a graph, in particular for trees. We proved that the problem of finding the rainbow connection number of a graph is hard to approximate to a factor below 2. We answered a question posed by Theresa Biedle, by giving an algorithm to augment the edge set of out planar graphs of connectivity one, so that it achieves 2-connectivity without losing outerplanarity, and keeping the pathwidth of it  $O(p)$ , where  $p$  is the pathwidth of the original graph. We also studied the product dimension of bounded treewidth graphs, and improved the previously known bound in the case of trees.

Our combinatorial geometry group showed the existence of strong centerpoints with exact constants. We have established improved bounds on Selection Lemmas for various geometric objects. For the unit distance problem on convex pointsets, we gave an alternate geometric proof of  $n \log n$  on maximum edge complexity. We have proved bounds on epsilon nets on grids for lines, line segments and convex objects. We considered the discrete version of bounding the piercing number as a function of the packing number and proved bounds for lines, pseudo-disks and rectangles.

In the area of algorithmic verification of system models, we have given a compositional construction of a formula automaton for MITL, and studied the problem of model-checking trace-based information flow properties for infinite-state system models. In the area of verification of functional correctness of implementations we have proposed a technique based on a novel notion of refinement and existing code-level verification tools to verify existing system implementations. We have used our methodology to do a machine-checked proof of the functional correctness of an embedded real-time operating system called FreeRTOS.

We have worked on two fundamental problems in algebraic complexity theory, namely polynomial identity testing and arithmetic circuit lower bounds. These two problems are intimately connected to the VP vs VNP problem, an outstanding open problem in the area which is also an algebraic analogue of the famous P vs NP problem. Our work has led to the resolution of some of the open questions in arithmetic circuit complexity.





## **Computer Systems**

In the area of program analysis, we designed and implemented a novel dynamic analysis tool for deadlock detection and reproduction which reduces programmer effort significantly. We also designed and implemented a scalable and incremental static analysis tool for detecting bugs. We developed and published an approach for precisely performing a program transformation called slicing, using a novel approach based on term rewriting. Secondly, together with some students and other faculty colleagues we developed and published an approach to match large applications (in source code form) with textual models, using information-retrieval techniques.

Our program verification group published papers on protocol verification and another on math API discovery. A software tool for the second has also been released. We also conducted a user study for another work on automated bug fixing.

In the area of scientific visualization, we developed novel methods to identify symmetric regions in scientific data and demonstrated applications to interactive exploration and feature-directed visualization. We also developed a visualization framework to identify and track the movement of clouds systems and used the framework to study various weather phenomena.

Research activities in wireless sensor networks focused on reliable multicast protocols for multihop WSNs, design, analysis and formal verification of security protocols for MANETs, design and implementation of secure routing protocols for MANETs, and energy-efficient clock synchronization protocols for WSNs with improved synchronization accuracy.

Research in the general area of operating systems included the study of code bloat and the use of machine learning techniques to identify bloat, information flow models in operating systems, the design of SSD aware systems in storage system design, and power management for memory in Linux

Over the past year, we have developed a conceptually new approach to address the chronic problem of selectivity estimation errors in

database engines. In the new approach, the traditional compile-time estimation process is completely eschewed. Instead, a small “bouquet” of plans is identified from the set of optimal plans in the query’s selectivity error space, such that at least one among this subset is near-optimal at each location in the space. Then, at run time, the actual selectivities of the query are incrementally “discovered” through a sequence of partial executions of bouquet plans, eventually identifying the appropriate bouquet plan to execute. The duration and switching of the partial executions is controlled by a graded progression of iso-cost surfaces projected onto the optimal performance profile. We have proved that this construction results in bounded overheads for the selectivity discovery process and consequently, guaranteed worst-case performance. Further, the plan bouquet approach has been empirically evaluated on industrial-strength database engines over benchmark environments. Our experimental results indicate that it delivers substantial improvements in the worst-case behavior of plan choices, without impairing the average-case performance, as compared to the native optimizers of these systems.

The research focus in high performance computing was on computer architecture and compiling techniques with a special focus on accelerator-based architectures and programming models and compiling for Graphics Processing Units (GPUs). Our group has also developed techniques for memory system performance and efficient memory hierarchy design for multicore architecture. Last, our group has proposed efficient techniques for parallel flow-sensitive points-to analysis.

We continued compilation for multi-cores research on the development of new compiler and runtimes techniques for heterogeneous multi-cores. Five key works include, (1) performing parallelization for multiple GPUs while automatically handling data movement through the compiler, (2) compiling for parallel architectures with distributed memory, (3) communication optimizations for distributed-memory parallel architectures, (4) development of compiler support for new dynamic scheduling runtimes, and (5) memory optimization techniques for affine loop nests.



## Electrical Engineering

**Staff: Academic: 18; Scientific: 5; Technical: 1**  
**Students: PhD: 79; MSc (Engg): 23; ME: 81**  
**Degrees Awarded: PhD: 9; MSc (Engg): 6; ME: 51**  
**Publications: 105**

The research work of the Department of Electrical Engineering falls in two major fields, namely: i) Power and ii) Systems and Signal Processing. The area of Power includes Power Systems, Power Electronics and High Voltage Engineering. The Systems and Signal Processing research area includes Machine Learning, Real Time Systems, Multimedia, Image and video Processing, Biomedical Signal Processing and Speech and audio signal processing. A brief report on the research activities in the different fields is given below.

### Power Systems

An improved approach for online computation of reactive power contributions from various reactive sources to meet the reactive load demand and reactive power losses based on the network power flow has been developed. The equivalent model of the line is considered by separating the shunt part of the transmission line and integrating it into nearby buses for the proper accounting of reactive power support produced by the line charging capacitances as separate reactive power sources like conventional capacitors in the ancillary service market. Detailed case studies with base and optimised case are carried out on a modified IEEE 30-bus system and a practical southern regional grid.

Direct identification of coherent synchronous generators in large interconnected multi-machine power systems has been developed using a support vector clustering (SVC) approach. The clustering is based on a coherency measure, which indicates the degree of coherency between any pair of generators. The proposed SVC algorithm processes the coherency measure matrix, which is formulated using generator rotor measurements to cluster the coherent generators. The proposed approach is demonstrated on an IEEE 10 generator 39-bus system and an equivalent 35 generators, 246-bus system of the practical Indian Southern Grid.

Network usage charges are one of the main constituents in the operational set up of de-

regulated power sectors. The power flow tracing is one such procedure to evaluate the extent of utilization of transmission paths by the sources in order to meet the desired contracts. Based upon the actual operating condition of the given system along with bus voltage profiles and associated branch parameters, virtual power flow tracing is carried out. Due to the non-linear nature of the power flow model, the virtual tracing is carried out for the equivalent network model of the original AC system. The equivalent model will have only real power bus injections as in the AC system.

Voltage instability has become a challenging problem in unbalanced multiphase distribution networks. Recently, the integration of Distributed Generation (DG) in distribution systems (DS) has increased to high penetration levels, and the impact of DG units on the voltage stability margins have become significant. In a low voltage distribution network, there is the increased likelihood of significant load unbalance between phases. This is undesirable as the resulting voltage unbalance can cause damage to equipment such as motors. The static voltage stability index L for the phase wise assessment of the voltage stability in the microgrids interconnected power system has been developed. The quantitative analysis of unbalance of voltage at all the nodes is also studied using the index MV0 and MV2. For simulation purposes, a practical distribution feeder consisting of 23 bus and emanating from the 132/11 KV grid substation is considered and case studies are presented to illustrate the phase wise voltage stability.

A new approach for solving the classical problem of automatically incorporating generator Q limits while obtaining adjusted load flow solutions using the Newton Raphson method has been developed and validated through extensive studies. A new index for characterizing the voltage stability of large systems has been developed.

A networked control systems (NCS) framework for the wide area monitoring control of smart power grids has been developed. A scenario is considered in which wide area measurements are transmitted to controllers at remote locations. The effects of delays and packet dropouts due to limited communication capabilities in the grid have been modeled. A robust networked controller is designed to damp wide-area oscillations based





on information obtained from Wide Area Monitoring Systems (WAMS), and analyze the improvement in system stability due to networked control. With communication integration being an important feature of the smart grid, a detailed consideration of the effects of communication is essential in the control design for future power systems.

### **Power Electronics**

We developed new pulse width modulation (PWM) methods for induction motor drives to reduce pulsating torque. An Experimental study on acoustic noise produced by inverter fed induction motor drives has been carried out. Advanced space vector based PWM methods to reduce power conversion loss in high power converters have been developed. Investigations have been carried out in the modeling and analysis of dc-dc converter to develop computationally efficient models for converters for the purpose of off-line simulation and real-time simulation of electric vehicles. New funding has been obtained for i) Development and deployment of miniature full-spectrum simulators for educational institutions, Dept. of Electronics & Information Technology, Govt. of India and ii) Technical advice to industry on induction motor drives.

A test setup has been built for evaluating the performance of closed loop Hall effect current sensors. In addition, PLL design procedures for single power converters to meet harmonic distortion and minimal settling time requirements have been developed. A Filter design for PWM rectifiers and its control methods has been investigated. New funding of Rs. 30 lakhs has been received from the Institute for Plasma Research and CDAC Trivandrum for the project titled "Design of a Crowbar based protection system for plasma tubes". Also, technical advice has been provided to industry on the analysis and design of current sensors, high voltage power supplies and its protection systems, photovoltaic converters, and components of power conversion systems.

### **High Voltage Engineering**

During a strike to the communication and other instrumented towers, isolated cables mounted on them are subjected to severe electric stress. A pertinent definition for this stress applicable to a

transverse magnetic mode of surge propagation has been proposed. A finite volume method based code has been developed for the analysis of thermal and electrical field distribution in transformer bushing. For the analysis of the surge induced in the electrical system of buildings due to a lightning strike to ground, a new methodology has been developed which involved: (i) evaluation of the distributed circuit model for the electrical wiring of the buildings, building steel and the supply lines for electrical leads and communication, (ii) incorporation of engineering models for the return stroke with a thin wire electrical field integral equation formulation based approach for the remote field calculation and (iii) formulation of a circuit file for the solution with an incident field represented by distributed voltage sources.

We have developed a prototype pulse-based gas-cleaning reactor. Investigations have been carried out to obtain High NO<sub>x</sub> pollutant removal efficiency using an enhanced electric field.

A novel method of indirect measurement of series capacitance of a transformer winding was implemented successfully on single isolated windings, as well as, on three-phase transformer units in a local factory.

An impulse radiating antenna based high power electromagnetic source is being developed. The Detection of buried mines using pulsed electromagnetic fields has been started. Research on novel materials for Electromagnetic Shielding, Chaffing and camouflage applications is being carried out. Research on improving the thermal conductivity of insulating materials used in a high voltage power apparatus has been initiated. Lightning shielding failure analysis of 1200 kV transmission lines has been carried out. The development of an improved version of Line Traps for use in High Voltage Substations has been started.

### **System Science & Signal Processing**

Novel theoretical results have been obtained to show that empirical risk minimization under 0-1-loss function is robust to label noise. It is also shown that none of the standard convex loss functions shares this robustness property. An







algorithm has been developed to discover most relevant temporal patterns from symbolic time-series data by using the minimum description length principle.

We have proposed new algorithms for epoch detection in voiced speech and closure-burst transitions of stops and affricates in continuous speech: performance of both algorithms exceeded those of the current state-of-the-art algorithms. We have proposed Attention-Feedback Segmentation for online handwritten words, which opened up a new direction of research in handwriting recognition. A patent has been filed for a novel algorithm for alignment of curved text in scene images. We have developed elegant, computationally simple algorithms for text localization from born-digital images and text segmentation from scene word images – these algorithms were placed in the second and third positions in Robust Reading Competitions, ICDAR 2013, and Washington DC, USA. We have combined local and global features for online Tamil handwritten character recognition – our results on ICFHR database are the best so far in the literature. National level research consortium projects on robust document analysis and online handwriting recognition on Indic scripts is continuing for the seventh year as part of the II Phase.

A state-of-the-art research laboratory with emphasis on signal and image processing research has been set up in the department. New techniques for obtaining smooth amplitude and frequency modulations in time-varying signals such as speech and audio have been investigated and developed. Optimum filtering schemes to suppress noise in speech, electrocardiogram signals, and images under various noise conditions have been developed. The filters were extended to compute dynamic parameters in speech recognition applications and were found to increase the overall accuracy in the presence of noise. Further research will be continued in the areas of signal and image restoration, automated image analysis, bio-acoustic signal analysis, sparse signal processing, phase retrieval, and sampling theories.

Algorithms have been developed for distributed target tracking in camera networks using the unscented information filter combined with a consensus algorithm. A Novel method for improving

motion compensation in a multi-view video encoder has been developed using 3D-Warping. A new DSA image registration method has been developed that uses a non-uniform MRF model and our new concept of pivotal and non-pivotal control points. A new scattered data approximation algorithm that does not require solving large system of equations has been developed.

### Electrical Communication Engineering

**Staff: Academic: 18; Scientific: 6; Technical: 1**  
**Students: PhD: 126; MSc (Engg): 10; ME: 77**  
**Degrees Awarded: PhD: 8; M Sc (Engg): 7; ME: 48**  
**Publications: 167**

The Department of Electrical Communication Engineering has expertise in the areas of signal processing, communications and networking, nanoelectronics, VLSI, electromagnetics, microwaves, photonics and optics. The research highlights for 2013 are presented below.

### Signal Processing

The detection of mixed sound sources has been explored, in terms of “who, what, where and when”, using single microphone data, multi-microphone data and a-priori trained stochastic models. A low-cost var-echoic (variable reverberation) enclosure using the existing reverberation chamber has been designed and constructed. This will be used for experiments with multi-microphone sound processing, under practical reverberation conditions. The structure of Carnatic music is being analyzed using machine learning methods. A hierarchical method of classifying different forms of a Carnatic music concert was proposed. The mixed sound source approach has also been used for the detection of segmenting polyphonic music.

Antenna selection techniques for spatial modulation systems, and spatial modulation schemes for low-complexity communication systems, have been developed. Channel estimation algorithms, based on the minimum bit-error rate framework for multiple input multiple output (MIMO) communication systems, were also developed.

A fast eigen-solution for solving homogeneous quadratic minimization problems with constraints has been developed. Novel sparse signal recovery techniques using a fusion framework have also





been developed. Signal processing algorithms for indoor positioning systems using inertial navigation systems have been developed.

Receive filters have been designed for vector-quantiser based source compression schemes to mitigate the effect of noisy channels. Training sequences that exploit channel reciprocity in multiuser (cellular) multi-antenna systems have been designed, with user selection. The limits of signal detection, under model uncertainties, such as uncertainty in the noise variance and knowledge of the data-bits, have been determined. In the context of GPS signal detection, new “differential post-detection integration” techniques have been proposed, that overcome some of the limitations of previous detectors.

Power management policies for energy harvesting sensors with acknowledgement-based packet retransmissions, have been designed. A decision-theoretic framework has been proposed, to model the power management problem as a Markov decision problem with partial observability of the channel state (since the acknowledgement messages from the receiver only provides partial information about the channel). The Markov decision theory has also been used for receive antenna selection, where the problem was modeled as that of sequentially deciding which of the available antennas to use, to receive each packet. Another significant work was presented as a two-part paper, describing the inner and outer bounds on the generalized degrees of freedom of multiuser MIMO Gaussian symmetric interference channels.

Several marginalized and Bayesian Cramer-Rao bounds, on the performance of sparse signal recovery in the Bayesian setting, were obtained. It was shown that the sparse Bayesian learning algorithms come very close to achieving these Cramer-Rao bounds, so that, at least when the true model matches with the assumed model, sparse Bayesian learning (SBL) is a good algorithm to use. However, it was found that in practice, SBL works quite well even when the true model is quite different from the assumed model.

### **Communications and Networking**

The Markov decision theory has been employed to develop algorithms for the deployment of

wireless relays in an “as-you-go” fashion, as a deployment agent walks from a sink (i.e., a base station) to a sensor (whose location is discovered as the agent walks over the line). Optimal algorithms have been developed for achieving one and two connected networks that minimize a sum cost involving the power and outage at each step. Heuristic algorithms have also been proposed; these algorithms are model-free. An experimental platform has been developed, and deployment experiments have been conducted on the Jubilee Gardens forest trails.

In earlier work on geographical forwarding in wireless sensor networks, a light traffic setting was considered, where just one packet traversed its way through the network, being locally optimally forwarded, based on a local trade-off between link quality and progress. This work has now been extended to the situation where pairs of packets contend for relays. The Markov stochastic game theory was used to derive locally optimal rules for the contending forwarder nodes to bid for a relay.

Online social networks are now being used more and more for disseminating content. In this situation, content creators can be viewed as contending for influence over the viewer. A stochastic model for a user’s time-line has been developed, which incorporates the following features: the level of influence that the content has, the decay of influence with time, the fact that the user scans the time-line from the top, thus paying less attention to items that appear low down on the screen or off the screen. The problem of competition for influence over the user has also been formulated.

In relation to codes for distributed storage networks, several advances have been made. In the first advance, the properties of codes were combined with locality: the codes were regenerated to construct a family. These are now termed as a family of codes with local regeneration. Bounds and optimal constructions of this class of codes, was also provided.

Progress has been made on understanding the behavior of regenerating codes at interior points of the storage-repair bandwidth tradeoff. The first code construction, that was probably optimal at an interior point, has been provided. It has also





been proven that exact-repair codes have a tradeoff that is clearly separated from the tradeoff that holds for their functional-repair counterparts.

Bounds and optimal constructions of codes, that are capable of recovering locally from multiple erasures, have also been developed.

In the field of sensor networks, in collaborative work across the IISc campus, a sensor platform based on the PIR sensor has been built, and is currently being tested.

Connections between discrete polymatroids, vertex graph coloring and physical layer network coding, have been established. Also, it has been shown that space-time coding can be employed for an interference network to lead to diversity gain, apart from interference alignment. Fast-decodable space-time codes, with large coding gain, have been constructed for multiple-input double-output systems. Also, techniques for minimizing the complexity of fast sphere decoding of space-time block codes, have been reported.

In research on high speed TCP protocols, TCP cubics and TCP compounds were studied, and their analysis in multi-router, multi-TCP environments was performed. Algorithms for spectrum sensing in a wide-band environment when observations are received in the compressed domain, were developed. Also, universal source coding techniques were used for sensing in a non-parametric sequential set-up. Cooperative ARQ protocols were developed to enhance the throughput and fairness, and, to ensure the quality of service in a WLAN network. Efficient power allocation algorithms for interference channels were developed. The optimal tradeoff between the average transmitted power and the average data queuing delay at the transmitter, for a fading point-to-point link with perfect channel state information at the transmitter, was comprehensively analyzed through geometric bounds on the stationary probability distribution of the queue length.

In collaboration with researchers in the Mathematics department at IISc and the Chinese University of Hong Kong (CUHK), thresholds for phase transitions in the Bethe approximation to the PML estimate were found. The type of interactive public communication necessary to generate an optimal-rate secret key from a source

of correlated randomness, is being investigated. An attempt is being made to obtain the performance guarantees for the generalized belief propagation algorithm, when used in the problem of counting constrained binary arrays.

Efforts are being made to reduce the complexity of lattice coding-based algorithms for reliable and secure computation in the setting of a bidirectional relay with Gaussian noise. In particular, the use of nested lattice codes using Low-Density Construction-A (LDA) lattices, is being investigated.

The problem of the distributed computation of a desired average on a network, was studied. The issues with a classical asynchronous gossip scheme were highlighted. An alternative scheme, based on reinforcement learning, was proposed, and its convergence to the desired average was proved. Another reinforcement learning algorithm, for the distributed computation of the dominant eigenvector of a nonnegative matrix, was proposed. This has applications in a wide variety of settings of current interest such as in ranking schemes, reputation networks, and principal component analysis.

New, optimal, interference-aware transmission policies for underlay cognitive radios, were developed. This is a promising technology to alleviate the critical spectrum shortage faced today. These include new and optimal low hardware complexity antenna selection rules for power and interference constrained multi-antenna cognitive transmitters, and new transmission rules for a general and popular interference outage constraint that is well suited for an underlay cognitive radio. A comprehensive new model for the interference caused by cognitive radios to higher priority primary users, was also developed. The model distinguishes itself by modeling not just snapshot statistics, such as probability distribution and moments, but also the more sophisticated time-varying statistics, such as the level crossing rate and the average fade duration. New optimal timer-based selection algorithms were also developed, which are fast, distributed, and scalable. For the first time, it was shown that the design of the selection scheme is intimately tied to the discrete rate adaptation policy used by all practical wireless systems. Further, a new, optimal timer scheme for the practically-motivated







scenario was presented, in which, the number of contending nodes is unknown or random. These have applications to a wide variety of wireless systems such as cellular systems, wireless LANs, sensor networks, and vehicular networks.

Powerful new splitting-based selection algorithms were developed, which significantly reduce the feedback overhead that plagues current orthogonal frequency division multiple access (OFDMA) systems. It was shown that these handily outperform several state-of-the-art ad-hoc approaches.

### **Microwaves and Photonics**

An all-pass filter circuit, with surface mount components was developed. The circuit demonstrated a superior bandwidth and delay slope for a small size (5.6/6 mm) and insertion loss (1dB). The wideband microwave absorption characteristics of a two-layer dielectric slab were demonstrated, by an appropriate design of the patterns on these layers. In addition, a model order reduction approach was developed, which can substantially reduce the computational requirements for the finite element analysis of electromagnetic scattering problems.

Optical orthogonal frequency division multiplexing (OFDM), is an effective solution to inter-symbol interference caused by a dispersive channel, such as an optical fiber. Mode Division Multiplexing (MDM) is used to enhance the capacity of an optical fiber system by providing additional degrees of freedom in the form of modes, in which a few modes are selectively excited at the transmitter and detected at the receiver. The OFDM, polarization multiplexed OFDM, and MIMO-OFDM (with coherent detection) schemes were studied.

### **Nanoelectronics and VLSI**

A new substrate for back gated graphene transistors with 30 nm  $\text{HfO}_2$  film on Silicon, has been proposed. It achieves the best reported transconductance values on bi-layer graphene transistors. Integrated microwave synthesized Zinc Ferrite, in a standard CMOS process, has been used to achieve the best inductor performance reported to date.

A new design, based on the fringe-field junctionless transistor, has been proposed, for an ultrasensitive displacement sensor. A combination of KOH and TMAH wet processing has been developed, to produce very low reflectivity silicon surfaces for photovoltaic applications.

A platform for bio-sensing technology, based on Etched Fiber Bragg Gratings (EFBG), has been developed. The theoretical performance limits of this technology have been determined, and various applications of this technique, such as the detection of bio-molecules, and the investigation of conformational changes in polymer films and gas detection ( $\text{CO}_2$ ), have been demonstrated. It has been hypothesized, that an array of receptors might enable a more selective identification of target molecules in complex samples. As part of a project funded by the Robert Bosch Center for Cyber Physical Systems at IISc, work has started on the development of EFBG sensor arrays. In the last year, a post-fabrication calibration method for EFBG sensor arrays, has been conceived and demonstrated. The method was able to calibrate a 4 element array to within 5% inter-sensor signal variation while the un-calibrated array response had an inter-sensor variation of around 400%.

A wafer scale fabrication method of a three-dimensional photonic metamaterial with a strong chiroptical response in the visible region of the electromagnetic spectrum, has been developed. The system was comprised of metallic nanoparticles arranged in a helical fashion, with a high degree of flexibility over the choice of the underlying material, as well as their geometrical parameters. This resulted in exquisite control over the chiroptical properties, most importantly, the spectral signature of the circular dichroism. In spite of the large variability in the arrangement, as well as the size and shape of the constituent nanoparticles, the average chiro-optical response of the material remained uniform across the wafer, thus confirming the suitability of this system as a large area chiral metamaterial. By simply heating the substrate for a few minutes, the geometrical properties of the nanoparticles could be altered, thus providing an additional handle towards tailoring the spectral response of this novel material.





In another project, a system of reciprocal nano-swimmers has been developed, which can be powered with small homogeneous magnetic fields, and whose motion resembles that of a helical flagellum moving back and forth. The diffusivities of the swimmers have been measured to be higher compared to non-actuated objects of identical dimensions at long time scales, in accordance with certain theoretical predictions. Randomness in the reciprocity of the actuation strokes was found to have a strong influence on the enhancement of the diffusivity, which has been investigated with numerical calculations.

The embedded sensing, communications and processing laboratory has focused on low power circuits and systems techniques for cyber-physical systems applications like tele-medicine and video surveillance. In this context, a project in the area of remote rural neonatal monitoring, in collaboration with St. John's Hospital, needs to be highlighted. In this project, a coin cell operated smart belt and smart socks for neonates are being developed. The smart belt has embedded sensors for monitoring temperature, breathing rate and heart rate. The smart sock has a sensor for monitoring oxygen saturation. This data is wirelessly transmitted to the city-hospital so that the neonates can be continuously monitored for the first two weeks of life. In case of any abnormalities in the readings, the doctors are notified, who in turn will initiate the appropriate intervention procedures. Initial prototypes of the devices have been tested, and the results will be published.

In the analog and RF systems laboratory, a new project, funded by the department of electronics and information technology (DEITY), on the design and characterization of CMOS based 20/60 GHz broadband transceiver components, was started. The primary objective of this project is application-oriented research, which will lead to the design of a critically needed RF component, resulting in an import substitution for Bharat Electronics Limited (BEL). In addition, using theoretical and experimental methods, the project will explore various techniques of extending the operating frequency range of CMOS based RF integrated circuits and systems. Ongoing work in the area of CMOS based cognitive radio components, and the design of Built-in-Self-Test (BIST) circuits for

high frequency analog/RF applications has resulted in several functional integrated circuits.

## Electronic Systems Engineering

**Staff: Academic: 9; Scientific: 5**

**Students: PhD: 44; MSc (Engg): 11; ME/M Tech: 81**

**Degrees Awarded: PhD: 6; MSc (Engg): 2; ME/M Tech: 28**

**Publications: 42**

The Department of Electronic Systems Engineering (DESE) was formerly known as the Centre for Electronics Design and Technology (CEDT). The name change from CEDT to DESE happened in January 2012. This centre was established in the Electrical Communication Engineering department of the Indian Institute of Science in November 1974. Over the years, the centre has been renamed as a department, and its activities have undergone major changes. The primary concern of the department is to harness appropriate technologies, processes, models, and concepts to build prototype systems that provide solutions to problems in a variety of application domains. The main mission of DESE is to conduct research in areas of importance to Industry and to offer programmes that train engineers as creative designers of cutting-edge electronics systems. The following is an area-wise description of the research activities over the past year.

**Communication Networks:** The main areas of work are: wireless ad hoc and sensor networks, 3G cellular systems, wireless local area networks (WLANs) and the Internet. Recent topics include lifetime maximization in sensor networks, QoS aware medium access control, resource management in 3G cellular networks, association policies for WLANs, and pricing for the Internet.

**Power Electronics:** Faculty interests include alternate energy systems, power converters, PWM (pulse width modulation) techniques and AC motor drives. Research includes multilevel inverter topologies and control for high power drives, bond graph modelling for the design of switched mode power controllers, sensor-less control for induction motors, desalination of seawater using hybrid energy technology, wind energy capture system for stand-alone applications, quality power supply with magnetic







arm switching and solar energy transport to kitchen for cooking purposes. A direct torque control of an Induction motor using 12-sided polygonal voltage vectors was designed and developed for variable speed electric vehicle applications. The 12-sided polygonal voltage space vector structure is further used for a sensorless vector control scheme, using current hysteresis controlled PWM technique. Here the machine reference voltage vector is estimated using current ripple information and machine steady state model. A low speed of speed sensorless operation is achieved below 1Hz of operation. A space phasor based current hysteresis controller with nearly constant switching frequency has been developed with minimum computational intensity, for any general n-level inverters.

**Signal Processing:** The research is focused on physical modeling, signal processing, and coding/information-theoretic aspects of emerging nanomemory technologies. There are also activities in mathematical biology and applications of quantum information processing. The research emphasis is on a solid mathematical foundation for these nano-physical information storage systems as well as practically feasible ways to meet the challenges of today's industrial R&D needs.

**Nanoelectronics and VLSI Design:** The research is focused on (i) compact modeling of multi-gate transistors (ii) investigation of thermoelectric properties of carbon nanomaterials (iii) performance assessment of 2D channel material based MOS transistors through novel device simulator development (iv) high performance TFET design (v) LDMOS and DeMOS device design and (vi) on-chip ESD Protection. Research has also been conducted on the formal verification of mixed signal systems, high performance sigma delta ADCs, and low energy signal processing architectures.

**Electronics Packaging:** Faculty members are working on low-cost organic package compatible thin-film synthesis methods for embedding ultrahigh capacitance decoupling capacitors for future high frequency, low voltage and high power density ICs, process methodology for realizing resistors on organic substrates using thin foil lamination and electro-less plating of Ni-alloys, and a large-area multilayer build-up process with micro-vias on an organic substrate.

**E-learning:** The current activity is focused on problem based learning (PBL). An intelligent tutor is under development that trains the student to acquire the ability to design simple control systems. Software tools are being developed that would facilitate automatic evaluation of answers to design questions in the first course on digital systems, when the solutions are presented in VHDL.

Keeping in mind our goal of working in areas that not only present great technical challenges but also are socially relevant, we have identified several multidisciplinary application domains that are listed below.

*Wildlife E-Monitoring:* The department is involved in applying technology for conservation and wildlife studies. A number of projects have been carried out in this field, including the development of camera traps, animal tracking using global positioning system (GPS) and wireless networking, and pugmark processing for tiger identification. The Centre is also highly committed to applying cutting-edge technologies for environmental monitoring and agriculture in semi-arid areas of the country.

*Smart Grids and Green Buildings:* Alternative sources of energy (solar, wind etc) must be harnessed to reduce dependence on the main power grid. This calls for designing and prototyping systems that interface highly variable energy-sources with the power grid. A cyber-physical system realizing this goal lies at the intersection of several disciplines including power electronics, instrumentation for sensing, measurement and actuation, control theoretic modelling and communications.

*Healthcare:* A project in neo-natal health monitoring, with faculty from ESE and ECE collaborating with pediatricians from St. John's Hospital, is under way already. The Instrumentation for monitoring patient vital signs and communication modules for conveying this to medical staff are the central themes of this project. Prosthetics is another direction being pursued actively.

*Transportation:* Traffic congestion management and pollution monitoring are among the major issues of worldwide concern. Embedded systems, incorporating location using GPS and





communication using GPRS technologies, have been designed and tested as part of a project to build a Real Time Passenger Information System. The system provides users an up-to-date snapshot of bus locations on the roads; further, it supports multiple modes of interaction with passengers, including web-based and mobile-phone based, to provide information like the estimated time of arrival of the next bus at a stop.

*Defence:* Several faculty across departments in the Division of Electrical Sciences are associated with a DRDO-sponsored project on Unattended

Ground Sensor (UGS) networks for detecting intrusions into protected spaces. In the prototype deployment that has been demonstrated several times, PIR sensors have been used for detecting intrusions and IEEE 802.15.4 MAC for communication. Important concerns that will receive special attention in the second phase of the project are improved detection and target classification algorithms, energy-neutral operation of nodes utilizing energy harvesting approaches, and the packaging of nodes for weather-proofing and camouflaging.

#### 4.1.4 Division of Mechanical Sciences (Chairman: K Chattopadhyay)

The Division consists of the following Departments/Centres/Units:

- ❖ Aerospace Engineering
- ❖ Chemical Engineering
- ❖ Mechanical Engineering
- ❖ Materials Engineering
- ❖ Product Design and Manufacturing
- ❖ Atmospheric and Oceanic Sciences
- ❖ Divecha Centre for Climate Change
- ❖ Civil Engineering
- ❖ Management Studies
- ❖ Centre for Sustainable Technologies
- ❖ Centre for Infrastructure, Sustainable Transportation and Urban Planning

##### Aerospace Engineering

**Staff:** Academic: 26; Scientific: 10

**Students:** PhD: 132; MSc (Engg): 27; ME/MTech: 58

**Degrees Awarded:** PhD: 7; MSc (Engg): 3; ME/MTech 28

**Publications:** 191

The Department of Aerospace Engineering, Indian Institute of Science, Bangalore, is one of the premier academic departments in its field covering academics and research and it continues to excel through very significant contributions to aerospace and allied fields. The research highlights from the department in four major areas during the year 2013 are presented briefly in this report.

**Structures:** Specific research has been pursued on developing analysis techniques for design optimization and structural integrity assessments (including processing effects) in laminated composite structures. The Non-Destructive Evaluation (NDE) of hygrothermal effects on polymer composite materials with varied porosity is being investigated through an experimental approach. The Effects of the addition of plain and functionalised CNTs to polymer composite materials is another exciting area of research that is being pursued. Software development testing activities for Integrated Vehicle Health Management (IVHM) and product life cycle analysis and design are being carried out. Isospectral inverse problems in vibration are addressed using analytical and computational methods. Finite element models for damage in composites and the effect of uncertainty in composite damage detection have also been developed.

During 2013, the following facilities have been added. Computer clusters, and a data center with specialized software codes, capable of handling supercomputing jobs involving multi-scale finite element simulation, wave propagation, impact dynamics, molecular dynamic and quantum mechanical problems involving several billions of degrees of freedom have been added. The data center also hosts software development testing





activities for Integrated Vehicle Health Management (IVHM) and product life cycle analysis, and designs software and simulation environments. The facility is being used internally and by groups in the campus, to perform simulation-centric research.

An hygrothermal chamber of inner volume (0.5 X 0.5 X 0.5) cubic meters has been set up/ This would facilitate experimental research to study the effect of humidity and temperature on the properties of polymer composites in the humidity range of 0.80% and a temperature range of 0-90°C.

The combustion and propulsion group carries out research on various aspects of combustion fundamentals in flames, liquid-droplet dynamics, propellant characterization, and novel electric propulsion methods. New energetic materials are being developed for application as rocket propellants. These include nano-materials for energetic compositions, and green propellants.

A compact, laboratory scale, model gas turbine combustor with multiple injectors and multiple turbulent flames, to emulate interaction dynamics in a modern annular aviation gas turbine combustor, is being commissioned. This setup will be used in studies relevant to annular gas turbine combustor configurations to understand the role of the mutual interaction of flames stabilized on various burners on combustion dynamics as well as other characteristics such as lean blow out and flashback.

Computational investigations and stability analyses seeking to understand the role of hydrodynamic instability in promoting thermo-acoustic instabilities in combustion systems are ongoing. A preliminary reduced order modeling approach that sets up the computational framework for these simulations has been delivered to the project sponsor (Pratt and Whitney, USA). The existing computational cluster has been upgraded to 128 cores and a high speed QDR infiniband has been added to ensure efficient scaling of parallel jobs over large numbers of cores.

Research on the breakup of liquid jets/sheets discharging from non-circular orifices and gas-centered swirl coaxial atomizers, to understand the role of atomizer geometry and flow conditions

on spray drop size distribution, is ongoing. In addition, a study of the impact of water drops on stainless steel surfaces comprising micro unidirectional parallel grooves, in order to understand the role of surface roughness in 'wetting', has been undertaken.

**Aerodynamics:** Laboratory experiments of turbulent boundary layers at significantly lower Reynolds numbers have revealed that the spectra of eddies, larger than those at inertial subrange, to scale according to the same law as predicted at higher Reynolds numbers. The Roles of stream-wise vortices in the late stages of a boundary layer transition were clarified from experiments performed in a low turbulence tunnel using particle image velocimetry and hot wire measurements. Here, the transition was effected well within the boundary layer without being forced by free-stream disturbances, while during local flow separation the separating shear layer itself was found to be stable with the breakdown seen at reattachment. Direct computations of the sound generated by free and impinging turbulent jets were obtained from large eddy simulations. The technique establishes a method for a more accurate estimation of the acoustic loading due to rocket motors. Analytical wave scattering models for supersonic co-flowing jets have demonstrated the existence of an upstream radiation sensitivity that has hitherto not been explored in any detail. The existence and role of absolute instability modes in swirl-stabilized combustors is being studied. A dual-shock-tube, automated, vertical shock wave reactor has been developed for blast mitigation studies; a new needle-less drug delivery system for gene transformation and vaccine delivery has been developed that will use solar energy. Also a manually-operated table top hypersonic shock tunnel has been designed as a teaching aid.

**Guidance and Control:** Research was carried out in the areas of search strategies and the collective behavior of agent swarms, terminal impact time and angle guidance, UAV task allocation using cooperative game theory, cyclic pursuit for consenses and vision-based landing of fixed-wing UAVs. The Problems of decoy deployment for strategies for target evasion, path planning with vision occlusions, UAV cluster control, path planning with parametric curves, composite optical flow based vision guidance strategies, UAV





formation control, extended Dubins' curves for moving target interception, were also investigated. Research activity also focused on the areas of state and parameter estimation, satellite formation flying, robust wing rock suppression, and interceptor midcourse guidance.

Two configurations of micro-air vehicles (MAV) that fit inside a cube of 150 mm have been fabricated and flown. A Robust flight stabilization system and integrated navigation and Control of MAVs have been tested in Hardware in loop simulation, where an indigenously developed integrated Autopilot hardware of weight 7grams is put in the loop. Autonomous flight is expected in the coming year. An Autonomous Nano-air vehicle (NAV) of 75mm size and weighing about 12 grams (all up weight) is being designed. The NAV has already been shown to fly with remote control. Robust PID control is also being designed to control the vibrations in helicopter rotors.

### **Space Technology Cell**

The ISRO-IISc Space Technology Cell (STC) was set up as per an initial MOU of 28 June 1982 between the Indian Space Research Organisation (ISRO) of the Department of Space (DOS), Government of India and the Indian Institute of Science (IISc) to foster the development of basic knowledge in space sciences and technologies through research at IISc with financial support from ISRO.

Several research projects were undertaken by IISc faculty during the year 2013. These projects were in the broad areas of computational mechanics, space propulsion, micro-electronics, remote sensing, sensors, and climate studies. Several projects were completed during the year. A new set of proposals were evaluated and some among them were approved for funding in the next financial year.

Thirty nine papers based on projects that were active in 2013 were presented and appeared in the proceedings of the 30<sup>th</sup> Annual Symposium on Space Science and technology held on 7 and 8 November, 2013. Theoretical studies were on flow modeling including aeroacoustics and atomization. Experiments were on materials and

setups for the characterization of nanowires, magnetic tunnel junctions, carbon nanotubes, investigations of nano-structured plasmonic crystals, and spray distribution in atomizers. Other studies include urban development, forest degradation, vegetation dynamics, self-healing circuits, the migratory cycle of sharks, earthquakes, and heat pipes. Sensors for health monitoring, detection of gases, and telemedicine are being developed under the STC umbrella.

### **Joint Advanced Technology Programme**

JATP facilitates interaction between DRDL/DRDO and IISc. Funds for several in-house research projects were granted this year. These included projects from aerospace engineering, mechanical engineering, materials engineering etc. These projects were selected in the area of basic research and are of interest to DRDL and DRDO. Some of these projects are on 3D failure criteria of composites, vision-based guidance in occluded terrains, complex turbulent flows, real time schemes for multi-core operating systems, thin-film interferometry, anti-corrosion coatings, carbon nano-composites, image analytics, and carbon composites interaction in shock tubes. In addition, several applied research projects were handled by individual faculty members and routed through JATP. A short course on aerodynamics and flight mechanics was organized for researchers from various labs. In addition, JATP hosted the interviews of sponsored candidates from the services and DRDO labs, and various meetings between IISc faculty and DRDO researchers.

### **Chemical Engineering**

**Staff: Academic: 11; Scientific: 2**  
**Students: PhD: 37; MSc (Engg): 6; ME: 33**  
**Degrees Awarded: PhD: 5; MSc (Engg): 2; ME: 14**  
**Publications: 34**

The Department of Chemical Engineering was started in 1943 as a wing of the Division of Pure and Applied Chemistry. The Chemical Engineering wing earned the full status of a department in 1947. In 1961, it was affiliated to the Engineering Faculty and renamed the Department of Chemical Engineering. Our department began as a center







for excellence in research and higher education in chemical engineering to address the needs of a phenomenally growing chemical industry in post-independence India. The department has evolved significantly over the last six decades, reflecting changes in the Indian chemical industry and the chemical engineering profession worldwide.

**Bioengineering:** Using fully atomistic simulations, we have identified novel pathways of the dissociation of protein complexes required for HIV entry into cells and have shown how dendrimers, potential drug candidates, can expedite dissociation and avert HIV entry. In a second study, we have quantified the minimum level of intervention that may allow a host protein called APOBEC3G to suppress productive HIV infection. Our findings represent progress in our efforts to identify novel intervention strategies for HIV infection.

Understanding the interactions of membrane proteins is important in a wide variety of events that can occur in biological membranes. Lysis and pore formation studies have been carried out on erythrocytes as well as supported bilayer membrane platforms. We have developed a kinetic model to quantify the rates at which pore formation and cell lysis occur as a function of the initial toxin concentration. From the kinetics, we are able to predict the pore formation density as observed in atomic force microscopy experiments as well as the lysis dynamics as monitored by hemoglobin release data. These results indicate that several hundred pores are required to initial rupture and lysis in erythrocytes. To gain an atomistic perspective on the action of pore formation, we have carried out fully atomistic and coarse-grained molecular dynamics simulations of the assembled pore complex in a POPC membrane. Coarse-grained simulations over a timescale of several microseconds reveal the presence of a stable pore in the membrane. Simulations reveal a novel mechanism for lipid rearrangement during the late stages of pore formation.

In a study of the influence of signalling on the motility in swimming bacteria, it has been demonstrated that the marine bacterium *Vibrio fisheri* displays a strong effect of signaling on motility long before the usually-studied collective

behaviours, such as quorum sensing, are seen: the addition of the signalling molecule in nanomolar concentrations to a bacterial suspension leads to an almost immediate loss of motility over a very short time scale (seconds). We have hypothesized that a direct interaction of the signal-receptor complex with a motor protein causes this fast response, and are currently attempting to identify the motor protein. Our further aim is to build a quantitative for the signal transduction pathway that results in long-term phenotypic changes (quorum sensing and biofilm formation).

**Hydrodynamic stability and transition:** Experiments have been carried out to demonstrate the existence of a dynamical instability induced by a soft wall in a micro channel of height about 100 microns. It is shown that the transition Reynolds number could be as low as 200, and the transition Reynolds number is reduced due to channel deformation. The transition Reynolds number is 10 times lower than that predicted by previous theories for the flows past flat walls. A linear stability analysis was carried out taking into account the flow modification due to wall deformation, and a numerical agreement was demonstrated between experiments and theory.

**Rheology of granular flows:** The effect of base friction on the flow development in the flow down an inclined plane was studied, and it was found that the flow development is very different for the ordered and disordered states. While there is homogeneous shearing in the disordered state, there is basal shear and a plug flow at the top in the ordered state. This difference in behaviour has been linked to the different flow regimes observed in the flows past bumpy and flat frictional bases.

Experiments on the slow shear of granular materials in a cylindrical Couette cell have shown interesting and seemingly puzzling behavior, where all components of the stress increase roughly exponentially with distance from the free surface. Several plausible explanations have been ruled out, and it now appears that this behaviour is a result of an anisotropic fabric arising from a combination of gravity, shear and confining boundaries. Recent investigations of this problem using DEM simulations have revealed signatures of such a fabric, and also a Taylor-







Couette like secondary flow that has hitherto not been reported.

**Complex fluids:** The effect of edge dislocations on the rheology of a lamellar liquid crystalline medium was studied. Defect interactions could cause the annihilation of defect pairs, as well as the creation of new defects. The excess viscosity due to edge dislocations was predicted from the hydrodynamics, and the effect of flow on the interaction between defects was also studied.

**Water treatment:** i) Defluoridation of drinking water. In 2012, a pilot scale defluoridation unit was set up at Yellampalli village to treat the reject water from a reverse osmosis unit. It was operated only for a month or so as water started leaking from the adsorption columns. So, experiments were conducted in our laboratory using both the reject water and synthetic water. The latter contained anions that were of the same order of magnitude as the reject water. Both activated alumina (AA) and a hybrid anion exchange resin that contained nanoparticles of hydrous zirconium oxide (HAIX-Zr) which were used as adsorbents.

The latter was developed by Prof. Arup SenGupta. In column experiments, about 130 bed volumes (b.v.) of reject water could be treated before a breakthrough occurred, i.e. the concentration of fluoride in the exit stream exceeded the desirable limit of 1 mg/L. When synthetic water with a pH of 5.5 was used, HAIX-Zr and AA were able to treat 750 and 1000 b.v. of water, respectively. The difference between the results for the raw water and synthetic water may be caused by the lower pH in the latter case. The concentration of nitrate was above the permissible limit for both the feed water and water treated with AA. HAIX-Zr was able to take up the nitrate, but only for the first 100 b.v.

(ii) Use of greywater discharged from a washing machine for flushing toilets: Greywater stored in an underground sump was pumped to an overhead tank and then used for flushing toilets (A.R. Shivakumar, private communication, 2011). After a few days of storage, the water developed a pungent odour. Experiments suggest that H<sub>2</sub>S could be one of the compounds responsible for

the odour. The concentration of H<sub>2</sub>S could be reduced significantly by passing the solution through a column of granular activated carbon.

(iii) Biosand filter: Biosand filters are domestic versions of slow sand filters, and are operated intermittently. The filter medium is locally available sand. A filter was constructed using a PVC tube, and water from a pond was fed to the filter daily. Using the MPN (most probable number) test, results showed that about 98% of the total coliforms could be removed after a week of operation. The filtrate was colourless, unlike the feed, which was green in colour.

(iv) Silver treated drinking water: It was found that the concentration of coliform bacteria c<sub>b</sub> could often be reduced significantly by keeping water in contact with a silver sheet (about 130 g of silver/L of water) for 8-24 h. However, only 20% of the samples tested had less than 10 coliforms/100 mL, which is the limit for drinking water. A majority of the samples showed a reduction in the concentration of bacteria, but the water was not potable even after a contact time of 24 h.

(v) Granular flow: The flow of sand through a bin with vertical orifices was examined. Unlike earlier attempts, the wall thickness was included as a parameter in the correlation. The Predicted and measured mass flow rates agreed well.

**Fluids Confined in Nanopores:** Using a combination of ab initio and classical grand canonical Monte Carlo (GCMC) simulations, we study the influence of commonly occurring functional groups on the adsorption selectivity to CO<sub>2</sub> in a CO<sub>2</sub>/N<sub>2</sub> mixture. COOH functionalized GNRs show the highest uptake for both carbon dioxide and nitrogen and have the highest selectivity toward carbon dioxide when compared with the other functional groups investigated. This study conclusively shows that certain functional groups have a higher preference for the uptake and separation of CO<sub>2</sub>. These results can be used while functionalizing materials such as metal organic frameworks, which can be constructed in a modular fashion, for storage and separation applications.



## Mechanical Engineering

**Staff: Academic: 18; Scientific: 5**

**Students: PhD: 108; MSc (Engg): 18; ME: 49**

**Degrees Awarded: PhD: 14; MSc (Engg): 10; ME: 27**

**Publications: 155**

Research activities in the department include theoretical and experimental work in numerous topics belonging to areas such as Solid mechanics, Fluid mechanics, Combustion, Thermal Sciences, Biomechanics, Micro-systems, Robotics, Acoustics, Vibration, Acoustics, Fatigue, Micro-Electro-Mechanical systems (MEMS) and Tribology.

Important aspects pertaining to research activities carried out during the calendar year 2013 in the Department of Mechanical Engineering are summarized below. The list of publications in journals and conferences reflect the broad spectrum of research activities undertaken by the Department.

### Solid Mechanics

#### **Fracture behavior of bulk metallic glasses:**

Bulk metallic glasses (BMGs) have attractive mechanical properties such as high strength and yield strain, but their tensile ductility is low. Some BMGs may exhibit high crack initiation toughness while others may be inherently brittle. The physics of fracture in a nominally ductile Zr-based BMG corresponding to three different structural states was systematically studied. Results showed that stable crack growth occurs inside a dominant shear band irrespective of the structural state and mode mixity, before attaining criticality. *The mean ridge heights on fractured surfaces were found to correlate with the toughness of the BMG.* The meniscus instability model was modified to explain the experimental observations.

Recent atomistic simulations and experiments have shown that brittle metallic glasses fracture by a cavitation mechanism. Atomic scale fluctuations in density and strength are believed to be responsible for this behavior. In order to gain further insights, a continuum analysis of cavitation in a heterogeneous plastic solid with distributed weak zones was conducted. *The analysis showed that the presence of weak zones associated with low atomic density can give rise to cavitation at low hydrostatic stress levels and also to interesting*

*bifurcation patterns including snap cavitation.* In a further investigation, it was found through atomistic and continuum simulations that shear bands can mediate cavity nucleation and coalescence owing to plastic flow confinement caused by material softening.

#### **Mechanics of fracture in single and polycrystalline FCC metals:**

A combined experimental-numerical study was performed to understand the process of void growth near a notch root in Al single crystals. Three equally-spaced cylindrical voids were placed directly ahead of the notch tip. The predicted load-displacement curves, slip traces, lattice rotation and void growth from the computational analysis were found to be in good agreement with the experimental observations. *The interaction between the notch and void through the development of shear bands was clearly delineated.* The numerical results showed considerable through-thickness variations in both hydrostatic stress and equivalent plastic slip. The above through-thickness variations affect the void growth rate and cause it to differ from the center-plane to the free surface of the specimen.

The effects of plastic anisotropy and evolution in crystallographic texture with deformation on the ductile fracture behavior of polycrystalline FCC alloys were studied through continuum simulations following two approaches. The first approach was based on the Hill yield theory, while the second employed crystal plasticity constitutive equations and a Taylor-type homogenization in order to represent the ductile polycrystalline solid. The initial textures pertaining to continuous cast Al-Mg AA5754 sheets in recrystallized and cold rolled conditions were considered. The results indicated distinct changes in texture in the ligaments bridging the voids ahead of the notch tip with an increase in load level which gives rise to retardation in porosity evolution and an increase in tearing resistance.

#### **Contact mechanics in the presence of Adhesion:**

A new framework to study the attractive forces resulting from van der Waals forces in the contact of deformable bodies has been developed. Adhesive force has been modeled as a body force in contrast to the surface force approximation used in other studies. Some fundamental questions that have remained



unresolved in contact mechanics are being addressed using this framework.

## Fluid Mechanics

A study of the stall flutter of blades of turbomachines, such as those in aircraft gas turbine compressors has been undertaken. Such flow-induced vibrations are detrimental both for the structural integrity of the blade and the overall machine performance. Using measurements at low speeds, it became possible to demarcate the boundaries for the stall flutter of a given blade geometry and get an insight into the flow physics responsible for it. Actual aircraft gas turbine compressors operate at transonic speeds, where shocks appear and the resulting flow physics is more complex as it involves the interaction of shocks and separation zones/wakes. A new transonic oscillating cascade facility is being developed to help understand this phenomenon.

## Combustion

Property variations in nanofluid concentrations and structure formation in functional droplets (nanofluids, precursors) subject to external heating in a contactless environment have been studied extensively. Acoustic levitation has been used as the primary mode for the detailed study of the precipitation, vaporization and flow physics inside such droplets. Extensive studies have also been done in respect of a) modeling and experiments on spray breakup and vaporization, b) instabilities of swirl stabilized flows (precessing vortex core, vortex breakdown bubbles) and c) Droplet combustion

**Analysis of the agglomeration dynamics and flow-induced transport in thermally heated levitated droplets:** In this study, the complex kinetics of nanoparticle agglomeration induced by recirculating flow inside a droplet has been studied. The droplet was levitated and hence was in a container-free environment. The effect of an external heat load on thermo-physical phenomena and agglomeration dynamics was also explored.

**Combustion Instability in swirl stabilized premixed flames under acoustic loading:** Modern gas turbine combustors or aero engines are prone to thermoacoustic instabilities arising out of the strong coupling among the pressure field, velocity perturbations and heat release from the flame front. The current study is dedicated towards understanding the fundamental physics that leads to the instabilities using laser-based diagnostics in a laboratory swirl stabilized burner.

**Droplet atomization and stability in an acoustic field:** Droplet atomization and the precursor to catastrophic breakup in an acoustic field have been studied experimentally in an acoustic levitator.

A new method of atomization, namely, air-assisted impinging jet atomization has been proposed and demonstrated for the atomization of viscous liquids. The results show that the droplet sizes beyond a critical momentum ratio are independent of liquid viscosity and surface tension over a large range. The chemical kinetics of  $\text{NO}_x$  formation in syngas-air combustion have been extensively studied and the various pathways of  $\text{NO}_x$  formation have been identified at atmospheric and high pressure combustion. The Planar Laser-induced Fluorescence (PLIF) technique has been used to study fuel-air mixing and combustion in a compact trapped vortex combustor which has potential to be incorporated in small gas turbine applications. The results show that highly stable combustion can be achieved along with high efficiency and low emissions with fuels such as methane and syngas, with the cavity fuel-air momentum ratio being an important parameter. This experimental work is complemented by multi-dimensional computational fluid dynamic (CFD) modeling of the associated thermo-fluid dynamic processes. A novel two-stage, low temperature combustor design is proposed as a hybrid heating source for a solar thermal power plant application. This design has the potential to achieve high energetic and exergetic efficiencies with near-zero pollutant concentrations.





## Thermal Sciences

**Solar cooling and desalination system using double stage adsorption technology:** Most rural areas in India are perennially starved of potable water and reliable electricity for the cooling needed for the preservation of agro-produce. The commercially available technology for desalination such as a multi-stage flash is energy intensive and requires heat input at high temperature ( $>120^{\circ}\text{C}$ ) whereas membrane-based technology like Reverse Osmosis consumes substantial electricity.

The Indian subcontinent receives abundant sunshine with reasonable insolation levels throughout the year. As such, there is a pursuit for cost effective desalination technologies using low grade heat energy ( $<100^{\circ}\text{C}$ ). An Adsorption-based solar desalination system addresses this need and can potentially run with a low temperature heat source ( $\sim 70^{\circ}\text{C}$ ) using a rooftop solar heater. It is envisaged that this technology could have a significant impact on Indian rural society by providing clean, potable water. In this system, brackish water is flash evaporated at low pressure. The low pressure steam generated is subsequently compressed to condenser pressure using a dual stage thermal compression process. This process is analogous to the mechanical compression used in a traditional refrigeration system. A Dual stage thermal compression is realized using four silica-gel adsorber beds in each stage which are cyclically cooled and heated using alternate streams of cold and hot water from solar heaters. The compressed steam released during the desorption process is eventually condensed state to the liquid state. The condensed water is potable and free of dissolved salts. The key features of the dual stage adsorption system being developed are listed below:

- Flash evaporation takes place at 1 kPa leading to a chilled water output at  $10^{\circ}\text{C}$ .
- A solar PV can be integrated with the adsorber system to meet the parasitic power requirements for the operation of valves and pumps.
- The adsorption system requires  $\sim 12$  kW of low grade heat at  $\sim 70^{\circ}\text{C}$ . This heat is obtained from hot water using a solar water heater.

- Depending on the ambient conditions, the system can be switched between a single-stage or two-stage mode of operation.
- The system requires minimal maintenance except for the periodic removal of brine concentrate from the evaporator.

**Development of a PCM Coupled Heat Pipe for spacecraft cooling:** The research highlights pertaining to this work are:

- The system requires minimal maintenance except for the periodic removal of brine concentrate from the evaporator.
- Phase Change Material (PCM) coupled heat pipes can significantly reduce the thermal mass of the existing heat pipe modules used for satellite cooling.
- Design of the PCM module is challenging as heating addition and release time frames are not symmetrical.
- Selection of a PCM material is challenging as it calls for minimal volumetric expansion during phase change.
- Thermal conductivity enhancers and heat sink modules have to be tailor designed for space applications depending on the transient spacecraft heat load.
- Potential of reducing the overall spacecraft electrical load as PCM coupled heat pipes can potentially eliminate the need for electrical heaters required to prevent the freezing of onboard electronic devices.

**Thermoelectric Generator for Urban transportation:** The research highlights in this work are:

- Design of a heat exchanger for recovering waste heat from the exhaust is critical on account of varying heat loads due to diverse driving conditions.
- Performance of the thermoelectric generator (TEG) module is affected by the temperatures of both the heat source and heat sink. The Placement of the TEG modules is a significant challenge in ensuring consistent and optimum performance.







**Research Test Bed for Solar Thermal Power by Organic Rankine Cycle :** This facility is being set up at IISc's Challakere Campus as part of a major project funded by the Government of Karnataka. The project is being executed through IISc's Interdisciplinary Centre for Energy Research (ICER), in which faculty members from the Department of Mechanical Engineering are actively participating. A short description of the test bed being set up is given below:

The solar thermal test bed for distributed power generation currently has been planned using an Organic Rankine Cycle (ORC) system that is capable of generating power from a medium temperature heat source. However, the research field can incorporate other power cycles. The test bed plant is designed initially for delivering a gross power output of 30 kWe and scalable to 100 kWe. It consists of the following major blocks: a Solar & Thermal Source Island, and a Power Island.

The Solar-island consists of a collector system, a tracking system and a heat transfer fluid (steam in this case). A diesel fired steam generator will act as an auxiliary heat source (in place of solar) to demonstrate the concept of hybridization for uninterrupted power generation. The power island consists of an evaporator, an expander coupled with a generator, and a condenser. The steam from the solar island provides the heat input to the evaporator. In the evaporator, organic fluid vapor is generated which is then expanded in the expander. The work done in the expander is converted to approximately 30 kWe (scalable to 100 kWe) gross electrical power. The expanded organic vapor then condenses in a water-cooled condenser and rejects heat to cooling water. Cooling water then finally dissipates heat to the atmosphere in cooling towers. The steam condensate from the evaporator returns to both the solar and boiler islands.

*The test bed research thrusts are:*

- Modular design of the solar field allows testing of multiple technologies in the solar field (different collector systems, coatings, mirrors, and tracking systems).
- The system design integrates and tests thermal storage, hybridization, and non-water based cooling systems.

- Various organic working fluids will be tested. To begin with, R245fa (with an operating temperature of about 150°C) will be used, but the solar field will be qualified to handle higher temperature organic fluids up to 350°C for high efficiency ORC plants.
- Performance testing of indigenously developed turbines/expanders can be conducted in this test bed.

**Research on Solidification Modeling / Process Development:** At the National Facility for Semisolid Forming, research on solidification modeling and process development for light weight manufacturing has progressed significantly. The following are some highlights:

- **Development of an enthalpy model for eutectic solidification:** A new micro-scale model for the solidification of eutectic alloys based on the enthalpy method has been developed. The model simulates the growth of adjacent  $\alpha$  and  $\beta$  phases from a melt of eutectic composition in a two-dimensional Eulerian framework. The present model can potentially be incorporated into the existing framework of enthalpy-based micro-scale dendritic solidification models thus leading to an efficient generalized microstructure evolution model.
- **A model for predicting shrinkage driven flow during solidification:** A CFD model for the simulation of solidification shrinkage has been developed. This is the first mechanistic model capable of predicting shrinkage induced flow, free surface deformation and void formation during a casting process. The present model provides the foundation for the development of a generalized shrinkage model to accurately predict the formation of internal porosity and external surface deformation due to shrinkage.
- **Thixocasting of wrought aluminium alloys:** Wrought aluminium alloys have excellent mechanical properties







but are generally not castable because of defects such as hot tearing. A novel method has been developed to cast a wrought aluminium alloy (6061) through a thixocasting route without any defect. This research forms the foundation of the development of cast products using wrought alloys, which will give excellent mechanical properties with aluminium, and hence further light weight automobiles can be achieved.

### **Biomechanics and Microsystems**

A two-axis micromachined in-plane accelerometer was fabricated, packaged, and tested. It has a special design feature that amplifies the displacement along two axes while retaining the de-coupling between the two axes. It is shown to have the highest figure of merit that combines sensitivity and bandwidth, as compared with accelerometers reported thus far.

### **Robotics and Design**

- Miniature grippers and micromanipulation platforms are perfected to handle cells of 10-15 microns in diameter. Breast cancer and liver cells cultured in-house using miniature perfusion bioreactors were manipulated and their bulk stiffness was characterized. This experimental component is complemented by a computational technique that measures force using visually captured images and estimating the bulk stiffness of cells by solving an inverse problem in mechanics.
- Static balancing techniques that use only springs to achieve the constant potential energy of a mechanism in all its configurations have been improved with practical applications in mind. In particular, two major goals have been accomplished: (i) making the balanced potential energy as low as possible and (ii) making the bearing reactions constant and minimum. Practical devices were built to demonstrate the methodology developed.

### **Technical Acoustics:**

A lumped-element flow-resistance network approach for the evaluation of the back-pressure of perforated-element automotive mufflers has been developed and corroborated. An analytical technique has been developed for determining end-corrections in a single-inlet single-outlet flow-reversal end-chamber muffler. This enables an extension of the plane-wave analysis right up to the cut-off frequency.

### **Acoustics and Vibration**

Asymptotic wave number expressions in fluid-filled orthotropic shells in various frequency regimes are being derived. The difficult low frequency expressions were developed bringing closure to this topic.

### **Materials Engineering**

**Staff: Academic: 20; Scientific: 5; Technical: 1**  
**Students: PhD: 97; MSc (Engg) 2; ME: 37**  
**Degrees Awarded: PhD: 7; ME: 15**  
**Publications: 187**

The research profile of the department is very broad. Research is being carried out in areas such as biomaterials, polymers, structural/functional ceramics and alloys, nanoparticles and thin films, coatings, materials and mineral processing and computational modeling.

In the field of nano particles research, new developments have taken place in the preparation of nanoengineered polyelectrolyte capsules using graphene oxide and polymers. These capsules have been characterized for their response to various stimuli such as enzymes, laser and pH, and drug delivery capabilities. A Nuclear magnetic resonance (NMR) technique has been employed to determine the T1 and T2 relaxivity of chitogen coated nanoparticles of Fe and Co-ferrite. Zn-based ferrite nanoparticles have also been tested for their potential application as contrast agents in the magnetic resonance imaging (MRI) technique. A polymer/graphene based bilayer architecture has been developed for application as a gas barrier material for which a patent has also been filed. Research has been initiated on





the role of electrolyte chemistry on the electronic and in-vitro electrochemical properties of micro-arc oxidized titania films of Cp Ti. In the area of bio-mineral-processing research, a selective flotation of spharelite from a sphalerite-galena mineral mixture has been achieved using cells and extracellular secretions of *Bacillus megaterium* after adaptation to the chosen minerals.

Micromechanical tests have been developed and used to determine the mechanical properties of bond coats on superalloys with high spatial resolution. An In-situ total internal reflection Raman tribometer has been developed to detect shear thinning in liquid lubricants and the alignment of crystals of solid lubricants under a contact. Indentation experiments have been used to study deformation and phase changes in molecular crystals and shape memory alloys.

In the field of intermetallics, there is intensive ongoing research on diffusion in solids with special emphasis on materials in electronic packaging, bond coats, and A15 intermetallic superconductors. Phenomenological models in binary and multicomponent systems have been developed. Extensive work has been carried out on the mechanical properties and oxidation resistance behaviour of intermetallic eutectics:  $\text{Ni}_3\text{Al} + \text{Ni}_7\text{Zr}_2$ ,  $\text{NiAl} + \text{Ni}_7\text{Zr}_2$  and  $\text{NiAl} + \text{Ni}_3\text{Al} + \text{Ni}_7\text{Zr}_2$ . These alloys have shown promise for high temperature applications. A combination of high strength and ductility has been achieved in the friction stir processed Ti-alloy Ti5553. Research has also been initiated to understand the precise role of Ru and Re in the micro-segregation of Ni-based superalloys. Combined experimental and computational studies have been undertaken to probe the effects of alloying elements on structural stability and fault energies in Ni- and Co- based superalloys. The Development of an Al-Cu based wrought alloy for high temperature applications and Mg-Li based superlight alloys for aerospace applications is also underway.

In the area of piezoceramics a great deal of understanding has been acquired with regard to the core structural factor which brings about depolarization in  $\text{Na}_{1/2}\text{Bi}_{1/2}\text{TiO}_3$  (NBT) based lead-free piezoceramics. Temperature dependent XRD, neutron diffraction and TEM studies in

conjunction with first principles computation, dielectric, ferroelectric and piezoelectric characterization revealed for the first time that the depolarization in NBT is caused by the subtle onset of out-of-phase octahedral tilt on a local scale. Research has also been initiated in polymer-ceramic ferroelectric/piezoelectric composites.

In the field of modeling, a simple mathematical model has been developed to describe slag-metal emulsion behaviour, and how droplets travel through the slag phase to enhance the heat and mass transfer of the system. The department's research profile in the area of computational materials science is expected to grow with the joining of Dr. Abhik Choudhuri in 2013 as an Assistant Professor. His research interest is in computational materials science, more specifically in the development of quantitative phase field models for the understanding of complex microstructural evolution in alloy systems.

## Product Design and Manufacturing

**Staff: Academic: 5; Scientific: 2**

**Students: Ph D: 29; M Sc (Engg): 8; M Des: 39**

**Degrees Awarded: PhD: 6; MSc (Engg): 3; M Des: 14**

**Publications: 29**

The Centre for Product Design and Manufacturing, commonly referred to as CPDM, has established an identity as a premier centre offering an MDes (Master of Design) degree in Product Design and Engineering which combines training on the holistic aspects of design with product realization. Simultaneously, the department is engaged in leading edge research in a number of areas such as design methodology, creative design, PLM (Product Lifecycle Management), CAE (Computer-Aided Engineering), automotive design, ergonomics, sustainable design and manufacturing, crash safety of transportation systems, etc. The research activities of the various laboratories in CPDM during the year 2013 are summarized below:

### ***Some of the major results obtained at IdeasLab and VR Lab are as follows:***

- Comparative evaluation of Biocard- a biologically inspired design method. Brainstorming has revealed that the





biologically inspired design method is more effective in stimulating the ideation of novel solutions.

- A computational method for the automated generation of physical embodiments from conceptual mechanical solutions has been developed within a FuncSION design platform.
- The SAPPhIRE model of causality has been found to provide a comprehensive framework for integrating the many definitions of function, and therefore provides an integrated view of all function-related work.
- A question-based procedure for the automated acquisition of expert knowledge has been developed.
- It has been found that many guidelines for improving the assembly of products conflict with guidelines for disassembly. This means that current methods have serious issues in satisfying both assembly and disassembly.

### **PLM (Product Lifecycle Management)**

**Laboratory:** Algorithms to represent heterogeneous material information along with shape information have been developed. These algorithms allow users to prescribe or model material in one of three ways – based on material features on the domain boundary, and a constructive combination of material primitives and material features inside the domain. A Medial Axis Transform of the domain is used to capture a smooth representation of the material composition which is then discretised as required.

### **CAR (Creative Automotive Research)**

**Laboratory:** The CAR (i.e. **C**reative-**A**utomotive-**R**esearch cum **C**onceptualize-**A**nalyze-**R**ealize) lab is heavily engaged in research related to crashworthiness and occupant safety design of transportation systems. Research encompasses the impact safety design of complete systems such as cars and railway coaches to the development of new lightweight materials for efficient crash energy absorption. Advanced numerical analysis tools based on explicit finite element analysis have been employed for simulating behaviors of components and systems under impact loads and experiments generating

valuable data have been carried out in two low velocity drop weight impact testing rigs and a high velocity ballistic impact testing set-up which were all developed in-house. A new approach was developed on the mechanical characterization of aluminium foam at high strain rates which led to insights into the cellular and phenomenological finite modeling of foam under impact loads; An extensive experimental and numerical study was carried out on the behavior of glass fiber-reinforced composite materials including tubes and plates under quasi-static and impact loads. Recently, a unique set-up was designed and installed for studying the effect of a tip rub impact on rotating blades which can be found in jet engine fans and compressors.

The students at the centre have created powerful design tools based on artificial intelligence for supporting the crash safety assessment of vehicle concepts and components, vehicle dynamics, etc. In the area of product realization, the CAR Lab has developed an aluminium-intensive electric mailvan for on-campus usage in IISc, and a lightweight aluminium-intensive electric car which is currently being tested.

## **Atmospheric and Oceanic Sciences**

**Staff: Academic: 9**

**Students: PhD: 26; MSc (Engg): 8; MTech: 10**

**Degrees Awarded: MSc (Engg): 7; MTech: 6**

**Publications: 31**

The Centre formally started in 1982 with the coming together of people from different departments at IISc having a common interest in the Indian monsoon, a phenomenon of great scientific challenge and social relevance. Since its inception, the main focus of work at CAOS is on understanding the monsoon and its variability in the context of a global climate. The centre offers M.Tech (Climate Science) and research programmes. Principal research areas include cloud physics, aerosol measurements and their impacts, radiative transfer in the atmosphere and oceans, geophysical fluid dynamics, coupled atmosphere-ocean general circulation and climate modeling, tropical convection, intraseasonal to multi-decadal variability of monsoon rainfall, air-sea-land interactions, subseasonal to interannual predictability, rainfall modeling and downscaling,





global carbon cycles and climate change, space-time structure and scaling in geophysical fields and the bio-geophysical circulation of the Indian Ocean, its thermodynamics along with the subtle coupling of tropical oceans with the monsoon.

The faculty in the centre have been instrumental in formulating the Indian Climate Research Programme (ICRP), science objectives for satellites to monitor the tropical climate and in the conduct of several national field experiments. Faculty from the centre are also offering video and web based lecture courses in fields of their expertise as part of the National Programme on Technology Enhanced Learning (NPTEL) initiative.

Recent studies have demonstrated that air pollutants can penetrate the stratosphere up to 20–25 km height by the pathways provided by the summertime circulation associated with the Asian monsoon. Aerosol trends over the Asian monsoon regime, therefore, assume the utmost importance in the transport of surface aerosols to the stratosphere. Data from several surface aerosol observatories in India have shown that the highest black carbon (BC) mass concentration is often found over the Indo-Gangetic Basin and the centre of the upward motion of monsoon circulation covers this regional BC-maximum. The spectral aerosol optical depth data for the last two decades measured from these observatories have indicated an increasing trend in the regional mean aerosol loading at the rate of 2.4% per year during the last decade. This would mean doubling of the annually and regionally averaged aerosol column loading over India by around 2050 (if this trend continues), and is attributed to the ever increasing anthropogenic sources. Results from aircraft campaigns have revealed that while most aerosols are located below the clouds over southern India, more than 70% of aerosols are located above the clouds over central India. Clouds, present below significantly absorbing aerosol layers, act as highly reflecting backgrounds and enhance aerosol absorption. Measurements of BC mass concentrations using high-altitude balloons have revealed strikingly large BC mass concentrations at free tropospheric heights. Concurrent measurements and radiative transfer simulations have shown that the large BC-induced absorption and the subsequent

atmospheric warming have changed the environmental lapse rate, leading to a stable atmospheric layer at these altitudes, thereby suggesting that BC creates its “own home” up in the atmosphere, a mechanism which favors the vertical transport of BC aerosols. A Steady increase in aerosols indicates that lower tropospheric sources can play a dominant role in supplying aerosols to the stratosphere. Aerosols are shown to interact with gaseous environmental chemicals and one potentially important reaction is ozone decomposition on aerosol. Aerosols, in general, and BC aerosols (because of porosity) in particular, provide the large surface area needed for heterogeneous chemistry in the upper troposphere and lower stratosphere, and the rate of reaction depends on the surface properties. In addition to the role of aerosols in heterogeneous chemistry, aerosol-induced warming of the stratosphere also can play an important role in ozone chemistry. Our study, when examined in conjunction with other recent findings, suggests that particles from such a large source could reach the stratosphere by vigorous overshooting convections associated with pre-monsoon and monsoon circulation and would pose a threat to the stratospheric ozone layer.

The Bay of Bengal receives a large influx of freshwater from precipitation and river discharge. To maintain the seasonal sea level as well as the salt balance of the bay, this excess freshwater has to be exported out of the bay. This export is accomplished by the East India Coastal Current (EICC) and the Winter Monsoon Current (WMC), which flow into the eastern Arabian Sea, and by an equatorward flow along the eastern boundary. The water that leaves the bay carries a certain amount of salt with it and the required inflow of saltier water, in order to maintain the salt balance of the bay, occurs via the Summer Monsoon Current (SMC), which flows from the Arabian Sea into the Bay of Bengal. This saltier water, however, slides under the lighter surface water of the bay. Maintaining the salt balance of the bay, therefore, demands upward mixing of this saltier subsurface water. We have shown that an efficient mechanism for this mixing is provided by the upward pumping of saltier water in several bursts during the summer monsoon along the meandering path of the SMC. Advection by currents can then take this saltier water into the







rest of the basin, allowing the bay to stay salty despite a large net freshwater input. This discovery was made from the data collected during a field experiment carried out in July-August, 2009 in the southern Bay of Bengal on board the ship *ORV Sagar Nidhi* as a part of the Continental Tropical Convergence Zone (CTCZ) programme.

Rainfall over India during the summer monsoon season is associated with a sequence of dry and wet spells, known as active and break cycles. This active-break cycle is a consequence of meridionally propagating cloud bands from near the equator up to the foothills of the Himalayas. Using numerical model simulations and wavelet analysis, it was shown that orography does not have a major role to play in determining this length scale of northward propagation during the boreal summer. The Absence of orography does delay the onset of the monsoon in the beginning of the season. However, once the onset is established, the space scale of the propagation is independent of the presence of orography. This result is important in understanding the thermal and mechanical role played by the Tibetan Plateau on the Indian summer monsoon.

Retrospective seasonal forecasts from various weather/climate prediction agencies were analysed for their ability to forecast the mean Indian summer monsoon, with particular emphasis on droughts and excess rainfall seasons. The skill for predicting extremes is reasonable, but some years saw exceptions. We found a remarkable coherence between the models in the successes and failures of predictions with all models generating a loud false alarm for the 1983 and 1997 monsoon seasons. While the EnSO-monsoon teleconnection was reasonable in most models, the EQUINOO-monsoon teleconnection was unrealistic, and is a major cause for the false alarm in most models.

### Divecha Centre for Climate Change

**Publications: 21**

The Centre has undertaken a detailed analysis of the retreat of the Himalayan glaciers through the use of satellite and ground-based data. The loss of glacier mass in the Himalayan glaciers has increased from 9 gigatons per year in 1975-85 to 20 gigatons per year in 2000-2010. Climate

models show that the glacier mass loss can increase to 35 gigatons per year during 2080-2090. The loss of glacier mass can be both on account of an increase in temperature and changes in precipitation patterns. The research undertaken by the Centre has shown that a local forest fire can generate sufficient soot to accelerate the melting of snow. The study of the glaciers in Sikkim showed that glaciers that are covered with rock debris retreated more slowly than glaciers without a debris cover. A new technique was developed to estimate the thickness of the Gangotri glacier using satellite data.

### Civil Engineering

**Staff: Academic: 22; Scientific: 4**  
**Students: PhD: 105; MSc (Engg): 3; ME/M Tech: 39**  
**Degrees Awarded: PhD: 15; MSc (Engg): 4; ME/M Tech: 27**  
**Publications: 163**

The Department of Civil Engineering was established in the year 1950 and has grown over the years into one of the finest centers of advanced research and training it is pro-active in industrial interaction and technology development. The Department has four major areas of activity namely, Geotechnical Engineering, Structural Engineering, Water Resources and Environmental Engineering, and Transportation Engineering.

The Major research areas of the Department during the year 2013 were; Earthquake Engineering, Solid Mechanics, Damage & Fracture Mechanics, Foundation Engineering, Soil Reinforcement and Geosynthetics, Computational Mechanics and Modeling, Structural System Identification and Condition Assessment, Reliability in Engineering Systems, Environmental Engineering, Climate Hydrology, Water Resource Management, Stochastic Hydrology, Watershed Hydrology, Hydrochemistry, Hydraulics, Dynamic characterization of soils, Seismic Microzonation and Earthquake resistant design, Reinforced soil structures, Geoenvironmental Engineering, Rock Mechanics, Sustainable Transportation Planning, Optimization of Transportation Systems, Driver Behaviour and Road Safety, and Traffic Management. The following paragraphs provide more details of the activities in a few of these research areas:







Laboratory, numerical, analytical and field investigations have been extensively conducted for understanding various problems of a fundamental nature as well as specific field conditions. Areas in ground improvement, earthquake engineering, foundation engineering, contaminant transport, theoretical plasticity have been studied. Image based techniques have been used for analyzing deformation profiles and shear bands in direct shear and quantification of deformation in physical modeling. Extensive spectrometric analytical techniques were used for the estimation of inorganic and organic contaminants in saturated and unsaturated soil media.

The Improvement of the engineering properties of soils by using unreinforced and reinforced aggregate systems for repeated and cyclic loads has been done. The characterization and assessment of organic modified clays for geo-environmental applications is underway. Specific case studies such as the stabilization of clays found in Kerala by an understanding of the fundamental soil fabric and chemistry has been possible by utilizing advanced characterization techniques such as electron microscopy. The recycling and reuse of materials such as flyash in geotechnical applications, characterization and engineering of landfills, solid waste and contaminant transport have formed a core research area in geoenvironmental engineering in the group.

The Development of region-specific ground motion predictive equations for the seismically active Himalayan region, and laboratory experiments for understanding the dynamic properties of sand for varying saturation have been analyzed. Field techniques such as spectral analyses of surface waves for understanding the dynamic properties of the ground and pavements insitu have also formed an important part of the work in the group. Additionally, the development of liquefaction mitigation techniques, and ground improvement techniques for the improvement of the dynamic properties of soils were also carried out.

The Stability problems of tunnels, reinforced earth foundations, buried infrastructure such as pipelines and anchors using analytical and

numerical techniques such as finite elements, and limit analysis have been investigated.

Experimental and analytical studies on the response of concrete to thermal and mechanical loads and the effectiveness of CFRP and geopolymers as repair materials and the behavior under creep and shrinkage in post-tensioned concrete beams and slabs have been carried out. Hygro-thermo-mechanical models have been developed for creep and shrinkage in concrete to account for hydration kinetics. The dehydration phenomenon taking place in concrete under thermal loads has been modeled.

An analytical model has been developed using the thermodynamic dissipation potential to predict the fatigue behavior of plain concrete. This model has been applied to estimate the fatigue strength and residual life of cracked concrete beams. This is also supported by experimental studies on the fatigue behavior on plain concrete beams of different sizes in order to seek reasons for the observed size effects. In addition, fracture and fatigue studies have been carried out on nuclear grade graphite.

The effect of bolted joint friction slip on the response of transmission line towers under wind and conductor loads has been studied.

Novel reliability methods have been proposed using Bayesian updating procedures for static and dynamical systems. The proposed methods have been validated using computational and experimental tools.

The spectral stochastic finite element method (SSFEM) is being used for uncertainty quantification in structural vibration and fluid-structure interaction problems. The Mechanics of nanotubes is being studied using classical shell theory and molecular dynamics (MD) simulations with an aim toward studying the multiscale mechanics of nanocomposites.

Modeling approaches were developed using microwave remote sensed data (TRMM) for rainfall using Archimedean copulas, to study the dependence of TMI channel combinations, with respect to precipitation, over the land regions of the Mahanadi basin. Studies conducted for





different rainfall regimes show the suitability of Clayton and Gumbel copulas for modeling convective and stratiform rainfall types. A statistical bootstrap technique was also investigated to estimate relative sampling errors using precipitation radar data, which can be successfully used over gauged or ungauged basins lacking in situ validation data. A methodology for the estimation of soil hydraulic parameters in multilayer soils was developed using an inversion of the STICS crop model. The method was tested in various soil and crop types in a Berambadi experimental watershed using LAI and surface soil moisture retrieved from RADARSAT-2. A simple model of the spatial disaggregation of evaporative fraction was developed using MODIS satellite data and validated at five sites using agro-meteorological tower data.

Hydrological extremes like floods and droughts are expected to be altered through land and atmospheric processes that are linked physically to a warming climate. Studies using recent advancements in the statistical extreme value theory namely, the block maxima approach for floods and the peak-over-threshold (POT) approach for droughts, were used to test the future utility of the paradigm of stationarity in hydrologic designs for extremes of weather like floods and droughts. A new mathematical approach, which overcomes the limitations of traditionally-used index-flood based RFA procedures was formulated in an L-moment framework for a univariate regional frequency analysis (RFA) of hydrometeorological extreme events. Further, a new kernel-based methodology was developed for the bivariate RFA of floods.

To analyse multiphase processes in geological systems such as seawater-freshwater, seawater-freshwater-oil,  $\text{CO}_2$ -water, DNAPL-water, two-dimensional numerical models of two and three phase flow, miscible-immiscible flow and non-isothermal flow were developed using finite difference and finite volume schemes.

An analysis on the activity-travel behaviour of non-workers from Bangalore city in India was carried out using a primary activity-travel survey data based on the out-of-home activity participation behaviour of non-workers.

The impact of various social, economic, environmental, and transportation system characteristics on walk and cycle mode choice, when they are used as a main mode, was studied. The environmental factors include density and land use. The impact is determined using a logistic regression model, developed from the house hold survey data of Bangalore city.

A Global Mobility Monitor Network (GMMN) covering the BRIC countries (Brazil, Russia, India, and China), the USA and Germany compared the status quo and future of mobility with respect to various indicators of demography and economics, transport demand and supply, and transport policy and regulation.

**New funding:** A sum of Rs. 254.28 lakhs has been sanctioned by CISTUP, DULT, IFCP, STP-IISc, MDPL and ITRA for eleven sponsored research projects in the year 2013.

**Future Research:** The future research areas in geotechnical engineering will include:

- Characterization of organic and inorganic contaminants transport through sub-soil.
- Rupture-based seismic hazard analysis for future seismic microzonation.
- New intensity scale for road damages due to earthquakes for seismic vulnerability assessment of road networks to handle post disaster mitigation.
- Novel correlation between SPT N and shear modulus applicable to any region.
- Study of Indian Railway Ballast Fouling.

Structural Engineering research in future may focus on:

- Use of iron tailings as fine aggregate in structural concrete and masonry mortars.
- R&D on construction wastes as fine aggregates.
- R&D on microstructure and bond development in cement stabilized earth.
- Established failure envelopes for cement stabilized rammed earth under a multi-axial state of stress.
- Studying behavior of structures under fire hazards, mechanics of nanomaterials and nanocomposites.





Water resource and environmental engineering will include:

- Hydrologic impacts of climate change.
- Surface and ground water modeling.
- Remote sensing of hydrological variables.
- Urban hydrology.

Transportation Engineering research in future may focus on:

- Sustainable transport modeling to assess transportation policies and projects.
- Non-motorized Transport (NMT) planning.
- Activity based travel demand modeling.
- Travel behaviour.
- Driver behaviour and road safety.
- Assessment of sustainability impacts of High Speed Rail (HSR).
- Transport network assessment and traffic management during post-earthquake scenario.

### Management Studies

**Staff: Academic: 7; Scientific: 4**

**Students: PhD: 52; MSc (Engg): 1; MMgt 28**

**Degrees Awarded: PhD: 4; MSc (Engg): 1**

**Publications: 34**

The role of firm level factors in obtaining external support for carrying out technological innovations by SMEs has been probed intensively. The objectives, strategies and achievements of SME internationalization have been studied in the context of Bangalore city. The role of MNCs in facilitating the entry of SMEs to international markets and the determining factors have been analyzed in detail.

The Demand Management and Strategies for the improvement of a market share in selected routes of KSRTC have been studied and this helped in identifying the service gaps and making use of the SERVQUAL model. A study of understanding the psychographics of consumer behavior in online marketing has been carried out for Indiaplaza.com

Currently, in the Applied Statistics field, major work is being carried out in the area of Bayesian Accelerated Life Testing (ALT) of Series systems. Bayesian methodologies are being developed for analyzing such ALT data arising from exponential, Weibull and log-normal component lives. The Development of optimal Bayesian designs for carrying out such ALT is also underway.

In Finance, work is being carried out in understanding different financial characteristics of Initial Public Offerings (IPO). The Return, volatility and liquidity of IPOs issued in NSE are being modeled using various publicly available information on them. Work is also underway in assessing the effect of a derivative introduction in NSE.

Research in energy, environment and technology management has focused on the sustainability assessment of various subsystems of the Indian economy. The subsystems included for assessment are megacities, urban mobility, energy technologies, rural energy, corporate sector and urban waste. The focus is on the evaluation of these systems against the sustainability benchmarks developed using the dimensions of economic, social and environmental sustainability, and arriving at trade-off solutions, which aim at meeting the sustainability targets.

### Sustainable Technologies

**Staff: Academic: 4; Scientific: 1; Technical: 1**

**Students: PhD: 21**

**Degrees Awarded: PhD: 1**

**Publications: 77**

The Centre for Sustainable Technologies (CST) established as a Centre for ASTRA (Application of Science and Technology for Rural Areas) in 1974, is IISc's inter-disciplinary research and technology development centre for providing sustainable solutions to a host of global concerns, primarily dealing with energy, buildings and environment. The Centre's focus is on promoting sustainable technologies tailored to suit the local conditions of resource availability and habitation. CST is pursuing R & D and dissemination activities in the broad areas of Energy Efficient Wood Burning Devices, Biomethanation, Biomass Gasification, Alternative Building Technologies, Green Buildings, BiPV, drinking water treatment including defluoridation, Hazardous waste management, Sanitation, Sustainable Biomass for Energy, Forestry, Bioenergy & Climate Change.

The vulnerability of the forest ecosystems to current climate risks was assessed and the drivers of vulnerability identified. Among the natural





forests, the dry deciduous forest type is most vulnerable and the semi-evergreen and evergreen forest types are characterized by low vulnerability; forest plantations are the most vulnerable. An assessment of the impact of the rural employment guarantee scheme – MGNREGA on vulnerability reduction was assessed in 4 states. The findings showed that in all the 4 districts where land development, water conservation and irrigation provisioning activities were implemented, the agricultural and socio-economic vulnerability declined among the beneficiary rural communities

Investigations on oxy-steam gasification methods resulted in improved hydrogen-rich synthetic gas generation from biomass. Experimental and modeling studies on the turbo-charging of a producer gas engine to increase the output from 27 kW to 74 kW are under progress.

The durability of concrete using iron ore tailings (IOT) as fine aggregate has been investigated and it has been found that the partial replacement of fine aggregate with IOT does not pose durability problems.

A Study on the impact of dust and temperature on the performance of PV panels has been started. A state-of-the-art test facility has been commissioned to experimentally test three PV panels concurrently under varying ambient conditions.

Field investigations on the degradation of ambient parameters on PV power plants – a collaborative project with SOLARSIS Pvt. Ltd (India) has been initiated to investigate the impact of soiling and dust deposition on the performance of large (> 2 MW) solar PV power plants. Two plants have been visited as part of this study, Kadiri (AP) and Sricity (TN). The uniqueness of the study includes investigating the impact of ambient parameters on the performance of various PV systems (viz., crystalline silicon, CIGS, CdTe, and other amorphous and thin-film based technology). The study would not only investigate the year round performance of PV plants, but would also study the geometry of large scale PV installations for various climatic zones.

Thermal comfort studies in BIPV structures: The study includes experimental and simulation-based investigation into thermal comfort under the BIPV

roof in tropical conditions. The study has yielded interesting observations pertaining to warm-humid conditions and also the performance of PV systems integrated as the building envelope.

## Infrastructure, Sustainable Transportation and Urban Planning

### Publications: 12

The Centre for infrastructure, Sustainable Transportation and Urban Planning (CISTUP) was established in the year 2009 at the Indian Institute of Science with the support of several departments of the Government of Karnataka. The main objectives of the Centre are to conduct basic and applied research, organize training programs, capacity building and develop expertise in the areas of infrastructure, transportation and urban planning.

CiSTUP is involved in research programs which cut across different disciplines including environmental science, ecological sciences, transportation engineering, intelligent and smart systems, water sciences and others which are useful for city planning and development. Studies involving pedestrian underpasses, vehicular overpasses, solid waste management, mitigating air pollution from transportation sources, traffic assessment at different junctions, bus stop and bus bays, auto rickshaw sector, all related to the city of Bangalore have been carried out at this Centre. Detailed reports highlighting recommendations for improving the quality of life of the people have been prepared and submitted to the concerned Government authorities.

The Transit Oriented Development (TOD) technique has been used to determine the existing population densities in the city of Bangalore and the strategies needed to promote ridership and additional density around the newly introduced metro system have been determined. To minimize private vehicular dependencies and promote public transit ridership in the areas around the metro stations, an integrated land use transport station area plan (LTSAP) has been developed. A methodology to assess the extent of socio-economic inequality within Bangalore urban agglomeration has been developed in order







to help academicians and policy makers strengthen the integrated functioning of the local level Governments with the metropolitan level. This would help in achieving a platform of policies and programs aiming at minimizing the extent of inequality within Bangalore urban agglomeration.

CiSTUP conducts training programs for capacity building and also develops expertise and provides complete technological and planning solutions for urban renewal and development

related to urban transportation and infrastructure engineering. Furthermore, CISTUP also actively participates in meetings and discussions organized by various government departments including the department of urban land transport, Bangalore metropolitan transport corporation, Karnataka state road transport corporation, Bangalore development authority besides others for the planning and maintenance of urban centers in the state of Karnataka.

#### 4.1.5 Division of Physical and Mathematical Sciences (Chairman: Rahul Pandit)

The Division consists of the following Departments/Centres:

- ❖ Instrumentation and Applied Physics
- ❖ Mathematics
- ❖ Physics
- ❖ High Energy Physics
- ❖ Contemporary Studies
- ❖ Cryogenic Technology
- ❖ Earth Sciences

##### Instrumentation and Applied Physics

**Staff: Academic: 12; Scientific: 6; Technical: 1**  
**Students: PhD: 70; MSc (Engg): 4; MTech: 10**  
**Degrees Awarded: PhD: 7; MSc (Engg): 4; MTech: 6**  
**Publications: 71**

The Department of Instrumentation and Applied Physics works with the aim to translate physical principles into useful instrumentation and novel physical systems. The Research and Development effort of the Department can be classified under the following subjects (A) materials research for a variety of applications, (B) sensors, actuators and measurement systems, (C) applied photonics, and (D) energy and environment. Materials research includes the synthesis and characterization of chalcogenide glasses for phase-change-memory applications and investigations of carbon nanotubes and graphene based materials for sensing and

actuation. The research on sensors, actuators and measurement systems, has focussed on bio-sensing, gas sensing, and radiation sensing, piezo-electric thin-film actuators, nano-metrology, scanning-probe microscopy, micro-cantilever-based chemical-detection systems and traffic measurement. Research in the area of imaging and applied photonics has concentrated on fiber-Bragg gratings, optical tomography, super-resolution imaging, image reconstruction and optical flow cytometry. In the areas of energy and environment, research has included water desalination, dye-sensitized solar cells, lithium-ion batteries, and studies on materials such as titanium nitride, graphene, amorphous silicon, ZnO nanowires, and polymer piezoelectrics, for novel applications in energy devices and energy harvesting. The highlights in each of these areas are given below.

In the context of developing chalcogenide glasses for phase-change memory applications, the electrical-switching behavior in amorphous Si-Te-Ge thin films was studied to understand the impact of input energy on the crystallization process and switching parameters. Studies were also performed on the temperature dependence of the resistance and crystallization and the possibility of multi-bit storage by employing the multi-resistance states in this electrical-switching behavior. Likewise, the physical ageing of Se-Te-Sb glasses was also studied.





Carbon nanotubes (CNTs) and graphene were studied for sensing and actuation applications. CNTs were demonstrated to enable a large enhancement in actuation gain. Flame detection using CNTs and photo-detection using graphene were investigated. Graphene was also studied for the development of hybrid electrodes for fuel cells. Graphene-and CNT-based conductive networks were investigated for photo-detection, chemical sensing, and vapour sensing. Novel periodic architectures for high-impact absorption were studied, and CNT and graphene foams were investigated for mechanical-energy absorption. Other properties were studied by means of nano indentation. Research on materials also included studies on the impact of chemical treatment on the surface, structure, optical and electrical properties of SnS thin films.

Investigations were undertaken on sensors for impact sensing, biochemical sensing, breath sensing, radiation sensing and motion sensing. In addition, actuators for energy harvesting, drug delivery and flexible electronics, for both sensing and actuation were pursued. Piezoelectric-type ZnO nanowires were synthesized and characterized for energy harvesting and sensing applications. A detailed experimental study was performed on the application of impact sensors for non-destructive materials discrimination and a distributed piezoelectric thin-film sensor array was developed for the monitoring of impact events. Research on biochemical sensing was initiated and polymer micro-cantilevers were fabricated for this purpose. Investigations on breath sensing included the realization of an improved version of the PVDF nasal- sensor system by incorporating the necessary electronics circuitry. The performance of this system was validated by using the PNIF (Peak Nasal Inspiratory Flowmeter) and the system was successfully used for the affected patients in a hospital (M.S.Ramaiah Hospital) for detecting the deviated-nasal-septum disorder. Research and development work on radiation detectors was continued and the thick-gas electron multiplier (THGEM) was fabricated. This was coupled with the CsI photocathode and a detailed performance study was carried out for UV-photon detection. Research was also conducted on high-precision motion and force measurements by means of optical-beam deflection. The Measurement and control of in-

plane motion were demonstrated. Investigations were also conducted on the development of sensors and actuators on elastomers by employing flexible PC boards.

Research on measurement systems focused on the control of machines by using EMG, EOG and EEG signals, development of a compact Atomic Force Microscope (AFM), a glass micropipette puller system, and an optical perimeter fence. Hardware and software tools were developed to control the machines by using EMG, EOG and EEG signals. A prototype of a compact atomic force microscope (AFM) was developed by integrating three-dimensional scanning into the AFM probe. To enable the fabrication of micropipette manipulators, a micro-pipette puller system was developed and demonstrated to enable independent control of the pipette's geometric parameters. Research was continued on the development of an optical perimeter fence and the same was demonstrated to alert residents of intrusion into their perimeter.

Research in applied photonics included investigations into fiber-Bragg gratings, optical tomography, super-resolution fluorescent microscopy, and optical metrology. A fiber-Bragg-grating-sensor package was developed for submicron-level displacement measurements. Fiber-Bragg grating sensors were employed to sense CO<sub>2</sub> at room temperature, evaluate blood pressure by using sphygmomanometry assisted by arterial-pulse waveform detection, measurement of temperature and pressure on the surface of a blunt cone in a hypersonic wind tunnel, and to evaluate airline exercises prescribed to avoid deep-vein thrombosis. Etched fiber-Bragg-grating sensor arrays were employed to measure molecular surface adsorption. A CNT-coated fiber-Bragg grating was employed for the development of a photomechanical optical modulator.

In the area of optical tomography and microscopy, a direct Gauss-Newton approach was developed to recover elasticity distribution from the measured intensity autocorrelation for quantitative ultrasound-modulated optical tomography. An approximately h1-optimal, Petrov-Galerkin, meshfree method was developed for application to the computation of scattered light. A Generalized





eigenvalue decomposition of field autocorrelation was studied in the correlation diffusion of photons in turbid media. Studies were also conducted in flux-density calibration in diffuse optical tomographic systems.

In the areas of super-resolution and fluorescence microscopy, image reconstruction was demonstrated to enable high-resolution imaging at large penetration depths in fluorescence microscopy. Extended light sheets were generated for single- and multi-photon fluorescence microscopy and applied to imaging in flow cytometry. Analytical techniques such as spatial filtering and Taylor-series expansion, were applied to improve the performance of confocal and 4 $\pi$  super-resolution fluorescence microscopy. Furthermore techniques were proposed to determine the electric field near the focus of a cylindrical lens for applications in fluorescence microscopy.

In the area of optical metrology, a hand-held imaging flow cytometer was developed for the quantitative diagnosis of malaria. A versatile opto-fluidic microscope was also developed for space biology and telemedicine applications and a microfluidic flow cytometer was designed.

Research on energy and environment focused on thin-film batteries, dye-sensitized solar cells, water filtration and water desalination. Investigations into novel anode materials for thin-film batteries were continued. Titanium nitride and graphene were explored as possible candidates, with very promising results. Alternative cathode materials (other than LiCoO<sub>2</sub>) were also explored and showed encouraging results. Studies were also performed on quantum-dot-based dye-sensitized solar cells.

In the area of water filtration and desalination, working prototypes of the desalination system were built. To cut down power consumption, gravitational pumping was investigated. A prototype was also built for the water-filtration system.

Investigations were also carried out on the identification of nonlinear dynamical systems by using a scaled, unscented transformation-based, directed Gaussian-sum filter. Likewise,

the identification of structural systems was developed by using variance-reduced particle filters. Furthermore a near-exact Girsanov linearization was developed for stochastically driven nonlinear oscillators.

New facilities that were added to the Department include a high-vacuum probe station, a spectrophotometer, DC-sputtering system, spectrum analyzer, electrochemical analyzer, and a chemical vapor deposition system.

## Mathematics

**Staff: Academic: 20**

**Students: PhD: 22; Int. PhD: 9**

**Degrees Awarded: PhD: 6; MS: 3**

**Publications: 37**

Faculty members in the Department of Mathematics are engaged in research in both pure and applied mathematics. New faculty members have joined in the past few years and new research areas have been established in the Department. The Highlights of research performed over the past year are as follows:

Weighted norm inequalities for Weyl multipliers were evaluated and proved. It was proved that the R-boundedness of the derivative of the multiplier is not necessary for the L<sup>p</sup> boundedness of operator-valued Fourier multipliers. Mixed-weighted norm inequalities, for various operators such as Riesz transforms associated to Dunkl harmonic oscillators, were obtained.

A non-stationary semi-Markov decision process on a finite horizon was investigated. The existence of an optimal control was established.

A zero-sum risk-sensitive, stochastic-dynamic game on a countable state space, was studied. The existence of a saddle-point equilibrium was established.

It was shown that the number of vertices of any crystallization of a connected closed 3-manifold is at least the weight of the fundamental group of the manifold.





Crystallizations of the lens spaces  $L(kq + 1, q)$  with  $4(q + k)$  vertices, were constructed and it was shown that these are vertex minimal when  $kq + 1$  are even.

An explicit, boundary-normal dilation was constructed for a triple of commuting bounded operators  $(A, B, P)$  on a Hilbert space  $H$  with the tetrablock as a spectral set.

A few problems of practical interest were investigated during this period. These included combined convection on a vertical cylinder in a non-Newtonian nanofluid, mixed convection in an axisymmetric stagnation flow of a non-Newtonian nanofluid on a vertical cylinder, natural convection heat and mass transfer from a sphere in non-Newtonian nanofluids, mixed convection with thermal radiation in a vertical pipe with a partially heated or cooled wall, and mixed convective boundary-layer flow over a vertical wedge embedded in a porous medium saturated with a nanofluid.

Several results were obtained on the zeros of random functions and eigenvalues of random matrices.

A natural family of Markov chains, on families called linear extensions, related to partially-ordered sets, or posets were studied. An explicit formula for the stationary distribution for any poset was given. Moreover, for a special class of posets, formulas were obtained for the eigenvalues of the transition matrices and the mixing time. Conjectures by Thomas Lam and Lauren Williams, related to random walks on affine root systems, were studied and significant progress was made on one conjecture.

A Medium error analysis of inf-stable and stabilized discontinuous Galerkin (DG) methods has been derived for the Stokes problem. For the first time, it has been shown that the DG methods converge under the minimal regularity for the Stokes problem. The Convergence of adaptive DG methods has been derived for the first time under the realistic conditions on the stabilizing parameters unlike in the other works in the literature. A  $C^0$  interior penalty method has been developed for the Extended Fisher-Kolmogorov

equation, a singularly perturbed PDE, and shown to be robust and optimally convergent. A new analysis of a posteriori error control for an elliptic obstacle problem has been derived and a simple and efficient error estimator has been obtained.

The dynamics of a holomorphic correspondence on the 2-sphere were studied. In the case where the correspondence is of a dominant topological degree, a definition of the analogue of the Fatou set was proposed, and a result towards establishing a Fatou-Julia dichotomy was proved. In the case where the topological degree is non-dominant, new conditions were discovered for a correspondence having small degrees to exhibit a form of equidistribution for the limit of the empirical distribution of an iterated ore-image.

Rigidity results for holomorphic maps between complex manifolds were investigated. Given two such manifolds of the same dimension, a general condition was established for a degree-one holomorphic map to be a biholomorphism. Rigidity results for maps between fiber spaces and between product spaces were also proved.

It was shown that a proper holomorphic map, between two non-planar bounded symmetric domains of the same dimension, one of them being irreducible, is a biholomorphism. Methods were developed that give a single, all-encompassing argument that unifies the various special cases in which the latter result is known.

An exact controllability problem, associated with the wave equation in a rapidly oscillating boundary with interior controls, has been investigated. We have also used the method of unfolding to study optimal-control problems in domains with oscillating boundaries. In the area of tomography, we have demonstrated a direct recovery of the elasticity distribution from ultrasound-modulated optical-tomography data gathered at a single detector. The reconstructions have been seen to be of good quality and the convergence of the algorithm quick. We have, en route, devised a means to estimate the Jacobian needed for these reconstructions, which use both the equations of correlation transport and momentum balance.







Work is going on to understand the complex representations of general linear groups over principal ideal local rings such as  $\mathbb{Z}_p$ ,  $\mathbb{F}_p[[t]]$ . Unramified representations of  $GL(3)$  over non-Archimedean fields have been studied.

The classical theorem of Burnside, which asserts that the canonical Burnside mark homomorphism of the Burnside algebra  $Br(G)$ , of a finite group  $G$ , into the product  $\mathbb{Z}$ -algebra of rank  $\#C_G$  is injective, where  $C_G$  denote the set of conjugacy classes of the subgroups of  $G$ , has been proved. The defining equations of the Burnside algebra  $Br(\mathbb{Z}_m)$ , of the finite cyclic  $p$ -group  $(\mathbb{Z}_m)$  over  $\mathbb{Z}$ , where  $m = p^n$ ,  $p$  is a prime number and  $n$  is a positive integer, were described and these results were used to prove more results for Burnside algebras of finite cyclic groups.

## Physics

**Staff: Academic: 26; Scientific: 6; Technical: 1**  
**Students: PhD: 149; Int PhD: 19**  
**Degrees Awarded: PhD: 13**  
**Publications: 147**

In the area of quantum materials the following investigations were carried out:

Broken Adiabaticity and Bulk Vibrational Raman Signature were discovered in the Band-Insulator-to-Topological-Insulator Transition in  $Sb_2Se_3$  under pressure. It was shown that there is an electronic topological transition from the band to the topological insulator in  $Sb_2Se_3$  at a pressure  $P_c \sim 2.5$  GPa, which shows up as an anomaly in the frequency and line-width of a Raman mode. The results were explained based on a time-dependent perturbation theory of phonon renormalization by using a four-band model, represented by Dirac matrices and a symmetry-invariant form of electron-phonon coupling.

Femtosecond, time-resolved, pump-probe experiments were carried out on iron pnictide superconductors. The temperature, fluence, and Co-doping dependence of quasiparticle (QP) dynamics and coherent acoustic phonons in  $CaFe_2As_2$  were studied by measuring transient reflectivity. Important results were obtained for the optical constants, sound velocity, and the elastic

modulus of the crystal, as well as the coupling between phonons, spin fluctuations, and Cooper-pair quasiparticles, over a wide range of the control parameters.

An Ultrafast, photo-induced enhancement of a nonlinear optical response was observed in 15-atom gold clusters on an indium-tin-oxide (ITO) conducting film. It was shown, for the first time, that the two-photon absorption coefficient is enhanced by an order of magnitude as compared to its value when the clusters are on a pristine glass plate, suggesting an almost 3-fold enhancement of the nonlinear-optical-refraction coefficient. These results were attributed to the excited-state energy transfer in the coupled gold-cluster-ITO system.

Nondegenerate, pump-probe, differential-transmission experiments on gold nanorods, with varying longitudinal surface-plasmon resonance, revealed a new phenomenon where the polarity of the transient transmission signal can be reversibly switched between photo bleaching and photo-induced absorption by controlling the probe fluence. A quantitative understanding of the results could be obtained by invoking a cascaded, two-photon absorption dominant, beyond a threshold probe fluence of  $\sim 75 \mu J/cm^2$ .

Resonant-Raman-scattering studies of multi-layer  $MoS_2$  films, comprising single, bi, four and seven layers, showed a strong dependence on the layer thickness, including the presence of new Raman modes, which are absent in the bulk. Resonant-Raman spectroscopy thus serves as a promising, non-invasive technique for the accurate estimation of the thickness of  $MoS_2$  layers, down to a few atomic layers.

In the area of Soft Matter, the following significant results were obtained.

A unique, reversible, shear-induced crystallization was demonstrated above the equilibrium freezing temperature in weakly swollen, isotropic and lamellar mesophases, with bilayers formed in a cationic-anionic, mixed-surfactant system. In addition to revealing a unique class of nonequilibrium phase transitions, this work presented a new approach to understanding





shear-induced phenomena in concentrated mesophases of mixed amphiphilic systems.

The existence of a rigidity-percolation transition and the onset of yield stress was demonstrated in a dilute, aqueous dispersion of graphene-oxide (GO) platelets (aspect ratio  $\sim 5000$ ) above a critical volume fraction of  $3.75 \times 10^{-4}$ , with a percolation exponent of  $2.4 \pm 0.1$ . A steady-state shear banding, in the plateau region of the flow curve, observed in particle-velocimetry measurements in a Couette geometry, confirmed that dilute suspensions of GO platelets form a thixotropic, yield-stress fluid.

An efficient dendrimer–DNA complexation and gene-delivery-vector properties of a nitrogen-core poly (propyl ether imine) dendrimer in mammalian cells was demonstrated through UV-vis, circular-dichroism (CD) spectral studies, ethidium-bromide fluorescence-emission quenching, thermal melting, and gel-retardation assays. Atomic-force-microscopy (AFM) studies on a dendrimer pEGFP-DNA complex showed an increase in the average z-height as a result of dendrimers decorating the DNA, without causing a distortion of the DNA structure.

A non-conventional strategy of using carbon nanostructures (CNs) [single-walled carbon nanotube (SWNT) and graphene oxide (GO)] for potentiating the efficacy of a bioactive molecule [paclitaxel (Tx)] for the treatment of lung cancer was explored. The results demonstrated enhanced cell death following a combination treatment of SWNT/GO and Tx, indicating a synergistic effect. The synergism was shown to be reactive-oxygen-species (ROS) dependent. It was also demonstrated that treatment with CNs was associated with enhanced mitogen-associated-protein-kinase (MAPK) activation, which was ROS mediated.

The delicate interplay between various microscopic processes, which drive grain-boundary motion that eventually culminates in different grain morphologies, was studied by using colloidal polycrystals under shear. These are ideally suited for bridging the gap between the microscopic and macroscopic processes underlying grain growth, since their dynamics can be followed in real space and real time with single-

particle resolution. This work has led to a holistic understanding of grain growth in polycrystalline materials. In particular, it has been shown that grain growth is asymmetric with respect to the shear direction.

New results were obtained by using surface-mechanical and particle-tracking measurements of nanoparticles trapped at the air–water interface as a function of their areal density. These provided insights into the underlying nature of such transitions in close-packed, high-density, nanoparticle monolayers in terms of the morphology and flexibility of these soft colloidal particles. The results are of special significance in the context of related studies on two-dimensional granular or colloidal systems.

Experiments were carried out that were able to tune significantly the photoluminescence decay rates of CdSe quantum dots embedded in an ordered template, by using lightly doped, small, gold nanoparticles (nano-antennae), of relatively low optical efficiency. Both the enhancement and quenching of the photoluminescence intensity of the quantum dots were observed to vary monotonically, with an increasing volume fraction of added gold nanoparticles, with respect to undoped quantum-dot arrays.

The first observations of confinement-induced enhancement of miscibility in nanoparticle-polymer blend films were made. A systematic variation of blend miscibility with confinement, for various compositions and matrix-polymer-chain dimensions, was observed. For fixed composition, a strong reduction in the glass-transition temperature,  $T_g$ , was observed with decreasing blend-film thickness.

The Interaction of dendrimers of different topologies, with supported lipid bilayers, was studied by using a combination of high-resolution, synchrotron, grazing-incidence, x-ray diffraction and reflectivity as well as fluorescence-correlation spectroscopy (FCS). Significant differences were observed in the interaction between generation 3 (G3) and generation 4 (G4) dendrimers in terms of the extent of penetration of the dendrimers into the bilayers as well as in terms of the change in lattice parameters of the underlying lipid bilayers.





A detailed experimental study was undertaken of the magnetic properties of the quasi-stoichiometric  $\text{Li}_x\text{Ni}_{2-x}\text{O}_2$  system ( $0.67 < x < 0.98$ ). It was found to exhibit a variety of magnetic ground states, namely, spin glass, cluster glass, re-entrant spin glass, and ferromagnetic.

Exchange-spring behaviour in oxides was demonstrated for the first time. However, an understanding of the exchange-spring behaviour in oxide systems is still lacking. The First-Order-Reversal-Curve (FORC) method was utilised to understand the magnetization reversal and the extent of the irreversible magnetization of the soft  $\text{CoFe}_2\text{O}_4$ -hard  $\text{SrFe}_{12}\text{O}_{19}$  nanocomposite in the nonexchange-spring and the exchange-spring regimes.

Another important study that was taken up was the growth of epitaxial  $\text{La}_{0.5}\text{Sr}_{0.5}\text{CoO}_3$  (LSCO) thin films on  $\text{LaAlO}_3$  (100) and  $\text{SrTiO}_3$  (100) substrates by pulsed laser ablation. By tuning the growth parameters, it was shown that it is possible to enhance the ferromagnetic transition temperature ( $T_C$ ) up to 262 K, as evident from ac-susceptibility, dc-magnetization, and resistivity measurements.

In order to understand the origin of low-temperature glassiness in the ferromagnetic state, a comprehensive magnetic study was carried out on two sets of  $\text{La}_{0.5}\text{Sr}_{0.5}\text{CoO}_3$  samples. The samples, which were prepared by the conventional solid-state-synthesis method, showed a low-temperature shoulder in both the dc-magnetization and the ac-susceptibility measurements, which exhibited characteristics of glassiness in the frequency dependence and in the memory effect.

A ferromagnetic-resonance (FMR) study on a grid, formed with permalloy nanowires, was taken up to understand spin-wave dynamics. The presence of two sets of magnetic nanowires, perpendicular to each other in the same device, enabled better control over spin waves.

The emergence of a low-temperature glassy phase in the widely known itinerant ferromagnet  $\text{SrRuO}_3$  is rather poorly understood. In order to throw light on this aspect, a detailed temperature dependent (5-250 K) neutron-diffraction study was undertaken. A freezing of the octahedral tilt near

the ferromagnetic transition and an unusual deviation in the octahedral tilt near the onset of a low-temperature spin-glass-like phase was observed.

Evidence was found for anisotropic magnetoimpedance behavior in (001) oriented  $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$  (LSMO) thin films, in the low-frequency-low-magnetic-field regime. (001) oriented LSMO thin films were deposited by using pulsed laser deposition, and characterized with X-ray diffraction and temperature-dependent-magnetization studies.

High optical sensitivity was discovered in graphene/ $\text{MoS}_2$  heterostructures: in hybrids of atomically thin layers of graphene and  $\text{MoS}_2$ . By depositing a layer of graphene on single- or few-layer molybdenum disulphides ( $\text{MoS}_2$ ), it was demonstrated that graphene-on- $\text{MoS}_2$  binary heterostructures display remarkable, dual optoelectronic functionality, which include highly sensitive photodetection and gate-tunable persistent photoconductivity.

Electrical transport in ultrathin (2nm diameter) nanowires of gold was investigated and it was shown that the transport can be dramatically altered by varying the separation of the nanowires from the supporting substrate. By carefully designing organic linkers between the nanowire and the substrate, a clear crossover was obtained from a Tomonaga-Luttinger liquid (TLL)-like transport, when the nanowires are placed away from the substrate, to a variable-range hopping (VRH) regime as the nanowires were brought into direct contact with the substrate.

The presence of long-range correlations in phase fluctuations was demonstrated by analyzing the higher-order spectrum of resistance fluctuations in ultra-thin NbN superconducting films. The experiment shows the possibilities for a novel, fluctuation-based, kinetic probe in detecting the nature of superconductivity in disordered, low-dimensional materials.

A high-magnetic-field low-temperature set up was developed for the study of conductance fluctuations in oxide-based, two-dimensional





systems. Several cutting-edge experiments are being performed by using this set up.

Work was carried out in the field of semiconducting chalcogenide glasses, on bulk films as well as on atomically thin multilayer films. FTIR, Raman, XPS, and optical studies were carried out on these films. In addition, photoinduced effects on chalcogenide multilayer films and chalcogenide-based solar materials are being investigated

Raman and EPR studies on the effect of mixed alkali in Oxyfluoro Vanadate glasses were carried out. Impedance and Raman spectroscopy were used to probe disorder and transport properties in polypyrrole thin-film devices. Electric-field-activated, nonlinear, anisotropic charge-transport studies in doped polypyrrole were carried out. An  $^{14}\text{N}$  NQR spectrometer, working from 5 to 3.32MHz, was fabricated as a part of the CSI programme.

Double-elements substituted  $\text{Co}_{3.8}\text{Fe}_{0.2}\text{Sb}_{12-x}\text{Te}_x$  ( $x=0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6$ ) samples were synthesized by induction melting, followed by an annealing process.

*The Thermoelectric* properties of PbTe were improved by the deliberate introduction of secondary phases in the bulk matrix of PbTe material, through a process known as matrix encapsulation.

The Thermoelectric properties of chalcogenide-based  $\text{Cu}_{2+x}\text{ZnSnSe}_{4-y}$  and  $\text{Cu}_{2.1}\text{Zn}_{0.9}\text{Sn}_{1-x}\text{In}_x\text{Se}_4$  based wide-band-gap materials, were studied. These materials are used for solar-cell applications and the thermoelectric properties are also promising for the fabrication of thermo-solar hybrid systems.

Single crystals of antimony-doped FeTe and  $\text{FeTe}_{0.5}\text{Se}_{0.5}$  were grown by the modified, horizontal- Bridgman method. Growth parameters were optimized to obtain high-quality single crystals. It was found that the antiferromagnetic (AFM) transition at  $T_N = 62.2$  K, which is a first-order transition, shifted to a lower temperature on doping in  $\text{Fe}_{1+y}\text{Te}$ . Alternatively, when the chalcogen site of the ternary compound  $\text{FeTe}_{0.5}\text{Se}_{0.5}$  was doped with Sb, superconductivity

was preserved, albeit with the superconducting transition temperature ( $T_c$ ) falling slightly and with a concomitant reduction in the superconducting volume fraction.

The scattering of carriers in semiconductors by charged dislocations was calculated by solving the Boltzmann-transport equation. The two-dimensional nature of the scattering potential was taken into account in the collision term. The mobility was calculated by assuming a random distribution of dislocations and averaging the result over all dislocation angles.

The sensitivity of high-operating-temperature HgCdTe infrared detectors was evaluated for different device parameters. The optimum-doping profile for suppressing an Auger recombination was simulated theoretically and compared with experimental data.

Investigations were carried out on the dynamics of dense liquids near the glass transition, kinetics of surface growth, plasticity dynamics in solid He, and on an atomistic simulation of nanoparticles and dendrimers in solution.

The well-known Jeans criterion describes the onset of instabilities in an infinite, homogeneous, self-gravitating medium supported by pressure. Most realistic astrophysical systems, however, are not isolated. A generalized, modified, instability criterion for such a case was obtained and a typical, disruptive tidal field was shown to make the system more stable against perturbations. The minimum mass, which can become unstable, is then higher (super-Jeans) than the usual Jeans mass. This approach, involving the inclusion of a tidal field, opens up a new way of looking at instabilities in gravitating systems.

A galactic disk is known to be embedded in an extended, dominant, dark-matter halo. The dynamical implications of a prolate-shaped, dark-matter halo of the Milky Way was studied; this shape was suggested by earlier modeling done here of the flaring of HI gas in the outer disk. The potential of a prolate spheroidal halo, with a radially varying eccentricity, was calculated, and it was shown that this does not result in a long-lived Galactic warp, contrary to suggestions in the literature.







The origin of grand minima in sunspot cycles was investigated by studying how fluctuations in the dynamo process cause them.

A variety of investigations were undertaken in understanding physics related to black holes, white dwarfs, and neutron stars, by using general relativity, magnetohydrodynamics, and their combination, where appropriate. New results were obtained regarding the spin of black holes and a new semi-empirical mass-spin formula was proposed. In order to explain the peculiar, enigmatic, over-luminous supernovae that have been observed, it was shown that there might exist very massive, significantly super-Chandrasekhar white dwarfs.

Slow gravity-modes in counter-rotating stellar disks around massive black holes were investigated by solving the Vlasov equation directly; unstable modes were found. The effect of a slowly evolving central black hole on the distribution function of a galaxy was studied by using an adiabatic invariance of the action; for an isothermal halo, this resulted in the formation of a cusp at the centre. This study will be extended to realistic galaxy-distribution functions by inverting the observed light profile (Sersic) and deriving the distribution functions that support it.

Exact spectral moment sum rules were derived for the retarded Green's function and self-energy of the inhomogeneous, Bose-Hubbard model, both in equilibrium and nonequilibrium situations. These will be very useful in benchmarking both experiments and approximate theories for ultra-cold bosonic atoms trapped in optical lattices.

Detailed calculations were carried out using the strong-coupling expansion, for ultra-cold bosons in an optical lattice at finite temperatures in the presence of superfluidity, developed earlier for parameter values used in published experiments. Excellent agreement was found with experimentally observed density profiles provided the temperatures quoted in the experiments were corrected suitably.

The gap renormalization of molecular crystals was studied within density-functional theory. It was possible to capture a polarization-induced gap renormalization within this method. Furthermore,

in a theory-experiment collaboration within the Department, the experimental findings of conductance quantization in nanomechanically exfoliated graphene and of intrinsic charge-traps and flicker-induced noise in MoS<sub>2</sub> field-effect transistors, were interpreted by using-density functional theory calculations.

By using fully atomistic MD simulation, the influence of surfactant-bilayer melting on the structure and thermodynamics of interface water was studied.

The translocation and encapsulation of siRNA inside a single-walled carbon nanotube was demonstrated, for the first time, by using atomistic simulations.

Studies of turbulence led to important insights into its statistical properties. In particular, (a) real-space manifestations of bottlenecks in turbulence spectra were found, (b) the most extensive studies of thermalization in the two-dimensional, Fourier-truncated, Gross-Pitaevskii equation for superfluid turbulence were carried out, and (c) the nature of multiscaling in Hall-magnetohydrodynamic turbulence was elucidated. Furthermore, recent studies of particles in turbulence uncovered new, universal exponents.

Extensive numerical studies of state-of-the-art mathematical models of cardiac tissue were carried out. These studies led to new insights into spiral- and scroll-wave dynamics in these models and also their control by the application of low-amplitude pulses, most recently in models with fibroblasts, mechanical deformation, or Purkinje fibers. This work has direct implications for the control of life-threatening cardiac arrhythmias.

Work on Bose-Hubbard models provided a unified theoretical framework for studying phases, transitions, patterns, and excitations in systems of cold atoms in optical lattices.

Research was carried out on the effect of frustration on interacting, lattice systems of bosons. The main results obtained were the existence of a novel, chiral- Mott phase in frustrated bosonic ladders, re-entrant phase transitions and phase-transition lines, with





continuously varying critical exponents in 1D bosonic systems with frustrated, long-range hopping, and the existence of different types of Mott phases in superlattices of strongly interacting bosons.

Theoretical work on spin-orbit-coupled fermions (fermions in synthetic gauge fields) showed that, under certain experimentally realizable conditions, a finite-momentum pairing state (FFLO state) can be realized.

The Properties of graphene nanoribbons were investigated and it was shown that they possess a sensory-organ-like response, which plays a crucial role in their magnetism.

Type 2 Diabetes Mellitus (T2DM) is one of the most prevalent endocrine disorders underlining the importance of developing molecular therapies to mitigate T2DM. It is characterised by a significant decrease in insulin-producing beta-cell mass, insulin resistance, and the presence of amyloid plaques, in which human-islet amyloid polypeptide (hIAPP) is the major component. hIAPP fibrillisation leads to amyloid formation. Peptides containing dehydrophenylalanine were designed, synthesized, and their three-dimensional structures were determined by using crystallographic methods. It was shown that the designed peptides inhibit hIAPP fibrillisation. A model for the mechanism of inhibition was proposed. It was demonstrated that the designed inhibitors protect beta cells from hIAPP induced toxicity.

In nurturing the idea of imaging using NIR light into a fully developed, direct, 3D imaging system, challenges from the theoretical and computational aspects have to be met. An instrument for carrying out direct, 3D, image reconstruction, based on diffuse optical tomography (DOT) using a single source and a single detector, was developed. In this study, the discretized, 3D, diffusion equation was solved by using the finite element method (FEM) with the Robin boundary condition. The model-based, iterative-image-reconstruction method (MOBIIR) was used for reconstruction by using experimental data from multiple measurement planes. The conventional, Gauss-Newton approach takes approximately 20 hours for an iteration. A faster approach, based on Broyden, was developed and implemented for

both 2D and 3D models. In order to speed up the algorithm, parallel computing approaches, based on CUDA, are being probed.

Work in experimental atomic physics was focused on two areas, namely, quantum optics and laser cooling.

In the area of quantum optics, the use of a control laser in a multilevel atom was studied. The control laser modifies the susceptibility of a medium. In the case of electromagnetically induced transparency and absorption (EITA), the control-induced modification to the imaginary part of the susceptibility was used.

In the area of laser cooling, in the context of the long-term goal of searching for the electric dipole moment (EDM) of the electron using laser-cooled Yb atoms, two ways of creating a continuous beam of cold atoms were demonstrated.

In research work related to the tapping of solar energy to address the future needs of our society, a low-cost, solar-water purifier was developed, which is now ready for commercial production. Furthermore, an ice maker, using electrical heat tapes to provide thermal energy, was demonstrated. Work to demonstrate the same with solar energy is in progress.

## High Energy Physics

**Staff: Academic: 9**  
**Students: PhD: 9; Int. PhD: 4**  
**Degrees Awarded: PhD: 4**  
**Publications: 38**

Majorana modes, lying at the ends of a superconducting wire, were investigated. The phase diagram for the existence of such modes was studied as a function of various parameters, such as the hopping amplitude, the on-site potentials, and the superconducting order parameter. The generation of such modes by periodic driving of some parameter in the Hamiltonian was examined and a new topological invariant, which can predict the appearance of such modes, was found. Transport across a junction of surfaces of two topological insulators





and a superconductor was studied, and it was shown that this provides a new way of identifying the order parameter of a p-wave superconductor. Ideas from quantum-information theory (such as entanglement entropy and fidelity) were used to find the different phases of Heisenberg antiferromagnets in one dimension.

A study of form factors, with applications to the pion, was carried out in great detail. The method of unitarity bounds was extended to obtain precise information on the low-energy modulus and the radius, and applied also to the muon anomalous magnetic moment. Supersymmetric models with invisible Higgs modes were studied. The presence of an indefinite CP for the Higgs at the ILC with polarized beams was studied. The newly introduced Borel summed and renormalization group summed theory was applied to several moments of the Adler function in QCD.

**Higgs physics and SUSY:** A comprehensive analysis was performed of a search potential of the LHC for a Higgs boson decaying invisibly, and new methods were suggested for probing the tensor structure of  $hVV$  ( $V=W/Z$ ) couplings in the production of Higgs in a vector-boson-fusion process as well as in association with a vector boson. A lower limit on the neutralino mass was obtained by performing a very complete analysis of the light-neutralino scenario such that it is consistent with limits on the invisible branching ratio for the observed Higgs signal, indirect and direct detection dark matter experiments, and the LHC limits on SUSY particles. The implications of the observed Higgs mass and the indirect constraints from a dark matter and flavor sector on supersymmetric models were analysed in a stochastic, superspace framework. Constraints on the MSSM were obtained in the context of light ( $< 1$  TeV) stop quarks, coming from color and charge breaking minima of the scalar potential. Novel effects on the phenomenology of third-generation squarks, of the polarization of the top quark produced in their decays were pointed out. Studies were also carried out on the potential of the flavor of violating (FV) decays of the stop quarks at the current and future LHC, for stop quark masses which are smaller than the top quarks. Hence, the usual strategy of using top quarks in the final states does not work.

A model was suggested for calculating particle yields in heavy ion collisions, with separate chemical freeze-out surfaces for strange and non-strange particles. It was shown that this may provide a natural explanation of the proton anomaly observed in heavy-ion collisions at the LHC. The predictions for the transverse spin asymmetries expected in charmonium production which can probe the Gluon Sivers function in collisions of electrons with transversely polarized protons, were refined.

A flux-tube model was used to understand the cross-over from a quark-gluon plasma to hadrons in heavy-ion collisions. The 3-point, flux-tube, vertices influence the hadronisation process, and produce characteristic signals in hadron multiplicities and two-point correlations. A Phenomenological analysis of the observed data at the LHC is in progress.

Strategies for efficient quantum algorithms were explored, combining the properties of superposition and factorisation. Specifically, the scaling of Hamiltonian-evolution algorithms was investigated with respect to the desired accuracy. Any Hamiltonian can be expressed as a sum of projection operators. Direct evolution, using Trotter's formula, is not efficient, but its conversion to a search problem results in exponential improvement. The procedure was illustrated by using Grover's algorithm as an example.

One of the main questions which was addressed is whether a particular class of theories, called Randall Sundrum Models, can provide a solution to the so-called flavour problem of the Standard Model. Special focus has been paid to the leptonic sector, and the results obtained suggest that additional symmetries or new radical scaling of these theories is required for them to form theories of flavour physics. Some generalisations of sequestering lepton numbers in extra dimensions have also been found.

Studies of the perturbative as well as the non-perturbative properties of non-commutative quantum field theories were carried out. The role of quantum ambiguity in the definition of entropy was investigated. Lorentz-violation effects in the





non-perturbative structure of quantum electrodynamics were also studied.

Black holes in Chern-Simons higher-spin supergravity were constructed and their thermodynamic properties were studied. The partition functions of these black holes were then evaluated from the dual CFT and exact agreement was found with the bulk partition function.

Parity-odd transport was studied at second order in the derivative expansion for a non-conformal charged fluid. It was shown that certain parity-odd transport properties at second order can be expressed in terms of the anomalies of the theory.

The structure constants of the  $N=1$  beta-deformed theory were studied. It was shown that, at one loop and in the planar limit, these structure constants are determined by the integrable anomalous dimension, the Hamiltonian of the theory. This result was used to propose a non-renormalization theorem for a class of structure constants for which evidence was provided at weak and strong 't Hooft coupling of the theory.

The Renyi entropies for the two-dimensional free boson CFT were evaluated analytically. The CFT is considered to be compactified on a circle and at finite temperature. We show that the finite-size corrections both for the free boson CFT, and the free fermion CFT agree precisely with the one-loop corrections obtained from bulk, three-dimensional handle-body spacetimes, which have higher genus Riemann surfaces as boundaries.

Through the duality between strongly coupled gauge theories and gravity, it was shown how quantum information in the gauge theory is processed by gravity. The Geometric aspects of this problem were explored.

It was shown that the boundaries of the attraction basins of black holes, arising in string theory, are the so-called subtracted geometries (and their generalizations). These geometries had arisen in attempts to understand black-hole entropy in terms of an emergent conformal symmetry.

The resolution of big-bang singularities is an outstanding problem in quantum gravity. It was shown

that some toy singularities of this kind can be resolved by using higher spin theories. This was done in universes with a positive cosmological constant as well as a zero cosmological constant. The zero cosmological constant case gives a possibly concrete way to embed this resolution in string theory.

It was shown that anti-deSitter gravity in  $2+1$  dimensions can be algebraically related to flat-space gravity by interpreting the inverse cosmological constant as a Grassmann parameter. The match could be of potential use in realizing holography in flat spacetimes, going beyond the celebrated (but apparently limited) AdS/CFT correspondence. This approach is also of technical utility: It gives tools for accomplishing singularity resolutions.

## Contemporary Studies

The Centre for Contemporary Studies was established in the academic year 2004-2005 with the aim of opening a window to the Social Sciences, Humanities and Arts. By organizing a series of seminars, lectures, and discussions, and by maintaining a steady stream of visiting scholars, the Centre for Contemporary Studies is providing opportunities to the scientific community in IISc, to experience a sample of the best scholarship and creativity outside the traditional boundaries of natural science.

During the period January 2013 to December 2013, the Centre for Contemporary Studies organized the following lectures and discussions:

Alessandro Portelli, Film Screening-Discussion: Music and Migration: Far away in Rome, the renowned oral historian and musicologist, Alessandro Portelli has been working on the music "foreigners" have brought back to the urban space of Rome.

Film: Had-Unhad. Director: Shabnam Virmani : A film that explores the vibrant nature of folk songs by a 15th century mystic poet, Kabir and the multiple meanings it evokes across the hostile border between India and Pakistan.







Dr. Susan Schreibman, Associate Professor in Digital Humanities, School of English, Trinity College, Dublin, Doing the Humanities Digitally: A one-day Symposium on “Re-sourcing Indian Cinema : Humanities Research, New Archives and Collaborative Knowledge Production” was organized on 29 October 2013 along with Book launch “Politics as Performance: A Social History of the Telugu Cinema by S.V. Srinivas”

About the book: Politics as Performance examines the deep connection between cinema and politics in India. It provides a picture of Telugu cinema, as both an industry and a cultural form, over fifty formative years. It argues that films are directly related both to the rise of an elite, which dominates Andhra Pradesh and other parts of India, and to the emergence of a new idiom of mass politics.

S.V. Srinivas (Senior Fellow, Centre for the Study of Culture and Society and Visiting Professor, Centre for Contemporary Studies): “Film, History and Politics: Looking beyond Bollywood” M.V. Rayudu (Professor of Electronics, Atria Institute of Technology; industrialist, publisher and archivist): “Archiving Telugu Cinema”

T. Vishnu Vardhan (Centre for Internet and Society): “Let Cinephiles Collaborate: Pleasures and Perils of Indian Film History on Wikipedia”

M. R. Raghava Varier, Chief Editor, Arya Vaidya Sala Publications, Kottakkal, History of Ayurveda : An Enquiry in Epistemology

Gauri Shankar Gupta, Indian High Commissioner, Republic of Trinidad and Tobago  
Building On Goodwill - India And The Former Communist States

Ravi Srinivas, Associate Fellow, Research and Information System for Developing Countries, New Delhi, Let Thousand Commons ‘Bloom’ and Flourish: From Tragedy of Commons to Proliferation of Commons

Nalin Shah, Hindi Film Music: Partition and After

Rajan Gurukkal, Former Vice-Chancellor, Mahatma Gandhi University, Kottayam, A Reappraisal of Gandhi’s Prescience.

C. V. Raju, President’s Award winner INTACH Lifetime awardee for Craft  
Reviving A Craft - How Etikoppaka Rediscovered Lacquer

A screening of the documentary film by Sunanda Bhat “Have You Seen The Arana?” was organized on 27 August 2013.

S. V. Srinivas, Senior Fellow, Centre for the Study of Culture and Society, Bangalore  
Telangana: From Maoism to Mass Culture

A Three Day National Workshop was organized on “*Eyes On Ison*” (*On The Comet’s Trail!*) Catalysed and Supported by NCSTC, DST, GOVT. OF INDIA, New Delhi during 20-22 AUGUST, 2013 at the Centre for Contemporary Studies. Inaugural address – Prof. Raghavendra Gadagkar, Chair, CCS, Indian Institute of Science. Speakers during the workshop were:

Ajay Talwar, The Amateur Astronomers Association, New Delhi  
Arunabha Mishra, AIPSN  
B.S.Shylaja, BASE, Jawaharlal Nehru Planetarium, Bangalore  
K.Pappootty, Kerala Sasthra Sahitya Parishath, Kozhikode  
Kiran Tikare, Bangalore Astronomical Society, Bangalore  
Niruj M Ramanujam, National Centre for Radio Astrophysics (TIFR), Pune  
Prajval Shastri, Indian Institute of Astrophysics, Bangalore  
Sabyasachi Chatterjee, Indian Institute of Astrophysics, Bangalore  
T.V.Venkateswaran, Vigyan Prasar, New Delhi  
Vasundhara Raju, (formerly) Indian Institute of Astrophysics, Bangalore  
Vivek Monteiro, Nav Nirmiti Learning Foundation, Pune  
Prof. Srinivasan Raghavendran & P T Manalakos, Global Recession and its Aftermath

A day long consultation on “Digital Humanities for Indian Higher Education” was organized on July 13, 2013 at the Centre for Contemporary Studies. The consultation was hosted by:





Higher Education Innovation and Research Applications Programme at the Centre for the Study of Culture and Society (HEIRA-CSCS), Bangalore  
 Centre for Education and Research, Tumkur University, Tumkur  
 Centre for Indian Languages in Higher Education, Tata Institute of Social Sciences, Mumbai  
 Centre for Contemporary Studies, Indian Institute of Science (CCS-IISc), Bangalore  
 Access to Knowledge Programme, Centre for Internet and Society (A2K-CIS), Bangalore.

Teena Antony, Centre for the Study of Culture and Society, Bangalore  
 open Ph.D Defence of: Women's Education Debates in Kerala: Fashioning Sthreedharmam

Dr. Rongili Biswas, Assistant Professor of Economics, Maulana Azad College, Kolkata; Associate Researcher in Economics (Honorary), University of Eastern Piedmont, Italy  
 In Quest of Flaubert: Palimpsest as a narrative mode

Prof. Nita Kumar, Brown Family Professor of South Asian History, Claremont McKenna College, California, An Indian Education for Indian Children: the family-school relationship and Indian arts

Prof. Rajan Gurukkal, Sundararajan Visiting Professor, Centre for Contemporary Studies, IISc; Former Vice Chancellor, Mahatma Gandhi University, Kottayam, Kerala  
 Implications of Knowledge Economy

Robert M Geraci, Associate Professor, Religious Studies, Manhattan College, New York  
 Fundamental and Applied: Religious Practices in U.S. and Indian Technology

Nishant N. Shah, Centre for the Study of Culture and Society, Bangalore  
 Open PhD Defence of "The Technosocial Subject: Cities, Cyborgs and Cyberspace"

B. Narahari Rao, Universität Saarländes, Sarbrücken  
 The Logical Geography of Educational Institutions of a Society

S. Balachander, Renowned acoustician & an exponent of the Chandra Veena  
 Talking Thro' The Strings: Art and Science in the Evolution of Music and Musical Instruments

Alan Grossman, Director, Centre for Transcultural Research and Media Practice, Dublin  
 Screening of the documentary "Promise and Unrest" (2010) 79 min, Philippines/ Ireland, Colour. Followed by an interactive session with the co-director, 27th March 2013.

Alexander Darius Ornella, Department of Religious Studies, University of Hull, UK  
 Machinic Bodies as Boundary Bodies: Reflections on the Impact of Body-Machine Images on Human Self-Understanding

Staging of the play COPENHAGEN by Michael Frayn was organized on 12 March 2013. The play was presented by the Centre for Film and Drama and arrangements with Samuel French (Jagriti)

Abstract: Frayn's play Copenhagen speculates on what might have transpired during a meeting between Nobel laureates Niels Bohr and Werner Heisenberg in Copenhagen in September 1941, at the height of the German advance into *Russia* and just three months before America's entry into the *war*. The power of National Socialist Germany was at its pinnacle, and the Germans had just been made aware, through Swedish sources, of U.S. plans to build an atomic bomb.

A three-day workshop on "Photography, Documentary Making and Exhibition Technique as an Aid to Education" *was organized during 5-7th March 2013 at the* Centre for Contemporary Studies. Instructors: Fabian Da Costa & Anne Da Costa

Abstract: It was a three day interactive workshop on the ways to implement photography, documentary making and exhibition methods for the purpose of education. The workshop was jointly conducted by renowned French documentary film maker, author and photographer Fabian Da Costa.

A combined talk was organized on 25 February 2013 by: Father Columba Stewart, Executive Director, Hill Museum & Manuscript Library; Prof.





Istvan Perczel, Central European University-Budapest, Hill Museum and Manuscripts Library-United States, Father Ignatius Payyappilly, Archdiocese of Ernakulam-Angamaly, Kerala on: A Narrative of the Manuscripts: From Digital Preservation to Historical Research

Ishtiaq Ahmed, Professor Emeritus, Political Science, Stockholm University, Honorary Senior Fellow, Institute of South Asian Studies, National University of Singapore

*Pakistan: The Garrison State. Origins, Evolution, Consequences (1947–2011)* Marcy Newman, Teacher, Writer, Activist *Separate and Unequal: On Coexistence*

A Two Day Workshop on: Ways of Knowing: Curriculum Development Workshop On Integrated Science Education 2013 was organized by the Centre for Contemporary Studies, IISc., in collaboration with Higher Education Innovation and Research Applications (HEIRA)-CSCS during 11-12 January 2013. The programme was as follows:

11 January 2013 Opening Session: Raghavendra Gadagkar & Tejaswini Niranjana Module 1 – *Ways of Knowing – (Ethnographic Methods)*, UG Humanities course at IISc. Maithreyi M. Respondent: Tanveer Hasan

Module 2 – *Ways of Knowing – (Psychological Method)*, UG Humanities course at IISc. Sabah Siddiqui. Respondent: Gita Chadha

Module 3 – *(Textual Analysis)*, UG Humanities course at IISc. Sneha PP

Respondent: Tana Trivedi. *“Science, Sociology of Science and Society: Is there a relationship?”*, UG Course at CUJ. Gita Chadha & Tanveer Hasan. Respondent: Anup Dhar.

Module 4 – *Ways of Knowing – (Historical Analysis)*, UG Humanities course at IISc. Nitya Vasudevan. Respondent: Rajan Gurukkal. *“Theatre” in “Ways of Seeing”*, UG Humanities course at IISc (ongoing) Prakash Belawadi

12th January 2013 *“Cognition: Beyond the Brain-Mind Divide”*, UG Course at CUJ

Anup Dhar & Tejaswini Niranjana. Respondent: Geetha Venkataraman.

*“Evolution: Dialoguing between Disciplines”*, UG course at CUJ

Anindita Bhadra & Maithreyi M. Respondent: Raghavendra Gadagkar

*“How to Observe Nature, and Why”*, UG course at CUJ (forthcoming)

Raghavendra Gadagkar.

*“History of Science and Technology in India”*, UG course at CUJ

Jahnavi Phalkey (on skype). Respondent: K. Sridhar

*“Health, New Technologies and Bio-Ethics”*, UG course at CUJ (forthcoming) Asha Achuthan (on skype).

Way forward - Raghavendra Gadagkar, Tejaswini Niranjana & Anup Dhar

Prof. Viren Murthy, Department of History, University of Wisconsin, Madison, United States Post colonialism, Marxism and the Problem of Pan-Asianism

These lectures were well attended by students, staff and faculty of the Institute as well as by a large number of people from the city; and each lecture was followed by lively discussions confirming the impression that there is a widespread interest in topics that lie on the border between the natural and human sciences. Some of the scholars visiting the Centre for Contemporary Studies are hosted through the Endowed Sundararajan Visiting Professorship.

## Cryogenic Technology

**Staff: Academic: 2; Scientific: 2**

**Publications: 29**

The prime focus of the Centre has been to support the low temperature activities of the Institute by supplying cryogenics uninterruptedly. To support the increased demand for cryogenics over the years, the Centre has been continuously upgrading the in-house infrastructure. This year, ~ 4,25,000 liters of liquid nitrogen and ~ 55,000 liters of liquid helium have been successfully produced and supplied to users.

The Faculty members of the Centre continue to engage in cryogenic research, which keeps with recent global trends in this area. They carried out research in a wide spectrum of fields like cryocoolers, cryogenic systems and





instrumentation, calibration of temperature sensors and level sensors, thermal-conductivity measurement at cryogenic temperatures, cryoadsorption, and cryotribology. A brief report of their research activities is given below.

Optimisation studies were continued on the linear-motor-driven pulse-tube cryocooler developed for the Department of Space. The pressure-wave generator of the system was improved to reduce the mechanical losses and the current required to drive the piston. A new pulse-tube cooler was developed which produced a no-load temperature of 74 K corresponding to 0.1 W at 80 K. Steps are now being taken to achieve a cooling power of 0.5W at 80K.

A small-capacity helium recondensation system is being developed as part of a project funded by DST. For this system, a two-pulse-tube cooler has been designed to produce 2 W at 25 K. The testing of the pulse-tube cooler is in progress. The other components of the recondensation system, like the tube in the tube heat exchangers and JT valves, are being developed.

The design and fabrication of the flexure spring for a self-regulating JT cooler is being carried out as a part of a project funded by DRDO.

After evaluating the performance of a linear-motor compressor for various motor configurations, the fabrication of a twin-pulse-tube-refrigeration system, capable of producing 3W at 80K, was successfully completed. The assembly of the pulse-tube cryocooler was done. The final integrated testing of the system is in progress.

The liquid-level-sensor calibration activities for ISRO are being continued to calibrate the level sensors of  $\text{LH}_2$  and LOX. Ten level sensors have been successfully calibrated by using an eleven-point calibration system. A prototype of a light-weight high-temperature-superconductor-based liquid-level sensor for LOX was developed and calibrated with the standard liquid level sensor to predict the linearity in various levels of  $\text{LN}_2$ . Furthermore, calibrations with LOX are being carried out. The development of a new cryostat for this calibration has been completed. The system integration and the LOX calibration are in progress.

An experimental set up has been developed for measuring the thermal conductivity of materials down to 4.5K through a BRFST sponsored project. A liquid-helium cryostat (Model: Janis-SVT-200T-5) has been used to measure the thermal conductivity of materials like SS 304 and Al 2024 and the results are comparable to the published data in the range of 300-4.5K. Studies are in progress to measure the thermal conductivity of some select materials like activated carbon and adhesives used for cryopanel of adsorption pumps. Recently, a two-stage G-M cooler, with a cooling power of 1 watt at 4.2K and a helium compressor have been procured to avoid the liquid-helium dependency for these experiments.

Experimental studies have been initiated to study the wear and friction properties of Polytetrafluoroethylene (PTFE) and its composites at cryogenic temperatures. A cryo tribometer is being developed to facilitate these experiments. After conducting trial runs at room temperature, studies will be extended down to the cryogenic-temperature zone.

The collaborative activity between the Centre and the Department of Space, to carry out the calibration of temperature sensors continues. A dedicated calibration has been set up and runs round the clock. Multiple calibrations of sensors from room temperature down to 4.2K, are being conducted. A few of these calibrated temperature sensors have been used during the recent successful launch of the Geosynchronous Satellite (GSAT 14). This year nearly 100 sensors have been calibrated and delivered to LPSC, Mahendragiri and Bangalore.

## Earth Sciences

**Staff: Academic: 6**

**Students: PhD: 20**

**Degrees Awarded: MSc (Engg): 1; ME/M Tech: 5**

**Publications: 31**

The Centre for Earth Sciences has six core faculty members who are involved in innovative, multidisciplinary research using geological, geophysical and geochemical tools to understand Earth processes. Equipped with state-of-the-art analytical facilities and wide-ranging expertise,







faculty and students are working on diverse problems in earthquake and tsunami geology, site amplification of seismic energy, global tectonics, core dynamics, the present-day carbon and hydrological cycle, ocean-atmosphere interaction, modern and paleoclimate studies, establishment of new proxies for the reconstruction of climate, petrology and geochemistry of igneous, sedimentary and metamorphic rocks. Some of the salient features of the research carried out during the year 2013 are:

It was shown that the stable isotopic composition of land snails is a new proxy of the seasonal variability of rainfall in India. A new experimental set up was developed for the measurement of C-isotopes in atmospheric CO<sub>2</sub>.

Insights were obtained on the tectonic correlation of India and Madagascar. CO<sub>2</sub> migration, during the charnockites genesis, was modeled. Evidence of crustal-scale subduction, in Neo-Archean from high P-T granulites of Scotland and from the chromite-silicate chemistry of the Sittampundi complex of South India, was obtained.

Ages and sizes of pre-2004 tsunamis were inferred from Andaman and Nicobar. High-resolution speleothem records revealed climatic variability in the Central Himalayas in the last 1800 years.

Stable isotopic compositions of the Hooghly river estuary have provided new insights on seasonality in the eastern part of the Indian sub-continent. Chromium recycling in the earth was explored by using Cr stable isotopes in mantle-derived rocks and their weathering products.

Numerical models of the lithosphere and mantle convection were studied. Evaluations were carried out of a best-fitting viscosity structure for the earth, constrained by plate velocities and deformation rates, geoid and dynamic topography. An understanding of the deformation of the tectonically active western north American belt was developed.

The effect of the lower mantle on dynamo action in the earth is being explored.

#### 4.1.6 Centres (Under Director)

The Centres under the Director consist of the following Departments/ Centres:

- ❖ Supercomputer Education and Research
- ❖ Nano Science and Engineering
- ❖ JRD Tata Memorial Library
- ❖ Robert Bosch Centre for Cyber Physical Systems
- ❖ Archives and Publications Cell

##### Supercomputer Education and Research

**Staff: Academic: 14; Scientific: 6; Technical: 2**  
**Students: PhD: 26; M Sc (Engg): 21; MTech: 24**  
**Degrees Awarded: PhD: 3; MSc (Engg): 8; MTech: 9**  
**Publications: 70**

The Supercomputer Education and Research Centre (SERC) at IISc provides excellent

opportunities for pursuing advanced research and education in various aspects of Computer Systems and Computational Sciences. SERC active areas of research include high performance computing, database systems, scientific computing, medical imaging, and bioinformatics. The Centre is involved in several sponsored research projects in collaboration with many government and private agencies. A brief summary of some of the major thrust areas of SERC is included below:

##### Database Systems

Over the past year, we have developed a conceptually new approach to address the chronic problem of selectivity estimation errors in database engines. In the new approach, the





traditional compile-time estimation process is completely eschewed. Instead, a small “bouquet” of plans is identified from the set of optimal plans in the query’s selectivity error space, such that at least one among this subset is near-optimal at each location in the space. Then, at run time, the actual selectivities of the query are incrementally “discovered” through a sequence of partial executions of bouquet plans, eventually identifying the appropriate bouquet plan to be executed. The duration and switching of the partial executions is controlled by a graded progression of iso-cost surfaces projected onto the optimal performance profile. We have proved that this construction results in bounded overheads for the selectivity discovery process and consequently, guaranteed worst-case performance. Further, the plan bouquet approach has been empirically evaluated on industrial-strength database engines over benchmark environments. Our experimental results indicate that it delivers substantial improvements in the worst-case behavior of plan choices, without impairing the average-case performance, as compared to the native optimizers of these systems.

### **Bioinformatic Databases and Software Tools**

The volumes of sequences in various sequence databases and three-dimensional protein structures in the Protein Data Bank have grown exponentially due to various rapid technological advances. Mining of these biological data (sequences and structures) to obtain useful knowledge is essential for researchers who are working in the areas of structural biology, genomics and proteomics. As a result, a new field of science called computational biology and bioinformatics emerged with a focus on developing efficient algorithms, search engines and databases which will help extract useful knowledge from the ever-rising volume of biological data. Thus, part of my group at the Supercomputer Education and Research Centre has developed several algorithms, web-based computing servers and databases to mine various biological sequence and three-dimensional structural databases. These algorithms and computing engines (see below table for details) would not only make sense of the complex biological data but also provide precise information. These are developed from the funds

provided by the Department of Biotechnology and Department of Information Technology.

### **Grid Applications Research**

The Grid Applications Research Lab conducted research in the following areas:

- A Framework for efficient executions of message-driven parallel applications on GPUs.
- Node-splitting based load balancing strategies for graph applications on GPUs.
- Acceleration of radiation calculations of climate modeling on GPUs.
- Prediction of queue waiting and execution times of parallel applications on production supercomputer systems.

### **Medical Imaging**

The medical imaging group primarily works in medical imaging related areas with a focus on computational methods in biomedical optical imaging. Their recent research contributions have focused on biomedical optical image reconstruction algorithms, where the emphasis is on making them deployable in real-time and computationally efficient.

Biomedical optical imaging enables continuous monitoring of disease (bed-side), which is highly desirable in the clinic, as optical imaging equipment are portable and non- ionizing. The challenging task here is that the quantitative accuracy provided by the reconstructed images depends on the reconstruction parameters, which used to be chosen heuristically. In this context, the previous year’s contributions have been to eliminate the bias introduced by these reconstruction parameters, and, even more potently, to facilitate their automatic setting through the matching of experimental data with the computational models. Moreover, as image reconstruction involves the repeated use of the computational model, the group has also worked on developing these computational models, a notable example being the modeling of terahertz hearing effects in realistic tissue.





As modern medical imaging equipment is multi-modal in nature, combining optical imaging with traditional medical imaging equipment, Phaneendra has also developed new pathways to incorporate the additional information provided by the traditional imaging modality into the biomedical optical image reconstruction procedure. The major contributions in this area in the past year include: (a) Utilization of prior information to optimize the minimal required measurements in image-guided diffuse optical tomography; (b) Analytical solutions for coupled partial differential equations encountered in diffuse fluorescence imaging using extrapolated boundary conditions; and (c) Gradient-free efficient reconstruction methods for image-guided diffuse optical tomography.

### Video Analytics Laboratory

The main research objective of the Video Analytics Laboratory is to develop robust algorithms for analyzing and understanding the content of visual information. The novel approaches developed at the Video Analytics Laboratory are outlined below.

- Proposed a subject independent human action recognition using spatio-depth information.
- Proposed a compressed video classification using Histogram of Oriented Motion Vectors (HOMV)
- Proposed a fast near optimal projection for sparse representation based classification
- Proposed real-time robust trackers in a sparse representation framework
- Proposed the following application based on our “Feature Match” technique:
  - Synthetic image super-resolution
  - Optic Disk detection in retinal images
  - Video Object Segmentation
  - Optical flow estimation
- The following systems were proposed under compressed domain video analysis:

- Fast moving-object detection in compressed H.264/AVC videos.
- Real-time anomaly detection in compressed H.264/AVC videos.

- Implemented the popular SIFT algorithm in GPU which runs many times faster than the existing GPU implementations.

### High Performance Computing Lab

The research focus of the HPC lab is on Architecture, compiling techniques, and high performance computing, with a special focus on accelerator-based architectures and programming models and compiling for Graphics Processing Units (GPUs). In particular, our group has developed efficient techniques for enhancing concurrent execution in GPUs. Our group has also developed analytical models for memory system performance and efficient memory hierarchy design for multicore architecture. Last, our group has proposed efficient techniques for parallel flow-sensitive points-to analysis.

### New facilities created

SERC currently facilitates the high performance and supercomputing needs of the Institute. To enhance these facilities, a new Captive Power setup was successfully commissioned in July 2013 consisting of 3x750 KVA DG sets (890 BHP/ 1500 rpm Cummins engines and 750 kVA/1043 A/50 Hz Stamford alternators) of radiator cooling along with an AMF panel consisting of (3x1600 A + 2x3200 A coupler) breakers and meters/relays. Also 2x500 KVA Riello PCI online UPS systems were installed and energized for ready use.

### New Funding:

1. “Development of Novel Computational Methods for Optical Molecular Tomographic Imaging”. Funding Agency: Department of Biotechnology [September 2013-September 2016]. Amount: Rs. 22.26 Lakhs.
2. “Accelerating Diffuse Optical Tomographic Image Reconstruction Using Graphics Processing Units and Multi-core Architectures”. Funding Agency: Department of Biotechnology [June 2013-June 2016]. Amount: Rs. 18.33 Lakhs.





3. "A robust middleware for job management on supercomputers". Funding agency: Department of Science and Technology [January 2013-December 2015]. Amount: Rs. 15 Lakhs.
4. "A framework for efficient executions of irregular applications on hybrid systems." Funding agency: Centre for Development of Advanced Computing [July 2013-April 2014]. Amount: Rs. 10 lakhs.
5. "Image Analytics using Feature Match Technique" Funding Agency: JATP, IISc. Duration: 2 years [April 2013-March 2015]. Amount: Rs. 6.53 Lakhs.
6. "Surface Anomaly Detection" Funding Agency: Wipro Technologies Pvt. Ltd.. Duration: 1 year [April 2013-March 2014]. Amount: Rs. 9.7 Lakhs.
7. "Cheque Image Analysis" Funding Agency: Tech Mahindra Pvt. Ltd.. Duration: 7 months [September 2013-March 2014]. Amount: Rs. 7.7 Lakhs.
8. "Intuitive Image Capture". Funding Agency: LG Software India Ltd. Duration: 1 year [September 2013-August 2014]. Amount: Rs. 15 Lakhs.
9. "Object Detection and Tracking" [Course]. Funding Agency: Philips India Pvt. Ltd. Duration: 3 months [October 2013-December 2013]. Amount: Rs. 2 Lakhs.
10. "Geometry and topology-driven analysis and visualization of scalar fields". Funding Agency: Department of Science and Technology. Duration: 3 years [2012-2015]. Amount: Rs. 24 Lakhs.
11. "Cyber surgery and remote patient care". Funding Agency: Robert Bosch Centre for Cyberphysical Systems. Duration: 3 years [2012-2015]. Amount: Rs. 300 lakhs

## Nano Science and Engineering

**Staff: Academic: 8**

**Students: Ph D: 50**

**Degrees Awarded: M Sc (Engg): 1;**

**Publications: 81**

The Centre for Nano Science and Engineering (CeNSE), established in 2010, leads the research effort at IISc in nano and micro technologies. With a state-of-the-art National Nanofabrication Facility

(NNFC) and Micro and Nano Characterization Facility (MNCF) fully functional, together with the various thematic research labs devoted to MEMS, NEMS, Sensors, Biophotonics, Neuroelectronics, Plasmonics, CVD, and Microfluidics, the Centre has become a hub of interdisciplinary R&D with researchers from elsewhere in IISc, the country, and industry.

**MEMS and NEMS:** Considerable effort has been devoted at CeNSE to developing MEMS and NEMS devices with emphasis on sensing technologies. Work on MEMS gyroscopes, MEMS microphones, and MEMS ultrasound transducers is at an advanced stage, with an emphasis on the fabrication of the devices. One highlight has been the integration of self-sensing in a MEMS cantilever beam through the incorporation of a metallic piezoresistor with a better effective gauge factor than semiconductor piezoresistors. This is achieved by enhancing the piezoresistive sensitivity of a metallic film a hundred-fold through selective nanoscale inhomogenization, and through precisely controlled electromigration, which creates a localized percolation network. This development, covered under a patent application, is even more promising for incorporation into NEMS, wherein size and the consequent high frequencies are not favourable to semiconductor piezoresistors.

The work on controlled electromigration has led to the discovery of control parameters that can be effectively used for targeted transport of metallic materials at the nanoscale. Most fascinating has been the discovery of a rather simple process to exploit electromigration for nanoscale patterning in what is now termed *electrolithography*. This process, covered by a provisional patent, has the potential to translate into a very cost-effective and efficient technology for nanoscale lithography.

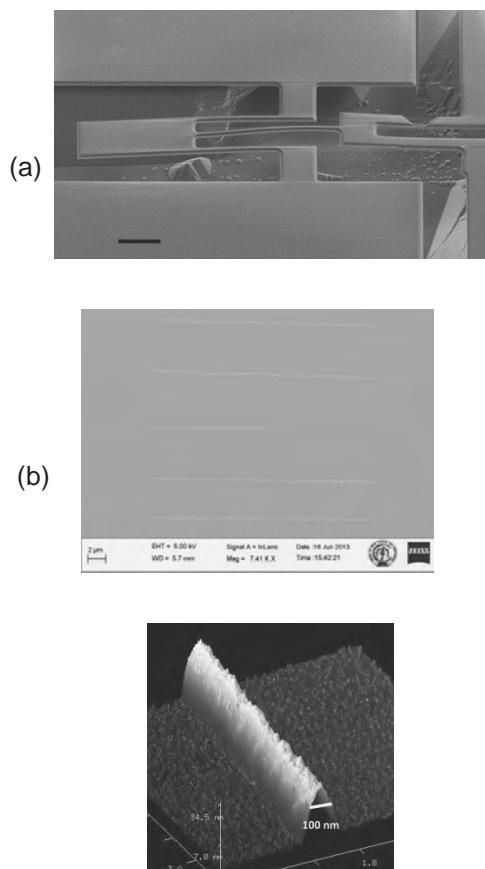
Carbon-based materials, such as carbon nanotubes and graphene, present the ultimate in size for a mechanical resonator. Scientists at CeNSE have successfully fabricated suspended single-walled carbon nanotube devices (CNT NEMS). These are the first known CNT NEMS fabricated using dielectrophoresis, and are expected to have better adhesion to metal







contacts. Consequently, they display lower losses and better sensitivities than demonstrated till now.



**Figure 1.** (a) A MEMS self-sensing cantilever with a gold piezoresistor. The gold film is locally inhomogenized using controlled electrolithography to boost the piezoresistive sensitivity by two orders of magnitude (work done in collaboration with the Department of Physics). (b) SEM image (left) and AFM image (right) of 100 nm wide and 50 nm thick Ti lines transferred with an electrolithography process invented at CeNSE (work done in collaboration with Materials Engineering).

**Nanoelectronics and magnetics:** A new substrate for a back-gated graphene transistor, with 30 nm  $\text{HfO}_2$  film on silicon, has enabled attaining the highest reported transconductance in a bi-layer graphene transistor. Integrating microwave-synthesized, nanocrystalline zinc ferrite as an inductor core in a standard CMOS process has led to the best inductor performance (up to 10 GHz) reported to date. A new design, based on a fringe-field junctionless transistor, has been employed to fabricate an ultrasensitive displacement sensor. A novel combination of wet processing with KOH and TMAH was developed to produce very low reflectivity silicon surfaces for photovoltaic applications.

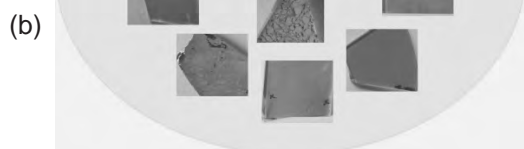
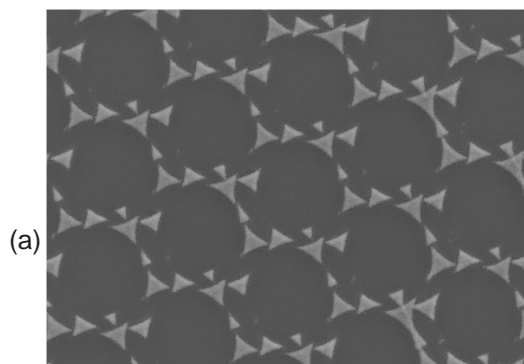
**Biosensors:** The highlight of the research work conducted in 2013 was the development of a platform bio-sensing technology based on etched fiber Bragg gratings (EFBG). The theoretical performance limits of this technology have been determined and various applications of this technique, such as the detection of bio-molecules and the investigation of conformational changes in polymer films and gas detection ( $\text{CO}_2$ ) have been demonstrated. It has been hypothesized that an array of receptors might enable more selective identification of target molecules in complex samples. In a project funded by the Robert Bosch Center for Cyber Physical Systems at IISc, work is under way on the development of EFBG sensor arrays, with a post-fabrication calibration method for EFBG sensor arrays conceived and demonstrated. The method was able to calibrate a 4 element array to within 5% inter-sensor signal variation, while the un-calibrated array response had an inter-sensor variation of around 400%.

**Photonics:** A method for a wafer-scale fabrication of a three-dimensional photonic metamaterial with a strong chiroptical response in the visible region of the electromagnetic spectrum has been developed. The system comprises metallic nanoparticles arranged in a helical fashion, with a high degree of flexibility over the choice of the underlying material, as well as their geometrical parameters. This results in exquisite control over the chiroptical properties, most importantly the spectral signature of the circular dichroism. Despite the large variability in the arrangement, as well as in the size and shape of the constituent nanoparticles, the average chiro-optical response of the material remains uniform across the wafer, confirming the suitability of this system as a large-area chiral metamaterial. By merely heating the substrate for a few minutes, the geometrical properties of the nanoparticles can be altered, providing an additional handle for tailoring the spectral response of this novel material. Separately, a system of reciprocal nano-swimmers has been developed, which can be powered with small homogeneous magnetic fields, and whose motion resembles that of a helical flagellum moving back and forth. The measured diffusivities of the swimmers is higher





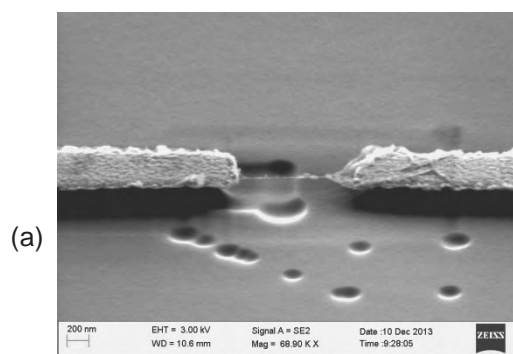
than that of non-actuated objects of identical dimensions at long time scales, in accordance with certain theoretical predictions. Randomness in the reciprocity of the actuation strokes was found to have a strong influence on the enhancement of the diffusivity, which has been investigated with numerical calculations.



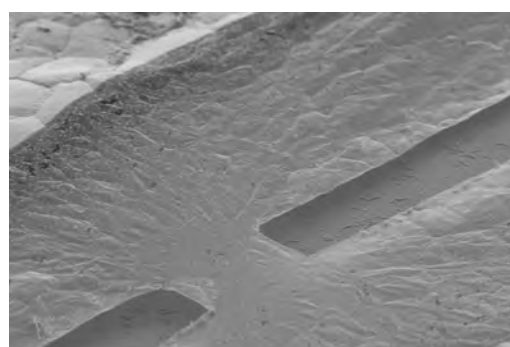
**Figure 2. (a) A SEM image of a wafer-scale nanophotonic device: Array of silver pyramids (size of the smallest pyramid ~ 50 nm), (b) Engineering palsonic substrates: Strongly chiral metamaterials.**

**Graphene and its wonders:** At CeNSE, thin sheets of graphene are routinely grown, and their properties measured and manipulated to engineer products that could be useful to human kind. Among its many remarkable properties, this single sheet of atoms is also one of the most impermeable in nature: even helium atoms cannot get through. In collaboration with Prof. Praveen Ramamurthy of Materials Engineering, scientists at CeNSE have integrated graphene with readily available polymers to make packaging material that has the lowest measured permeability to water. To keep potato chips crisp, packages on

supermarket shelves need to have a permeability of less than one gm per square meter per day of water. The new graphene-polymer composite has a permeability that is 10 million times lower. Such low permeability to water is required to keep organic electronics “crisp” and working.



(b)



**Figure 3. (b) A NEMS resonator made up of a single walled CNT. (b) A suspended graphene structure fabricated from transferless graphene grown on electrodeposited copper.**

**The Power of GaN:** In the next generation of power electronics devices, nitrides of Al, In and Ga are already replacing Si, the current material. Researchers at CeNSE are involved all the way from very fundamental materials development to the fabrication and testing of such devices. By controlling the presence of defects in GaN, transistors smaller than 100 microns, which can enable the next generation power electronics have been developed. Such devices can play a significant role in ensuring better energy efficiency for a greener world.

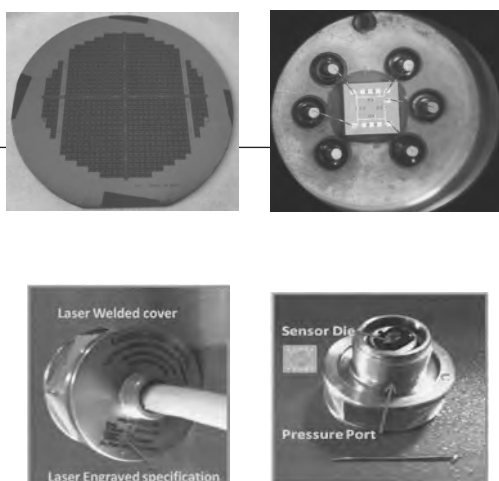
**Device development and Packaging:** Device development undertaken at the Centre at various





scales and using varied materials is now ably supported by a full fledged Advanced Packaging Lab that is the first MEMS packaging Lab in the country. In its very first year of operation, the lab has demonstrated its capability in terms of developing MEMS packaging. The development of the following completely packaged devices was completed during 2013:

1. MEMS-based 1.2 Bar Absolute Pressure Sensors with built in Electronics.
2. MEMS-based 400 Bar Absolute Pressure Sensors with built in Electronics.
3. Micro Pump for drug delivery, in collaboration with DESE.
4. Spin-offs from Micro pump: viz., Pressure regulator, Millibar Pressure Calibrator and a mini cooling System.



**Figure 4. From wafer to packaged product: Development of a 400 bar pressure sensor entirely done at CeNSE**

**Outreach:** In addition to its regular academic activities, CeNSE has been engaged in outreach programs that draw upon and leverage its comprehensive facilities. The Indian Nano-electronics Users Program (INUP), underway since 2008, is an important initiative that makes available the state-of-the-art device fab to researchers from academic institutions around the country. More than 1100 researchers have been trained at various levels through this continuing and highly successful program.

A path-breaking initiative of CeNSE is the establishment of the *Industrial Affiliate Program*, through which industries in high technology join hands with IISc and CeNSE for mutual benefit, to use the synergies to “push the envelope”, as well as to tackle the important technical problems an Affiliate may encounter. Launched in mid-2013, the IAP has enlisted six major global companies to date as Affiliates. Earlier in the year, a two-day meeting was held with industries and public R&D institutions to explore the various ways they could collaborate with CeNSE. In late 2013, a meeting was organized on “Nanotechnology in Agriculture” by inviting researchers in the field from around the country.

### JRD Tata Memorial Library

**Staff: Librarian-in-charge: 1; Deputy Librarian: 2; Asst. Librarian: 1; Scientific: 1; Technical: Publications: 2**

J.R.D. TATA Memorial Library, at the Indian Institute of Science, is one of the oldest Science and Technology libraries in India. Started in 1911, as one of the first set of departments in the Institute, it has become a precious national resource center in the field of Science and Technology. The collection of the Library which includes books, journals, reports, theses, Indian Patents and standards is regarded as one of the richest collections in the country. This rich and valuable collection, built over nine decades, has some rare reference materials and back volumes of several important journals. Apart from its print resources, the Library has access to a large collection of e-journals, eBooks and databases. Functioning as an effective support system for information services across the campus continues to be the primary goal of the library.

During the year 2013, the Library added 5032 documents including 2187 (including 1069 kannada books) books, 2327 bound volumes and 518 Gift books. An eBook cataloguing service has been introduced. Bibliographic data of 300 e-books have been added to the Libsys database. E-books' data processed during the week is added to the Weekly List. The total holdings of the Library





have increased to about 5,02,432 physical documents which include other materials like Technical Reports, Standards, Theses & Dissertations. The Library continues to primarily subscribe to e-only journals and over 765 e-journals are being subscribed to at a cost of nearly Rs.10 crores. The 'Electronic Theses Repository' contains about 2209 theses. Apart from these, it also contains around 3500 digitized books which are out-of-copyright.

The Circulation section has registered 729 new members. A Total number of 36,295 transactions were carried out by the Circulation section during 2013. Work such as reshelving, shelf rectification, shifting etc. are carried out in the library regularly.

The Library continues to maintain pre-eminence in providing access to a large number of e-resources. Some major e-resources include the complete journal publication of the following Societies:

1. American Chemical Society - ALL journals and its Archive
2. Royal Society of Chemistry - ALL Journals and its Archive
3. American Society for Microbiology - ALL Journals
4. Society for Industrial and Applied Mathematics (SIAM) - Complete journal collection and Archive
5. American Institute of Physics - Journals and Archive
6. American Physical Society Journals, including Physical review Online (PROLA) Collection
7. Institute of Physics Publishing - Complete collection including its Archive
8. Oxford University Press - Complete Mathematics, Physical and Life Science Collections
9. JSTOR Archive

Some of the Backfile collections to which access is provided on a perpetual access basis include:

- 1 Elsevier Backfiles in eleven subject categories such as Biochemistry, Organic Chemistry, Inorganic Chemistry, Physical and Analytical Chemistry, Chemical Engineering, Materials Science, Mathematics, Physics General, Pharmacology, Neuroscience,

Engineering Technology

2 Wiley InterScience backfiles in eight subject categories which include Biochemistry, Polymer Science, Analytical Science, Cell and Developmental Biology, Chemistry, Genetics & Evolution, Materials Science, Physics and Astronomy

3 With the support of the Authorities and the approval of the Journal Purchase Committee, the following backfiles have been added to the e-collection

Nature backfiles

American Chemical Society Legacy Archive

Institute of Physics Publishing Journal Archive

Apart from the above, as a core member of the INDEST-AICTE Consortium of MHRD, access is provided to over 6000 electronic journals, several databases and major e-resources including :

- 1 Association of Computing Machinery Journals
- 2 IEEE / IEE Journals
- 3 Elsevier Science Direct
- 4 Springer Link Journals
- 5 ASTM Journals and Standards
- 6 ASCE Journals
- 7 ASME Journals
- 8 Emerald full-text

"Web of Science" which was subscribed to by the INDEST-AICTE Consortium is now subscribed to by the Institute

Similarly, 27 Nature Group Journals were also added to the Library subscription from 2014. These were earlier subscribed to by the INDEST-AICTE Consortium.

The Library has been using LIBSYS, a Library Management Software for its functions such as Acquisition, Cataloguing, Serials Control, and Circulation. Online access to Library holdings data is through WEB-OPAC. Users have the facility to browse and search the Library database and view the status of a document or their own transactions and make on-line reservations for a document that has been issued. Presently, the OPAC database has about 1,92,161 books and 2,02,007 records of bound volumes of periodicals.







Content page access for books through the Web OPAC is provided to all users of the library. An article indexing service for articles published by the Institute faculty has been initiated.

### **Hardware-Software initiatives**

Currently, the Library is using LibSys-4 for its housekeeping operations. Since the software support for the current version is not likely to be continued, the library has planned for LibSys 7 or any other new Library Information Management Software, for which funds have been sanctioned by the authorities.

For the optimum use of the e-resources subscribed to, Sixth Sense Journal search: a federated search engine is being procured with the approval of the Journal Purchase Committee. The software was on trial for almost two years.

Also, computing facilities in places like user areas, computer sections and operational units are being augmented.

The Library has been providing photocopies of documents available in the Library within the copyright laws to Scientists/academicians/students. The UGC has identified the Library as a Document Delivery Center for the Southern Region and fixed charges for these services. Initially, financial assistance was provided by UGC-INFLIBNET for the purpose. The Library continues to provide this service. In addition, as a member of INDEST, the Library provides document delivery to other INDEST members.

In addition, the Library continues to provide e-mail based services such as new additions of books and journals, Interactive services like reminders, reservations and overdue intimations and an e-mail based reference service. The Library web page has been designed to disseminate up-to-date information from the Library. The web-page provides comprehensive information on the collections, new additions and all the services provided by the Library. The page also serves as a portal to access e-resources.

The Library procures books by placing orders on vendors who offer substantial discounts while providing prompt delivery. This has resulted in discounts ranging from 25% to 34% across various publishers.

The Library is recognized as the Resource Center for Mathematics for the Southern Region by the National Board of Higher Mathematics, Dept. of Atomic Energy, Government of India., and is receiving financial assistance for expanding this collection on Mathematics.

### **Robert Bosch Centre for Cyber Physical Systems**

Recent advances in sensing technologies, low power microelectronics, VLSI, wireless communication, and algorithms for signal processing, data mining, computing and communications, have created unprecedented possibilities for measuring, monitoring, making inferences about, and controlling the systems around us. Along with the rise of these technologies, we have seen the emergence of new challenges to human life and endeavor.

The emerging field of Cyber Physical Systems aims to leverage advances in technology to address some of the challenges in areas as diverse as health care, energy, and infrastructure management. Embedded sensing, distributed processing, and control, form the building blocks of a cyber-physical system, where all elements are coordinated over a communication network. An example of a cyber physical system is a smart electrical power grid that would interconnect a number of traditional and renewable (and, possibly intermittent) sources to loads that are instrumented and controllable so that fine-grained control could be exercised over the distribution of the available energy. Another example would be a large office or an apartment building with a smart structure and smart environment management. Sensors embedded in the structural members of the building could help in deciding whether the building is safe to occupy after a seismic event. Sensors and actuators interconnected by a wireless communication network could monitor and manage a multitude of ventilation devices, water tanks, pumps and solar water heaters.

Some major considerations in the design of these cyber physical systems include low power, sensitive, robust and manageable sensors, very





low power electronics, energy harvesting and miniature charge storage devices, energy conscious, high performing, and verifiable systems software, light weight distributed algorithms for signal processing, decision making, time synchronization, and control, wireless mesh networks that provide quality service, control systems that operate effectively over such wireless networks, and light weight security protocols amongst others.

The main domains of research at the Robert Bosch Centre for Cyber Physical Systems (RBCCPS) include the following broad categories: healthcare, agriculture, smart buildings, water, and mobility. Core technology programs have been identified and are now in active development. These include optical sensing, networking, and data & storage analysis. Laboratories are being set up for mechanical prototyping, and developing and testing low-cost optical sensors. A majority of the technology translation processes and metrics are now in place. There are currently a total of 25 projects divided across the various domains. Major projects in the water and transportation verticals have been initiated.

The Centre has received its first external funding for projects from ACM, IBM (USD 40,000 + USD 10,000). Two proposals associated with RBCCPS as an incubator are in the final rounds for BIRAC/SPARSH innovation/entrepreneurship funding. Currently, a total of 41 project assistants, research associates, and Ph.D. students are associated with RBCCPS projects. The Centre has supported 15 student internships. The Centre has also recently received notification of a successfully funded DST-UKIERI (United Kingdom-India Education and Research Initiative) proposal jointly with the Heriot-Watt University.

### Archives and Publications Cell

#### Technical: 1

The Archives and Publications Cell, established on May 17, 2007, has a two-fold responsibility. The first is to collect, catalogue and preserve all documents, photographs and other articles of relevance to the Institute. The second is to

coordinate and facilitate the publication activities of the Institute.

### Archiving and science outreach

#### Digitizing

- Original documents from 1909 to 2000 have been scanned and have been made searchable (OCR). Documents from 1909 to 1959 have been uploaded.
- Council Proceedings from 1909 to 1930 (three volumes) which were handwritten have been typed and made searchable (OCR). Proceedings from 1931 to 2010 have been scanned and made searchable (OCR). All these documents have been uploaded.
- Proceedings of the Finance Committee meetings from 1924 to 2010 have been digitized and uploaded. Proceedings from 1909 to 1924 (two volumes) which were handwritten have been typed and made searchable (OCR). They are in the process of being uploaded.
- A Miscellaneous collection of documents including budget estimates, Scheme of Instructions, Administrative Manuals and Bye-laws have been digitized and uploaded.
- All the issues of the Journal of the Indian Institute of Science from 1914 to 2013 have been digitized and are in the process of being published online. Missing issues are being procured from libraries across the country.

#### Exhibitions

- Life of Raman: An exhibition of rare photographs from the life of Sir C.V. Raman (April – August, 2013). The posters for the exhibition were commissioned by the Royal Society of Chemistry, London and sent to APC by Prof. D. A. Long, University of Bristol.
- Open Circuit Wind Tunnel: An exhibition of models tested at the Open Circuit Wind Tunnel, rare archival photographs and original documents pertaining to the Aerospace Engineering Department (October, 2013) Ripple... Knowledge in Action: An exhibition of models designed





and built by the Centre for Product Design and Manufacturing (December, 2013-January, 2014)

### IIScPress

- IIScPress – WSPC Publications: IIScPress and World Scientific Publishing Company (WSPC), Singapore have a joint publishing collaboration to co-publish textbooks and monographs in all major disciplines under the following series:
  - IISc Centenary Lectures Series (ICLS)
  - IISc Lecture Notes Series (ILNS)
  - IISc Research Monographs Series (IRMS)
- IISc – Cambridge Series: Very recently, IIScPress entered into a collaboration with Cambridge University Press, United Kingdom and has launched the following book series:
  - IISc-Cambridge Research Monographs Series (ICRMS): The monographs to be published in this series will address contemporary topics of science and engineering.
  - IISc-Cambridge Centenary Lecture Series (ICCLS): As part of the 2009 Centenary celebrations, IISc instituted a series of lectures by eminent scientists. In this series books are based on lectures delivered at IISc by distinguished speakers.
  - IISc-Cambridge Lecture Notes Series (ICLNS): This series fulfils an important need in higher education in science and engineering, particularly in India. These books are authored by distinguished scholars.
- Journal of the Indian Institute of Science: The Journal of the Indian Institute of Science has been published by the Institute since 1914. Previously, the Journal published original research work carried out by the faculty and students of the Institute as well as other institutions around the world. Since 2007, however, the Journal format has been changed. It became a quarterly Journal and published only invited review articles, each issue being guest edited by eminent researchers. In the year 2013, Volume 93 of the Journal was published; the four special issues were entitled:
  - Vol. 93 No. 1 (January - March 2013)  
Imaging and Microscopy  
Guest Editor: Gopalkrishna Hegde, Centre for Nano Science and Engineering
  - Vol. 93 No. 2 (April - June 2013)  
Water Management in Changing Environment  
Guest Editor: Mohan Kumar M. S., Dept. of Civil Engineering
  - Vol. 93 No. 3 (July - Sept. 2013)  
Cyber Physical Systems  
Guest Editor: Bharadwaj Amrutur, Dept. of Electrical Communication Engineering
  - Vol. 93 No. 4 (October - December 2013)  
High Performance Advanced Composites  
Guest Editor: S. Gopalkrishnan, Dept. of Aerospace Engineering



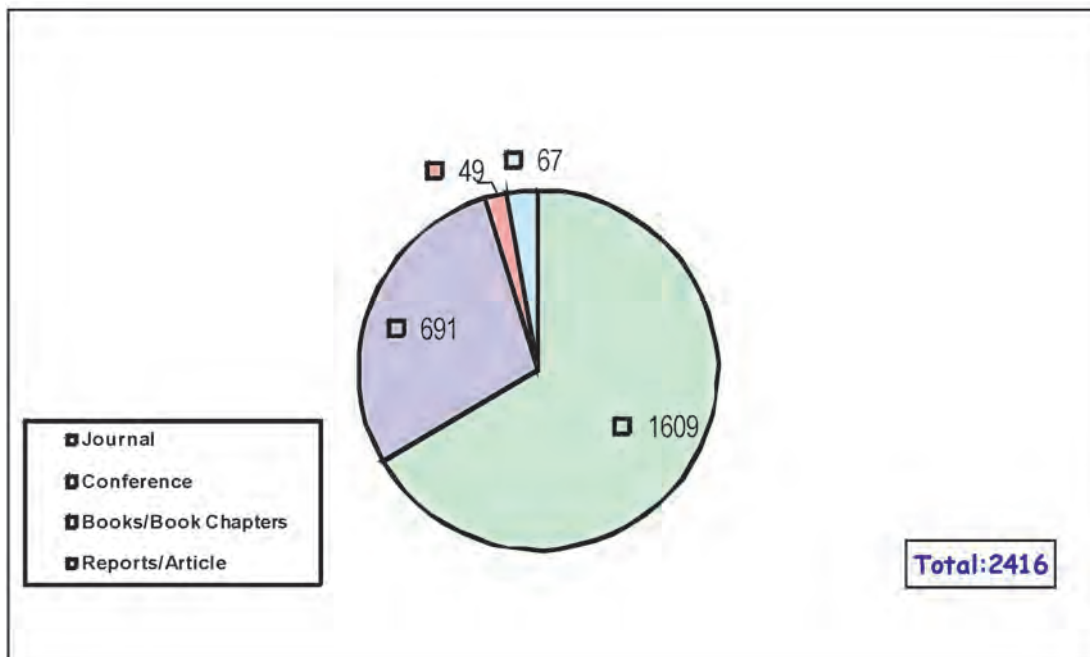


## 4.2 Research Publications

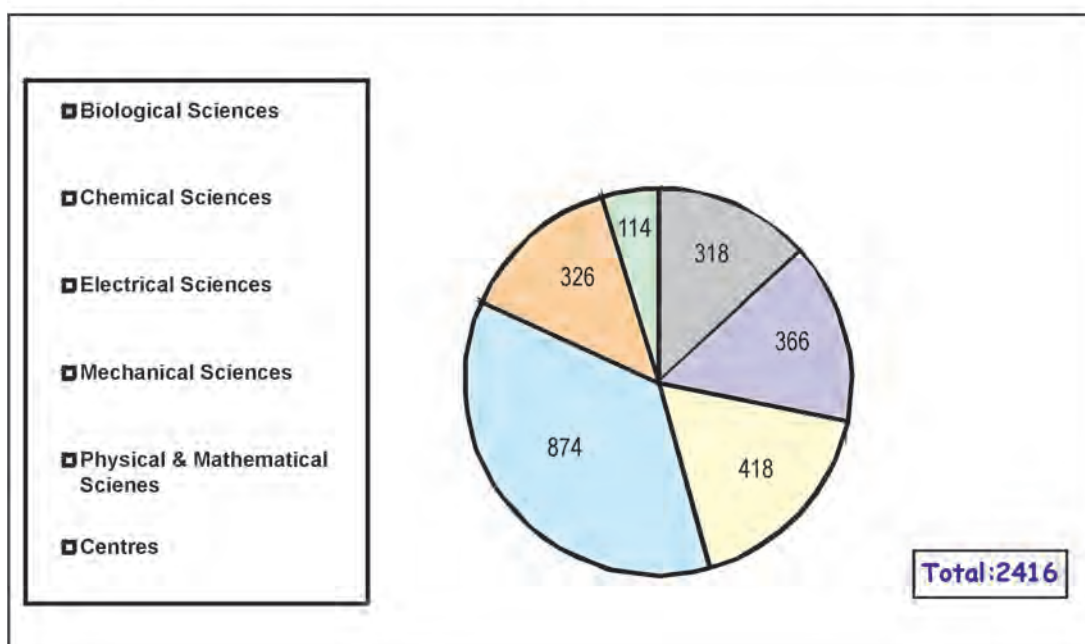
The faculty, students and scientific staff of the Institute have published research papers in national and international journals of high impact. They have also been invited to present papers, chair technical sessions, and present state-

of-the-art reports in several national and international conferences. The total number of publications including research papers/conference proceedings/reviews/reports/books/book chapters are given below:

### Research Publications 2013-14



### Research Publications 2013-14 - Divisional Break-up







### 4.3 Programmes and Courses

#### Research

□ PhD    ▼ Int PhD  
**Science**

|                                      |   |   |
|--------------------------------------|---|---|
| Biochemistry                         | □ | ✓ |
| Ecological Sciences                  | □ | ✓ |
| Microbiology and Cell Biology        | □ | ✓ |
| Molecular Biophysics                 | □ | ✓ |
| Molecular Reproduction               |   |   |
| Development and Genetics             | □ | ✓ |
| Neuro Sciences                       | □ |   |
| Inorganic and Physical Chemistry     | □ | ✓ |
| Materials Research                   | □ | ✓ |
| Organic Chemistry                    | □ | ✓ |
| Solid State and Structural Chemistry | □ | ✓ |
| Mathematics                          | □ | ✓ |
| Physics                              | □ | ✓ |
| Astronomy and Astrophysics           | □ | ✓ |
| High Energy Physics                  | □ | ✓ |
| Earth Sciences                       | □ | ○ |
| Institute Mathematic Initiative      | □ |   |

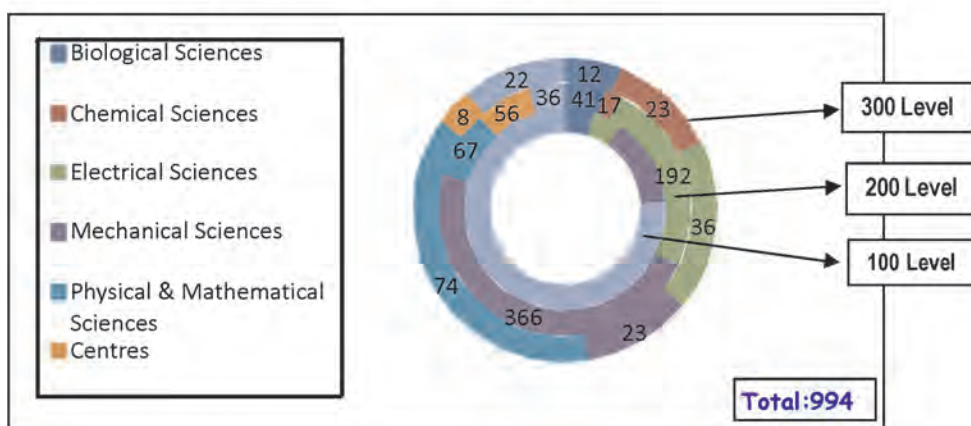
#### Courses

● ME    ○ M.Tech    ⊕ M.Des    ϕ M.Mgt    θ B S  
**Engineering**

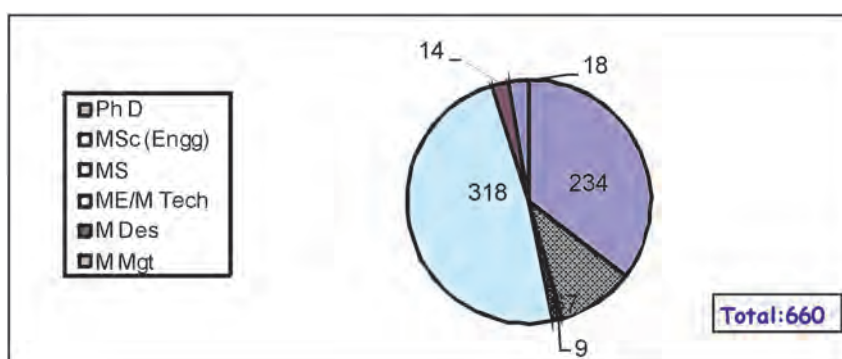
|                                      |   |   |   |  |   |
|--------------------------------------|---|---|---|--|---|
| Chemical Biology                     | □ |   |   |  |   |
| Computer Science and Automation      | □ | * | ● |  |   |
| Electrical Engineering               | □ | * | ● |  |   |
| Electrical Communication Engineering | □ | * | ● |  |   |
| Electronics Design and Technology    | □ | * |   |  | ○ |
| Aerospace Engineering                | □ | * | ● |  |   |
| Chemical Engineering                 | □ | * | ● |  |   |
| Mechanical Engineering               | □ | * | ● |  |   |
| Materials Engineering                | □ | * | ● |  |   |
| Product Design and Manufacturing     | □ | * | ⊕ |  |   |
| Atmospheric and Oceanic Sciences     | □ | * |   |  | ○ |
| Civil Engineering                    | □ | * | ● |  |   |
| Management Studies                   | □ | * |   |  | ϕ |
| Nano Science and Nano Technology     | □ |   |   |  | ○ |
| Instrumentation                      | □ | * |   |  | ○ |
| Supercomputer Education and Research | □ | * | ○ |  | θ |
| Under Graduate Programme             | □ | * | ○ |  | θ |

**Courses:** Teaching Courses are offered at 2 levels: Postgraduate Courses at the 200 level and advanced research topics at the 300 level.

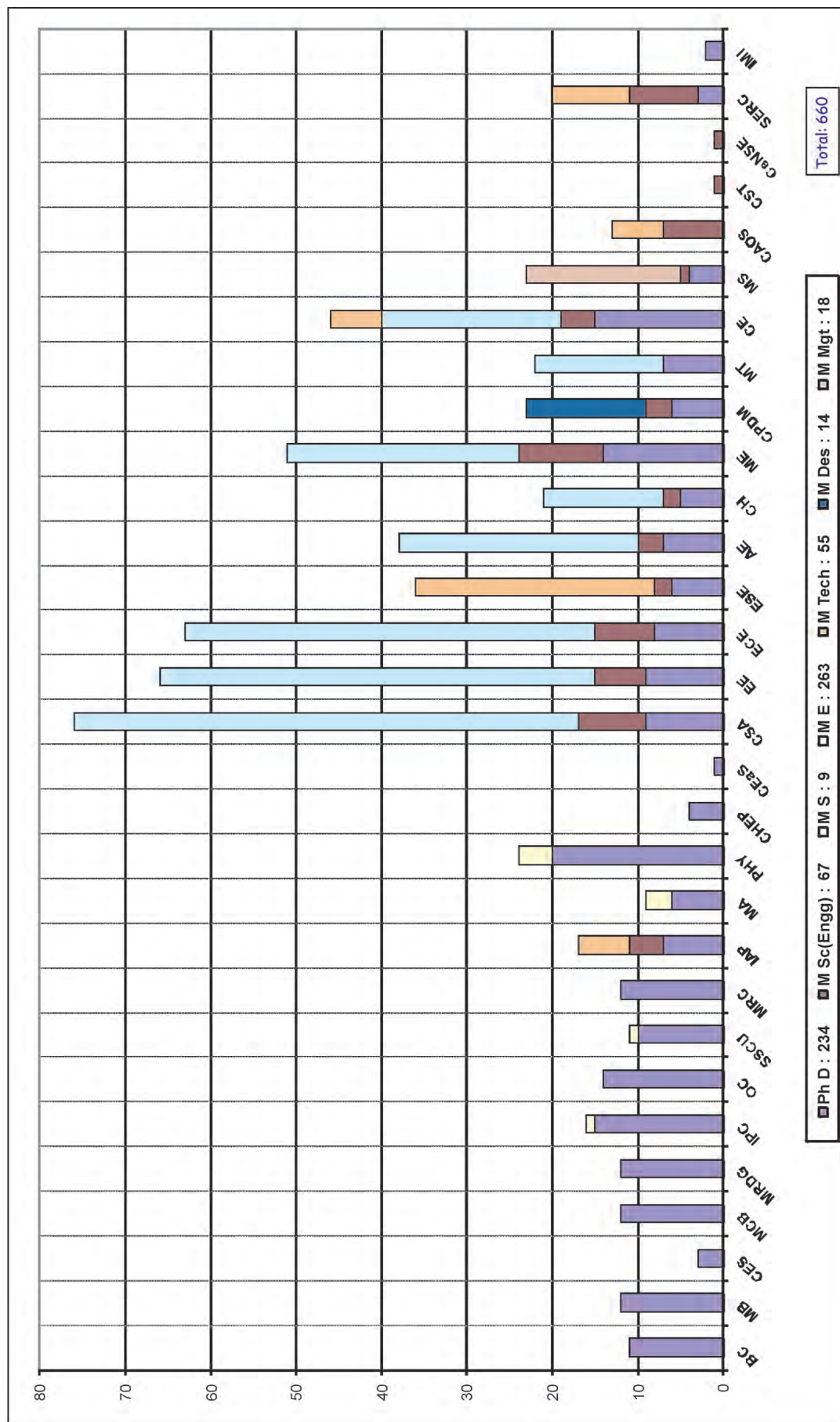
**Courses Offered 2013-14**



### 4.4 Degrees Awarded



## Degrees Awarded 2013-14





#### 4.5 Research Conferments: PhD, MSc (Engineering)

##### Doctor of Philosophy (PhD)

##### Biochemistry

1. **Mr Rupwate Sunny Dinkar:** BS:Molecular Mechanisms Underlying Phosphatidylinositol – Specific Phospholipase C Mediated Regulation of Lipid Metabolism
2. **Mr Tadi Satish Kumar:** DNA Double-strand Break Repair: Molecular Characterization of Classical and Alternative Nonhomologous End Joining in Mitochondrial and Cell-free Extracts
3. **Mr Ajay Kumar Dixit:** Structural and Functional Characterization of Calcium-Dependent Protein Kinase (CaCDPK1) from *Cicer arietinum*: Effects of Autophosphorylation and Membrane Phospholipids
4. **Mr Prakash Bhandari:** Host Gene Expression Profiling of Japanese Encephalitis Virus Infected Cells: Identification of Novel Pro- and Anti-Viral Genes
5. **Mr Goswami Arvind Vittal:** Role of Grp75 chaperone folding machinery in the maintenance of mitochondrial protein quality control
6. **Mr Krishnendu Khan:** Structure-function relationships of *Saccharomyces cerevisiae* meiosis specific Hop1 protein: Implications for Chromosome condensation, pairing and spore formation
7. **Mr Vijaykumar Nallani:** Transcriptional regulation by a biotin starvation- and methanol-inducible zinc finger protein in the methylotrophic yeast, *Pichia pastoris*
8. **Mr Debojit Guha:** Functional characterization of C4 protein of Cotton leaf curl Kokhran virus – Dabwali
9. **Ms Josyula Nitya Kalyani:** Structure-function relationship of Diaminopropionate ammonialyase (DAPAL) – a PLP dependent enzyme and its interaction with pyridoxal kinase
10. **Mr Shwetank:** Infection of human cell lines by Japanese Encephalitis Virus: Increased expression and release of HLA-E, a non-classical HLA molecule
11. **Ms Hima Rani S:** Implications of Soluble Diacylglycerol Acyltransferases in Triacylglycerol Biosynthesis of Yeast and Plants
12. **Mr Rishi Kumar N:** Insights Into the *Trans*-splicing Based Expression of Heat Shock Protein 90 in *Giardia lamblia*
13. **Mr Devanjan Sinha:** Unraveling the intricate architecture of human mitochondrial presequence

translocase - Insights on its evolution and role in tumourigenesis

14. **Mr Bhagawat S Chandrasekar:** Studies on Novel Functional Responses of Mouse Peritoneal Macrophages to Interferon-gamma: Roles of Nitric Oxide Synthase 2
15. **Ms Mrinal Srivastava:** Identification of an Inhibitor of Nonhomologous DNA End Joining: Role in DNA Repair and Cancer Therapeutics

##### Ecological Sciences

16. **Ms Geetha R:** The Distribution, Dynamics & Impacts of Invasive *Lantana Camara* in a seasonal Forest of Mudumalai, Southern India
17. **Ms Sekar Sandhya J C Bhuvana:** Species-specific and Habitat Correlates of Butterfly Dispersal Ability: Exploring Dispersal Using Patterns of Population Genetic Structure
18. **Mr Hari Sridhar:** Causes and Consequences of Heterospecific Foraging Associations in Terrestrial Bird Communities
19. **Ms Nandita Mondal:** Fire Ecology of a Seasonally Dry Tropical Forest in Southern India

##### Microbiology & Cell Biology

20. **Ms Shataparna Banerjee:** Early, essential and non-ubiquitous functions for fission yeast splicing components: indications for alternative spliceosome transitions during assembly and catalysis
21. **Mr. D Mohan Kumar:** Proteomic approaches to study glioma development, progression and therapy
22. **Ms Soumya A M:** Genetics of glioma: Transcriptome and miRNome based approaches
23. **Mr Saurabh Mishra:** Molecular Characterisation of *Mycobacterium tuberculosis* Fic Protein and its Gene and Identification and Characterisation of a Novel Functional Interaction between FtsZ and NDK in *Mycobacteria*
24. **Mr Sharath Chandra A:** Characterization of the cis and trans acting factors that influence p53 IRES function
25. **Ms Smriti Ahuja:** The Mechanism of decoding at the P-site of the ribosome and the role of 3 GC base pairs in targeting the initiator tRNA to the P-site of the ribosome





26. **Mr Nima Dondu Namsa:** Studies on Phosphorylation and oligomerization of rotavirus nonstructural protein 5 (NSP5) and cellular pathways that regulate virus replication
27. **Mr Imtiyaz Ahmad Khanday:** Target Genes and Pathways Regulated by *OsMADS1* during Rice Floret Specification and Development
28. **Mr Debjit Khan:** Interaction of Cellular Proteins with p53 IRES: Implications in Regulation of Translation of p53 mRNA
29. **Mr Anirban Mitra:** Insights into occurrence and divergence of Intrinsic Terminators and Studies on Rho-dependent termination in *Mycobacterium tuberculosis*
30. **Mr Jamma Trinath:** Mechanistic and functional insights into *Mycobacterium bovis* BCG triggered PRR signaling: Implications for immune subversion strategies
31. **Mr Sudhanshu Kumar Shukla:** Role of DNA methylation in glioblastoma development
32. **Ms. Sangeeta Chakraborty:** Multi factorial Regulation of Virulence and Survival by a Novel Enzyme “ Lactoylglutathione lyase” in *S. Typhimurium*

#### Molecular Biophysics Unit

33. **Ms Smita Mohanty:** Functionally Interacting Proteins: Analyses and Prediction
34. **Mr M Selvaraj:** Structural studies on *Mycobacterium tuberculosis* peptidyl - tRNA hydrolase and ribosome recycling factor, two proteins involved in translation
35. **Ms. N Megha Karanth:** Protein NMR studies of *E. coli* IIVN and the Protease-VPg polypeptide from *Sesbania mosaic virus*
36. **Mr Rajesh Sonti:** Conformational Analysis of Designed and Natural Peptides: Studies of Aromatic/Aromatic and Aromatic/Proline interactions by NMR
37. **Mr Ravi Kumar:** Understanding the regulatory mechanisms of *Mycobacterium tuberculosis* sigma factors
38. **Mr Kallol Gupta:** Mass Spectrometric Deconvolution of Libraries of Natural Peptide Toxins
39. **Mr Bhaskara Ramachandra Moorthy:** Structure, Stability and Evolution of Multi-domain proteins
40. **Mr Deivanayaga Barathy V:** Structural studies on mycobacterial aspartic proteinases and adenyl cyclases
41. **Ms Piyali Saha:** Protein Engineering of HIV-1 Env and human CD4
42. **Ms Paramita Sarkar:** Resurrection of omega: the smallest subunit of bacterial RNA polymerase
43. **Mr Nirnath Sah:** GABA<sub>A</sub> receptor mediated phasic and tonic inhibition in subicular pyramidal neurons

44. **Mr Vikas Navratna:** Structural and biochemical characterization of proteins involved in peptidoglycan synthesis in gram-positive bacteria
45. **Ms Shukla Jinal Kaushikkumar:** Understanding the regulatory steps that govern the activation of *Mycobacterium tuberculosis*  $\sigma^k$

#### Molecular Reproduction, Development and Genetics

46. **Mr Subhash Chandra Verma:** Regulation of chitin oligosaccharides utilization in *Escherichia coli*
47. **Ms Pradhan Shalmali Avinash:** Identification of Therapeutic Targets for Oral Squamous Cell Carcinoma
48. **Ms Meera Saxena:** Mechanisms of Drug Resistance and Epithelial-Mesenchymal Transition in Cancer
49. **Ms Thejaswini V:** Primary Microcephaly Gene MCPH1 shows signatures of Tumors Suppressors and is regulated by miR-27a in Oral Squamous Cell Carcinoma
50. **Mr Robert Sonowal:** Investigations on the possible role of aromatic beta glucoside metabolism in self-defense in Enterobacteriaceae
51. **Ms Mamta Rai:** Spatio-temporal control of *Drosophila* indirect flight muscle development and maintenance by the transcription factor Erect wing
52. **Ms Priyanka Sehgal:** Role of Insulin-like Growth Factor Binding Protein 2 (IGFBP2) in Breast Cancer
53. **Mr Nishad Matange:** Moonlighting functions of the Rv0805 phosphodiesterase from *Mycobacterium tuberculosis*
54. **Mr Mohammed Iqbal Rather:** Transcriptional and posttranscriptional regulation of the tumor suppressor *CDC73* in oral squamous cell carcinoma: Implications for cancer therapeutics
55. **Mr Ankur Sharma:** Unfolding the Mechanism of Notch1 Receptor Activation: Implications in Cancer Stem Cell Targeting

#### Inorganic & Physical Chemistry

56. **Mr Dibyendu Mallick:** Exploring Structure and Reactions: Computational Studies on Three-Membered Rings, Metal-Boron Multiple Bond and Biradical Reactions
57. **Mr Subhendu Roy:** Understanding the Structure, Bonding and Reactivity of Unsaturated Metallacycles: A Computational Study
58. **Mr Hari Krishna Reddy Kurre:** Electronic Structure and Bonding in Metallaboranes and Main Group Compounds
59. **Ms Rati Sharma:** Theoretical Approaches to the Study of Fluctuation Phenomena in Various Polymeric Systems







60. **Mr Debasish Manna:** Deiodination of Thyroid Hormones by Iodothyronine Deiodinase Mimics
61. **Mr Vankayala Kiran:** Physicochemical, Electrical and Electrochemical Studies on Titanium Carbide-Based Nanostructures
62. **Mr Udishnu Sanyal:** Modulation of Nanostructures in the Solid and Solution States and Under an Electron Beam
63. **Mr Dipak Dutta:** Functionalized Layered Double Hydroxides and Gold Nanorods
64. **Mr Yapamanu Adithylakshman:** Ultrafast Raman Loss Spectroscopy (URLS): Understanding Resonant Excitation Response and Linewidth Changes
65. **Mr Tridib Kumar Goswami:** Studies on the Photocytotoxic Effect of Ferrocene-conjugated Copper(II) Complexes
66. **Mr. Saptarshi Chatterjee:** Hyperbranched Polyacetals and Polydithioacetals
67. **Ms Puja Prasad:** Studies on Near-IR Light Photocytotoxic Oxovanadium Complexes
68. **Mr Sandip Mukherjee:** Serendipitous Assembly of 3d Metal-ion Polyclusters: Structures, Magnetic Behavior and Theoretical Studies
69. **Mr P Arun Kumar:** Mechanistic Investigation of Metal Promoted Nucleophilic Additions
70. **Mr Patil Yogesh Prakash:** Syntheses and Structure Elucidations of Ternary Metal [Cu/Co] Complexes with Nucleic Acid Constituents
71. **Ms Neha Arora:** Rational Synthesis, Stabilization, and Functional Properties of Metal and Intermetallic Nanoparticles
72. **Mr Rajesh Chalasani:** Functionalized Nanostructures: Iron oxide Nanocrystals and Exfoliated Inorganic Nanosheets
73. **Mr Chakrapani Kalapu:** Synthesis, Physicochemical and Electrochemical Studies on Iridium, Osmium and Graphene Oxide – Based Nanostructures
74. **Mr Sattaiah Naidu Kola:** Chemistry of Ru(II) complexes bearing sigma bonded H-X (X = H, Si, C) species/fragments
75. **Mr Raja Mitra:** Targeted Delivery of Cytotoxic Metal Complexes into Cancer Cells with and without Macromolecular Vehicles
79. **Ms Amitha Shetty:** Physical and Device Properties of ZnO Based Hybrid Structures
80. **Mr Suresh P:** Nanostructurization of Transition Metal Silicides for High Temperature Thermoelectric Materials
81. **Mr Basanta Kumar Roul:** Group III-nitride epitaxial heterostructures by plasma-assisted molecular beam epitaxy
82. **Mr Ranajit Sai:** Development of CMOS-compatible, microwave-assisted solution processing of nanostructured zinc ferrite films for gigahertz circuits
83. **Mr Sugavaneshwar R P:** Vapour Phase transport growth of one-dimensional ZnO nanostructures and their applications
84. **Mr Ankur Goswami:** Design and Development of Microsereolithography (MSL) System and its applications in microfabrication of Polymer and Ceramic Structures
85. **Mr Mohammad Ibrahim Dar:** Solution-Based Synthesis of Metal and Metal Oxide Nanostructures: Investigations in Magnetism, Luminescence, Spectroscopy (SERS), Energy Storage (LIB) and Generation (DSC)

#### Organic Chemistry

86. **Mr V Ganesh:** Studies on the Ring-opening Reactions of Vinylcyclopropanes, Vinylcyclobutanes, and other Small-Ring Systems
87. **Mr Phaneendra Gutala:** Enantiospecific Total Synthesis of Phomopsolide B, Macrospherulides A & E and Total Synthesis & Determination of Absolute Configuration of Synargentolide B.
88. **Mr Sandip Bhowmik:** Design and Applications of Bile-salt/Lanthanide based Hydrogels
89. **Mr Ramesh K:** A Study of Supramolecular Gels and Self Assembly of Novel Bile Acid Conjugates
90. **Mr Arkajyoti Chakrabarty:** Bile Acid Based Supramolecular Gels, Semiconductor Nanocrystals and Soft Hybrid Materials
91. **Mr Bagul Rahul Suresh:** Studies of Exo- and Endo-Receptor Properties of Poly(Propyl Ether Imine) (PETIM) Dendrimers Through Organometallic Catalysis, Photoluminescence and Stimuli Responsive Reversible Cross-Linking
92. **Ms Namita Kumari:** New Supramolecular Ion Sensing Probes and their Application in the Detection of Environmentally Relevant Ions
93. **Mr Santosh Kumar Misra:** Synthesis and Characterization of Cationic Lipids and Carbon Nanomaterials based Composites for the Delivery of Bioactive Oligo/Polynucleotides and Drugs in vitro and in vivo
94. **Mr N Damodara Reddy:** Design and Access to Disallowed and Unusual Conformers of Peptides in

#### Materials Research Centre

76. **Mr Gadige Paramesh:** Investigations into the Structural and Physical Properties of  $\text{Li}_2\text{O}-\text{M}_2\text{O}-2\text{B}_2\text{O}_3$  (M=Li, Na & K),  $\text{BaO}-\text{TiO}_2-\text{B}_2\text{O}_3$  and  $2\text{Bi}_2\text{O}_3-\text{B}_2\text{O}_3$  Glass Systems
77. **Mr Murali Banavoth:** Earth Abundant Alternate Energy Materials for Thin Film Photovoltaics
78. **Mr Ritupan Sarmah:** Dynamics of driven dissipative systems





Crystals and in Solution: Structural Consequences of the Imidate and Thioimidate Isosteres for the Peptide bond

95. **Mr Shrinidhi A:** Organic Transformations in Water: Synthetic and Mechanistic Studies towards Green Methodologies
96. **Mr Basudeb Maji:** Novel Benzimidazole based Ligands for Selective Stabilization of Human Telomeric G-quadruplex DNA, their Putative Anticancer Activity and Role of DNA Secondary Structures in the Carbon Nanotube Solubilization

#### [Solid State & Structural Chemistry](#)

97. **Mr Rakesh Sharan Singh:** Phase Transition, Relaxation Phenomena and Reaction Dynamics in Correlated Molecular Systems
98. **Mr Soumit Sankar Mandal:** A Few Applications of Porous Materials in Biology and Environment
99. **Mr Bhaskar Devu Mukri:** Synthesis, Structure and Catalytic Properties of Pd<sup>2+</sup>, Pt<sup>2+</sup> and Pt<sup>4+</sup> ion substituted TiO<sub>2</sub>
100. **Mr Amol Gopalrao Dikundwar:** Organic Fluorine in Crystal Engineering: Consequences on Molecular and Supramolecular Organization
101. **Mr Konda Shiva:** Sn-based Nanostructured Materials as Anodes for Rechargeable Lithium-Ion Batteries
102. **Mr. Venkateswar Reddy U:** Study of Enantiomeric Discrimination and Enzyme Kinetics Using NMR Spectroscopy
103. **Mr Sumanta Mukherjee:** Internal Structure and Self-assembly of Low Dimensional Materials
104. **Ms K. Catherine Kanimozhi K:** Rational Design of Diketopyrrolopyrrole-Based Conjugated Polymers for Ambipolar Charge Transport
105. **Mr Rajib Biswas:** Dynamics of Water under Confinement and Studies of Structural Transformation in Complex Systems
106. **Mr Sajesh P. Thomas:** Phase Behaviour in Crystalline Solids: Exploring the Structure Guiding Factors via Polymorphism, Phase Transitions and Charge Density Studies

#### [Electronic Systems Engineering](#)

107. **Ms Rekha Verma:** Investigation of electro-thermal and thermoelectric properties of carbon nanomaterials
108. **Mr Ram Krishna Ghosh:** Exploration of real and complex dispersion relationship of nanomaterials for next generation transistor applications
109. **Mr Mathew K:** Induction Motor Drives Based on Multilevel Dodecagonal and Octadecagonal Voltage Space Vectors

110. **Mr. Pankaj Kumar Thakur:** Poisson's Solution and Large-Signal Model for Independent Double Gate MOSFET

111. **Mr Najath Abdul Azeez:** Studies on Current Hysteresis Controllers and Low Order Harmonic Suppression Techniques for IM Drives with Dodecagonal Voltage Space Vectors
112. **Mr Jaison Mathew:** Investigation on Dodecagonal Multilevel Voltage Space Vector Structures by Cascading Flying Capacitor and Floating H-bridge Cells for Medium Voltage IM Drives

#### [Computer Science and Automation](#)

113. **Mr Arnab De:** Access Path Based Dataflow Analysis for Sequential and Concurrent Programs
114. **Mr Amulya Ratna Swain:** Weighted Average Based Clock Synchronization Protocols for Wireless Sensor Networks
115. **Mr Deepak Rajendraprasad:** Rainbow Colouring and some Dimensional Problems in Graph Theory
116. **Mr D Harish:** Reeb Graphs: Computation, Visualization and Applications
117. **Ms Archana Ravindar:** Investigations on CPI Centric Worst Case Execution Time Analysis
118. **Mr. Lakshmanan K:** Online Learning and Simulation based Algorithms for Stochastic Optimization
119. **Ms. Geetha Manjunath:** Semantic Analysis of Web pages for Task-based Personal Web Interactions
120. **Ms. Suparna Bhattacharya:** A Systems Perspective of Software Runtime Bloat -Origin, Mitigation and Power-Performance Implications
121. **Mr. L A Prasanth:** Resource Allocation for Sequential Decision Making under Uncertainty: Studies in Vehicular Traffic Control, Service Systems, Sensor Networks and Mechanism Design
122. **Mr Raghavendra K R:** Model-checking infinite-state systems for information flow security properties
123. **Mr N N R Ranga Suri:** Outlier Detection with Applications in Graph Data Mining
124. **Mr Swaprava Nath:** Mechanism Design for Strategic Crowdsourcing

#### [Electrical Communication Engineering](#)

125. **Mr Naveen K P:** Relay Selection for Geographical Forwarding in Sleep-Wake Cycling Wireless Sensor Networks
126. **Mr D Packiaraj:** Analysis of Multi-Conductor Coupled Microstrip Lines with an Aperture in the Ground Plane for Compact Broadband Microwave Components





127. **Mr Lakshmi Prasad N:** Low-Complexity Decoding and Construction of Space-Time Codes
128. **Mr Basavaraj T:** NoC Design & Optimization of Multicore Media Processors
129. **Mr Bharath B N:** Reverse Channel Training in Multiple Antenna Time Division Duplex Systems
130. **Mr. Vikram Chaturvedi:** Low Power and Low Area Techniques For Neural Recording Application
131. **Mr Srinidhi N:** Multi-antenna Communication Receivers using Metaheuristics and Machine Learning Algorithms
132. **Mr Rajath V:** Time-based All-Digital Technique for Analog Built-in Self Test
133. **Ms Revathy P:** High-k Dielectrics for Metal-Insulator-Metal Capacitors
134. **Mr A Karthik:** Fast, scalable, contention-based algorithms for multi-node selection in OFDMA and cooperative wireless systems
135. **Mr Mustafa Khandwawala:** Belief Propagation Algorithms for Mean-Field Combinatorial Optimisations

#### Electrical Engineering

136. **Mr Sridhar Alapati:** Studies on Electrical Treeing in High Voltage Insulation Filled with Nano-Sized Particles
137. **Mr Sreenivasa Sivaprasad Jaldanki:** Control, Modulation and Testing of High-Power Pulse Width Modulated Converters
138. **Ms Preetha P:** Studies on Epoxy Nanocomposites as Electrical Insulation for High Voltage Power Apparatus
139. **Mr. Kurre Ravishankar:** Transient Analysis of EHV / UHV Transmission Systems for Improved Protection Schemes
140. **Mr Sudipta Das:** Loss ratios of different scheduling policies for firm real-time systems: Analysis and Comparisons
141. **Mr. Naresh Manwani:** Supervised Learning of Piecewise Linear Models
142. **Mr. Soumitra Das:** Study on Pulsewidth Modulation Techniques for a Neutral-Point Clamped Voltage Source Inverter
143. **Mr Deepak Kumar:** Methods for text segmentation from scene images

#### Aerospace Engineering

144. **Mr Vijay Kumar Sutrar:** A Computational Study of Structural and Thermo-Mechanical Behavior of Metallic Nanowires
145. **Mr Ajith V:** Wave Propagation in Healthy and Defective Composite Structures under Deterministic and Non-Deterministic framework

146. **Mr Afroz Javed:** Compressible Mixing of Dissimilar Gases
147. **Ms Sikha Hota:** Optimal Trajectory Planning for Fixed-Wing Miniature Air Vehicles
148. **Mr Arnab Maity:** Optimal Guidance of Aerospace Vehicles using Generalized MPSP with Advanced Control of Supersonic Air-breathing Engines
149. **Mr Prasiddha Nath Dwivedi:** Nonlinear and Optimal Guidance, Control and Estimation of Endo Atmospheric Interceptors for High Speed Re-entry Targets
150. **Mr Manu K V:** Experiments on the late stages of boundary layer transition
151. **Mr Kiran Chutkey:** Investigation of Plug Nozzle Flow Field
152. **Ms Madhumita Pal:** Accurate and Efficient Algorithms for Star Sensor Based Micro-Satellite Attitude and Attitude Rate Estimation
153. **Mr Srisha Rao M V:** Experimental Investigations on Supersonic Ejectors
154. **Mr Umesh K:** On the Effect of Material Uncertainty and Matrix Cracks on Smart Composite Plate
155. **Mr Kaushik Das:** Multi-agent Positional Consensus under Various Information Paradigms
156. **Mr M Suresh:** UAV Group Autonomy in Network Centric Environment
157. **Mr R Sriram:** Shock Tunnel Investigations on Hypersonic Impinging Shock Wave Boundary Layer Interaction

#### Chemical Engineering

158. **Mr Siva Rama Krishna Perala:** Alternative Mechanisms for Size Control in Synthesis of Nanoparticles- Population Balance Modelling and Experimental Studies
159. **Mr Mohan Kumar Singh Verma:** Transition in flexible tubes and channels
160. **Ms Sheeja Manchira Krishnan:** Modeling the Population Dynamics of Erythrocytes to Identify Optimal Drug Dosages for the Treatment of Hepatitis C Virus Infection
161. **Mr. Neelesh Bharti Shukla:** Swelling, Adsorption and Degradation Characteristics of Superabsorbent Polymers
162. **Mr. N Siva Mohan Reddy:** Experimental Determination and New Correlations for Multi-component Solid Solubilities in Supercritical Carbon Dioxide
163. **Mr S Sankar Kalidas:** Metal Nanoparticle Engineering: Development of a Process 'Toolkit' for Synthesis and Self-assembly into Functional Nanoscale Architectures
164. **Mr Girish M:** Monodisperse Gold Nanoparticles: Synthesis, Self-assembly and Fabrication of Floating Gate Memory Devices







165. **Mr Sahadev Pradhan:** Analytical and numerical modeling of rarefied gas flows

#### Civil Engineering

166. **Mr Sandeep Kumar Chouksey:** Strength and Deformation Behavior of Municipal Solid Waste (MSW) Based on Constitutive Modeling Approach
167. **Ms Vandana Sreedharan:** Characterization and Assessment of Organically Modified Clays for Geo Environmental Applications
168. **Mr S Shashidhar:** Influence of permeation of synthetic groundwater solutions on the hydro-mechanical properties of Barmer bentonite
169. **Ms. Anitha Kumari S D:** Effect of Particle Shape On the Mechanical Behaviour of Granular Media: Discrete Element Simulations
170. **Mr Abhishek Kumar:** Seismic Microzonation of Lucknow based on Region Specific GMPE'S and Geotechnical Field Studies
171. **Mr Ravi K:** CHM (Chemo-Hydro-Mechanical) behaviour of Barmer-1 bentonite in the context of deep geological repositories for safe disposal of nuclear waste
172. **Mr Sreevalsa Kolathayar:** Comprehensive Seismic Hazard Analysis of Inda
173. **Ms Shaik Rehana:** Regional Hydrologic Impacts of Climate Change
174. **Mr. Partho Biswapati Choudhury:** Intelligent Models For Prediction Of Blast Induced Ground Vibration Parameters Based On Explosive And Geotechnical Characteristics
175. **Ms. Shibani Jha:** Analytical and Numerical Modelling of Complex Multiphase Flow Processes in Geological Environments
176. **Ms. Asha M Nair:** Behaviour Of Geosynthetic Reinforced Soil-Aggregate Systems Under Static, Repeated And Cyclic Loads
177. **Mr Sat Kumar:** Spoil moisture modelling, retrieval from microwave remote sensing and assimilation in a tropical watershed
178. **Mr. Jagdish Prasad Sahoo:** Upper Bound Finite Element Limit Analysis For Problems Of Reinforced Earth, Unsupported Tunnels And A Group Of Anchors
179. **Mr. Debarghya Chakraborty:** Lower Bound Limit Analysis of Different Plane Strain And Axisymmetric Geomechanics Stability Problems Using Finite Elements And Linear Programming
180. **Ms Raji M:** Endochronic Constitutive Model for Sands and Its Application to Geotechnical Problems
181. **Mr D Santhosh:** Frequency Analysis of Floods- A Nonparametric Approach

182. **Mr V S Sundar:** Monte Carlo Simulations with Variance Reduction for Structural Reliability Modeling, Updating and Testing

#### Materials Engineering

183. **Mr Chandan Mondal:** Evolution of Texture and its Correlation with Microstructure and Mechanical Property Anisotropy in AA7010 Aluminum Alloy
184. **Ms Swathi S K:** Thiophene Derivative Photovoltaics: Device Fabrication, Optimization and Study of Charge Transport Characteristics
185. **Ms. Nisha Verma:** Mechanism and modeling of contact damage in ZrN-Zr and TiAlN-TiN multilayer hard coatings
186. **Dibyendu Chakravarty:** Densification Mechanisms for Spark Plasma Sintering in Alumina and Alumina Based systems
187. **Mr. Mithun Palit:** An investigation on the effect of structural and microstructural attributes on magnetostriction of Tb-Dy-Fe and Fe-Ga alloys
188. **Vyasa Vikasa Shastry:** Some Processing and Mechanical Behaviour Related Issues in Ti-Ni based Shape Memory Alloys
189. **Mr. Md Zafir Alam:** Tensile Behavior Of Free-Standing Pt-Aluminide (PtAl) Bond Coats
190. **Mr Praveena M:** Design, Fabrication and Application of In Situ Total Internal Reflection (TIR) Raman Tribometer For the Chemical Analysis of Tribological Systems
191. **Mr Ranjith K:** Design and Synthesis of Band GAP Engineered Conjugated Molecules for Organic Electronics
192. **Mr Govind:** Effect of Li Addition on the Plasticity of AZ31 Mg-alloy
193. **Ms Rohini Garg:** Structural, ferroelectric, piezoelectric and phase transition studies of lead free (Na<sub>0.5</sub>Bi<sub>0.5</sub>)TiO<sub>3</sub> based ceramics
194. **Mr Satyajit Gupta:** Development of Hybrid Organic/ Inorganic Composites as a Barrier Material for Organic Electronics
195. **Mr Manish Patel:** Densification, Oxidation, Mechanical and Thermal Behaviour of Zirconium Diboride (ZrB<sub>2</sub>) and Zirconium Diboride-Silicon Carbide (ZrB<sub>2</sub>-SiC) Composites
196. **Mr Shyam Kanta Sinha:** Synthesis and Transformation of AuCu Intermetallic Nanoparticles

#### Mechanical Engineering

197. **Mr Venkata Mangaraju Karanam:** Studies in the Dynamics of Two and Three Wheeled Vehicles
198. **Mr Vijay Chaudhry:** Mechanics and Mechanisms in Fretting Damage for Stainless Steel and Chromium Carbide Coatings







199. **Mr Pankaj Madhukarrao Nadge:** High Reynolds number flow over a Backward-Facing Step
200. **Mr Sudarshan Krishna Hegde:** Pragmatic Design of Compliant Mechanisms Using Selection Maps
201. **Mr S Ravishankar:** Robust Registration of Measured Point Set for Computer-Aided Inspection
202. **Mr Vinay Senve:** Coupled Heat Transfer Processes in Enclosed Horizontal Heat Generating Rod Bundles
203. **Mr Sangamesh Deepak R:** Static balancing of rigid-body linkages and compliant mechanisms
204. **Mr Maneesh V Kunte:** An asymptotic analysis of the dispersion characteristics of isotropic and orthotropic fluid-filled cylindrical shells
205. **Mr Avulapati Madan Mohan:** Air-assisted Atomization Strategies for High Viscosity Fuels
206. **Mr Kale Kishor Bhaskar:** Specification and Verification of Tolerances for Parts with Free-form Surfaces
207. **Mr Nirmala Kumar Kund:** Study of Solidification and Microstructure Produced by Cooling Slope Method
208. **Mr Samrat Rao:** Structure of the Tropical Easterly Jet in NCAR CAM-3.1 GCM
209. **Mr Pravin Kishor Verekar:** Experiments on rolling sphere submerged in an incompressible fluid

#### [Product Design & Manufacturing](#)

210. **Mr Prasad S Onkar:** Development of 2D and 3D Sketching Environment to support early phases of design
211. **Mr Shivakumar N D:** Insights into the Formulation of PU Foam and its Mechanical Behavior under Quasi-Static and Impact Loads
212. **Mr. Venkatesh G S:** An Exploration of Natural and Polymer Based Composites for Advanced Engineering Design

#### [Management Studies](#)

213. **Mr A Aravindhan:** Data perspectives of workflow schema evolution: cases of task deletion and insertion
214. **Mr. Udayaadithya A:** Implementation of a Democratic Decentralized Welfare Scheme: An Institutional Perspective
215. **Ms. Kumudhini Ravindra:** Community Microgrids For Decentralized Energy Demand-Supply Matching: An Integrated Decision Framework

#### [Mathematics](#)

216. **Mr Ravi Prakash:** Homogenization of Optimal Control Problems in a Domain with Oscillating Boundary

217. **Mr Subhamay Saha:** Single and Multi-Player Stochastic Dynamic Optimization
218. **Mr. Tamal Banerjee:** Analyzing Credit Risk Models in a Regime Switching Market

#### [Instrumentation and Applied Physics](#)

219. **Mr Tushar Kanti Bera:** Studies on Multifrequency Multifunction Electrical Impedance Tomography (MfMf-EIT) To Improve Bio-Impedance Imaging
220. **Ms Lakshmi K P:** Studies on Si15Te85-xGexTe85-xAgx Amorphous Thin Films For Possible Applications in Phase Change Memories
221. **Ms Tara Raveendran:** Stochastic Dynamical Systems: New Schemes for Corrections of Linearization Errors and Dynamic System Identification
222. **Ms. Srijeeta Bagchi:** Studies on Quantitative Photoacoustic Tomography: Model-Based Reconstruction Using Deterministic and Stochastic Algorithms
223. **Mr. Guru Prasad A S:** Fiber Bragg Grating Sensors: An Exploration of Applications in Diverse Fields
224. **Mr Tamilarasan Sabapathy:** Ultrafast Laser Inscribed Waveguides on Chalcogenide Glasses for Photonic Applications
225. **Ms Baishali Garai:** Development and Performance Study of Thick Gas Electron Multiplier (THGEM) based Radiation Detector
226. **Mr Rajaboina Rakesh Kumar:** Growth of Semiconductor and Semiconducting Oxide Nanowires by Vacuum Evaporation Methods
227. **Mr Sudeep Joshi:** Towards Flexible Sensors and Actuators: Application Aspect of Piezoelectric Thin Film

#### [Centre for High Energy Physics](#)

228. **Mr Sandeep Chatterjee:** Model Studies of the Hot and Dense Strongly Interacting Matter
229. **Mr Debtosh Chowdhury:** Flavor and Dark Matter Issues in Supersymmetric Models
230. **Mr Abhiram Soori:** Electronic Transport in Low-Dimensional Systems— Quantum Dots, Quantum Wires and Topological Insulators
231. **Ms Monalisa Patra:** Topics in the Exploration of New Physics at the International Linear Collider with the inclusion of Beam Polarization
232. **Mr Abhishek Muralidhar Iyer:** Randall-Sundrum Model as a Theory of Flavour





## Physics

233. **Mr Sayantan Majumdar:** Flow Induced Instabilities, Shear-Thickening and Fluctuation Relations in Sheared Soft Matter
234. **Mr Bidya Binay Karak:** Theoretical Study of the Solar Magnetic Cycle and its Irregularities
235. **Mr Sayak Ghoshal:** Pulsed Laser Ablated Dilute Magnetic Semiconductors and Metallic Spin Valves
236. **Mr Debangsu Roy:** Exchange Spring Behaviour in Magnetic Oxides
237. **Mr Jamshid Moradi Kurdestany:** Phases, Transitions, Patterns, and Excitations in Generalized Bose-Hubbard Models
238. **Mr Vinod E M:** Investigations of Phase Change Memory Properties of Selenium Doped GeTe and  $\text{Ge}_2\text{Sb}_2\text{Te}_5$
239. **Mr Santhosh M:** Elasticity and structural phase transitions of nanoscale objects
240. **Mr Chandra Kant Mishra:** Gravitational Waves from Inspiralling Compact Binaries and their Implications: 3PN Waveforms, 3PN Energy Flux, 2.5PN Linear Momentum Flux and Parametrized Tests of post-Newtonian Theory
241. **Ms. N V S P Sameera Ivaturi:** Electron Field Emission Studies of Nanostructured Carbon Materials
242. **Mr P Anjaneyulu:** Charge Transport in Semiconducting Polymer Devices
243. **Mr Biswanath Chakraborty:** Raman Spectroscopy of Graphene and Graphene Analogue  $\text{MoS}_2$  Transistors
244. **Mr Tapan Chandra Adhyapak:** Mesophases of active matter: translational order, critical rheology and electrostatics
245. **Ms Vanya Srivastav:** Modeling, Fabrication and Characterization of HgCdTe Infrared Detectors for High Operating Temperatures
246. **Mr Nishant Kumar Singh:** Dynamo Action due to Turbulence in a Linear Shear Flow
247. **Mr Jayanth Vyasnakere P:** Ultracold fermions in synthetic non-Abelian gauge fields
248. **Mr Alok Ranjan Nayak:** Spiral-wave Dynamics in Ionically Realistic Mathematical Models for Human Ventricular Tissue

249. **Mr Laxmi Narayan Tripathi:** Preparation and optical properties of hybrid assemblies of metallic gold nanoparticles and semi-conducting CdSe quantum dots
250. **Ms. Geetanjali:** Magnetic Ordering in Bulk and Nanoparticles of Certain Bismuth Based Manganites  $\text{Bi}_{1-x}\text{A}_x\text{MnO}_3$  ( $\text{A} = \text{Ca}, \text{Sr}$ ): Electron Paramagnetic Resonance and Magnetization Studies
251. **Mr Yogesh Maan:** Tomographic Studies of Pulsar Radio Emission Cones And Searches for Radio Counterparts of Gamma-ray Pulsars
252. **Mr Anupam Gupta:** Numerical studies of Problems in Turbulence: (1) Fluid Films with polymer additives; (2) Fluid Films with inertial and elliptical particles; (3) Scaled vorticity moments in three- and two-dimensional turbulence.
253. **Mr. Sivasurender C:** Structure and Dynamics of Binary Mixtures of Soft Nanocolloids and Polymers
254. **Mr Chanchal Sow:** Magnetic and magneto-transport studies in transition metal oxides: Role of competing interactions
255. **Mr. Kaustuv Manna:** Evolution of the Magnetic Ground States with Lattice Distortion and Chemical Inhomogeneity in Doped Perovskite Oxides

## Centre for Earth Sciences

256. **Ms Tania Guha:** Establishment of an experimental system in India to measure the mixing ratio and stable isotopic composition of air  $\text{CO}_2$  & Observations from urban and marine environments
257. **Ms Vanessa Mary Rachel Andrade:** Seismotectonics of the Andaman-Nicobar Plate Boundary and Evaluation of 2004 Deformational and Depositional Features towards Assessing Past Tsunamigenic Earthquakes

## Supercomputer Education & Research Centre

258. **Mr Adarsha Rao:** Polymorphic ASIC for Video Decoding
259. **Ms Radhamanjari Samanta:** Timing-Driven Routing in ULSI Physical Design under Uncertainty

## IISc Mathematics Initiative

260. **Mr Singh Samar Bahadur Narendra B Usha:** Study of Higher Order Split-Step Methods for Stiff Stochastic Differential Equations
261. **Mr Ravi Prasad K J:** Development of Efficient Computational Methods for Better Estimation of Optical Properties in Diffuse Optical Tomography



### Computer Science & Automation

1. **Mr. Sampath Jayaram:** A Theoretical Study of the Synergy and Lazy Annotation Algorithms
2. **Mr. D Srimugunthan:** Efficient usage of Flash memories in high performance scenarios
3. **Mr. Jay Rajesh Thakkar:** Transducer-based Algorithmic Verification of Retransmission Protocols over Noisy Channels
4. **Mr. Raghavendra G S:** Identification and Quantification of Important Voids and pockets in proteins
5. **Mr. Chethan Kamath H:** Constructing Provably Secure Identity-Based Signature Schemes
6. **Mr. Kanuj Kumar:** Reconstruction of 3D Neuronal Structures
7. **Mr. Vikas Kumar:** Construction of Secure and Efficient Private Set Intersection Protocol
8. **Mr. Amogh Margoor:** Improving the precision of a scalable demand-driven null-dereference verification for Java
9. **Mr. Aravind Acharya N:** Model-Checking in Presburger Counter Systems using Accelerations
10. **Ms. Kamala R:** MIST: Migrate the Storage Too
11. **Mr. Thejas C R:** Automatic Data Allocation, Buffer Management and Data Movement for Multi-GPU Machines

### Electrical Communication Engineering

12. **Ms. Anusha Gorantla:** Diversity-Rate Trade-off in an AWGN channel with Fading
13. **Mr. Talak Rajat Rajendra:** Timer-based Selection Schemes for Wireless Networks
14. **Ms. Potnis Varada Raghvendra:** Modelling and Performance Analysis of New Coolstreaming for P2P IPTV
15. **Mr. Nivesh Mangal:** SOI based Integrated-optic Microring Resonators For Biomedical Sensing Applications
16. **Mr. Sachin Bharadwaj:** Analysis and Optimization of Cooperative Amplify-and-Forward Relaying with Imperfect Channel Estimates
17. **Mr. Jithin K S:** Spectrum Sensing in Cognitive Radios using Distributed Sequential Detection
18. **Mr. N Mukund Sriram:** Grassmannian Fusion Frames for Block Sparse Recovery and its application to Burst Error Correction

### Electrical Engineering

19. **Mr. Kommi Krishna Reddy:** Reactive Power Coordination in Grid Connected Wind farms for voltage Stability Enhancement
20. **Mr. Arun Venkitaraman:** Generalized Analytic Signal Construction and Modulation Analysis
21. **Mr. Sunder Ram K:** Optimum Savitzky-Golay Filtering for Signal Estimation
22. **Mr. Gopalakrishnan K S:** Study on DC-Link Capacitor Current in a Three-Level Neutral-Point Clamped Inverter

### Electronic Systems Engineering

23. **Ms. Samta Shukla:** Wireless Sensor Networks: Bit Transport Maximization and Delay Efficient Function Computation
24. **Ms. Tupti Walvekar:** Ring Oscillator Based Temperature Sensor
25. **Mr. Srinivas N R:** Composite Current Space Vector Based Powerline Communication (PLC) Method for Grid Connected Inverters in AC Microgrids

### Aerospace Engineering

26. **Mr. Jonathan Jean Pierre Roffet:** Active Wave Control Using Electro Active Polymers
27. **Mr. Sumit Kumar Patel:** A Residual Based h-Adaptive Strategy Employing a Zero Mean Polynomial Reconstruction
28. **Mr. K Sandilya:** Determination of Isospectral Rotating and Non-Rotating Beams
29. **Ms. Prachi Joshi:** Analysis and Detection of Ionospheric Depletions over the Indian Region in the Context of Satellite Navigation

### Chemical Engineering

30. **Mr. Ganagalla Srinivasa Rao:** Crystal nucleation in binary hard sphere mixtures
31. **Mr. Vaidyanathan M.S:** Modeling Lysis Dynamics of Pore Forming Toxins and Determination of Mechanical Properties of Soft Materials

### Mechanical Engineering

32. **Ms. Binita Pathak:** Study of droplet dynamics in heated environment
33. **Mr. Chanekar Prasad Vilas:** Optimal Synthesis of Adjustable Four-Link Planar and Spherical Crank-



Rocker Type Mechanisms for Approximate Multi-Path Generation

34. **Mr. V Kaushik:** Experimental and numerical investigation of mode I fracture behavior in magnesium single crystals
35. **Mr. Anoop Raghunath Kini:** Semisolid Die casting of Wrought A6061 aluminium Alloy
36. **Mr. Vijay Kumar:** Viscous vortex method simulations of stall flutter of an isolated airfoil at low Reynolds numbers
37. **Mr. Indukuri Harish Varma:** Feasible and Intrinsic Kinetostatic Maps for Compliance Mechanisms
38. **Mr. Vijay Kumar V:** Numerical Simulation of Convection Dominated Flows Using High Resolution Spectral Method
39. **Mr. M Muthu Krishnan:** Study of Multiple Asperity Sliding Contacts
40. **Mr. Pathak Harshavardhana Sunil:** Adaptive Mesh Redistribution for Hyperbolic Conservation Laws
41. **Mr. Raghvendra Pratap Singh:** Simulation of Flexible Multibody Dynamics Systems using Hybrid FEM

#### [Product Design and Manufacturing](#)

42. **Mr. Ujjwal Pal:** A Computational Platform for Automated Identification of Building Blocks in Mechanical Design for Enhancing Ideation
43. **Mr. Ram Kinker Mishra:** Muscle Fatigue Analysis During Dynamic Contraction
44. **Mr. Amardeep A Singh Sehemby:** Development of an Advanced Methodology for Automotive IC Engine Design Optimization using a Multi-Physics CAE Approach
45. **Mr. Mahesh C:** Prediction of the Mechanical Behaviour of a Closed Cell Aluminium Foam Using Advanced Nonlinear Finite Element Modelling

#### [Civil Engineering](#)

46. **Mr. Karthikeyan Lanka:** Predictability of Nonstationary Time Series using Wavelet and Empirical Mode Decomposition based ARMA Models
47. **Mr. Shashi Narayan:** Smooth Finite Element Methods with Polynomial Reproducing Shape Functions
48. **Ms. K Geetha Manjari:** Probabilistic Analysis of Engineering Response of Fiber Reinforced Soils
49. **Ms. Ila Chawla:** Hydrologic Response of Upper Ganga Basin to Changing Land Use and Climate
50. **Ms. Teddy Kizza:** Modeling Salinity Impact on Ground Water Irrigated Turmeric Crop

#### [Centre for Atmospheric & Oceanic Sciences](#)

51. **Mr. Jahfer Sharif K K:** Influence of river discharge on climate in a coupled model
52. **Ms. Thushara Venugopal:** Sensitivity of Sea Surface Temperature Intraseasonal Oscillation to Diurnal Atmospheric Forcings in an OGCM
53. **Mr. Rohit Ghosh:** Interannual Variation of Monsoon in a High Resolution AGCM With Climatological SST Forcing
54. **Ms. Deepika Rai:** Variation of Marine Boundary Layer Characteristic over Bay of Bengal and Arabian Sea
55. **Mr. Anirban Sinha:** Dynamics and Stability of Multiple Jets in Geophysical Flows

#### [Centre for Sustainable Technologies](#)

56. **Ms. Priyanka Murthy:** Sustainable and Energy Efficient Treatment Potential Mixed Algal Consortia for High Nutrient Organic Wastewaters
57. **Mr. Ravi Kumar D:** Effect of Extractives and Crude Proteins On Kinetics of Hydrolysis in a Solid State Bio-Reactor

#### [Instrumentation](#)

58. **Mr. Subhajit Banerjee Purnapatra:** Spatial Filtering Techniques For Large Penetration Depth and Volume Imaging in Fluorescence Microscopy
59. **Mr. Dinesh Naik:** Development of Handheld Impedance Spectroscopy Instrument Suitable For Biological Tissue Characterization
60. **Mr. Ovhal Ajay Ashok:** Shape Optimization of a Cylindrical-Electrode Structure to Mimic the Orbitrap

#### [Management Studies](#)

61. **Mr. Srikanth K:** Building Flexibility Into Product Development Teams: Role of Structural Antecedents On The Efficiency Of The Teams

#### [Centre for Nano Science and Engineering](#)

62. **Ms. Kala S:** ASIC Implementation of a High Throughput, Low Latency, Memory Optimized FFT Processor

#### [Supercomputer Education & Research Centre](#)

63. **Mr. Jayaprakash:** Automated selection of hyper-parameters in diffuse optical tomographic image reconstruction







64. **Mr. A Kalyan Ram:** Development and Validation of Analytical Models for Diffuse Fluorescence Spectroscopy/Imaging in Regular Geometries
65. **Mr. Sudip Hazra Choudhury:** Communication Structure and Mixing Patterns in Complex Networks
66. **Mr. Vishal Metri:** Stochastic Chemical Kinetics: A study on hTREK1 potassium channel
67. **Mr. Gurunath M Katagi:** Analysis of MD simulation trajectories of proteins performed using three forcefields and identification of mobile segments
68. **Mr. Rajath Kumar R:** Prediction of Queue Waiting Times for Metascheduling on Parallel Batch Systems
69. **Mr. Cijo George:** Adaptive Fault Tolerance Strategies for Large Scale Systems
70. **Mr. Bharath Venkatesh:** Fast Identification of Structured P2P Botnets using Community Detection Algorithms
71. **Mr. Gaurav Kumar Singh:** Partitioning and Mapping of Computation Structure on a Coarse-Grained Reconfigurable Architecture
72. **Mr. Mohit Dhingra:** Elasticity in LASS Cloud, preserving Performance SLAs
73. **Mr. Prasanna Vasant Pandit:** Cooperative Execution of Open CL Programs on Multiple Heterogeneous Devices

## 4. 6 External Registration

### Admissions in the current year

| Department | Sponsors   | No. Admitted |
|------------|--|--------------|
| AE         | DRDO, ISRO, Honeywell Technology Solutions Laboratory  | 5            |
| EC         | ISRO, ROBERT BOSCH Engineering and Business Solutions Limited<br>Texas Instruments India Pvt. Ltd.                                 | 3            |
| CS         | DRDO, Accenture Technology Laboratory, Xerox Research  | 3            |
| IN         | ISRO, DRDO   | 3            |
| MB         | Vittal Mallya Scientific Research Foundation   | 1            |
| MD         | Institute of Ayurveda and Integrative Medicine Foundation of<br>Revitalization of Local Health Traditions                          | 1            |
| ME         | CSIR–Central Mechanical Engineering Research Institute<br>MTRDC, DRDO, Research and Development Division<br>TATA Steel, Jamshedpur | 3            |
| MG         | Aeronautical Development Establishment<br>DRDO, IBM India Pvt. Ltd., Infosys Ltd.,<br>Siddaganga Institute of Technology           | 4            |
| MT         | BHEL Corporate R and D Division  | 1            |
| NE         | Solid State Physics Laboratory   | 1            |
|            | <b>Total</b>   | <b>25</b>    |



### Students on Roll under the External Registration Programme

| Sl. No. | Sponsors  | No. Admitted |
|---------|---|--------------|
| 1.      | Aeronautical Development Agency, Bangalore                              | 5            |
| 2.      | Aeronautical Development Establishment, Bangalore                       | 2            |
| 3.      | International Advanced Research Centre for Powder Metallurgy, Hyderabad | 1            |
| 4.      | Bhabha Atomic Research Centre, Mumbai                                   | 2            |
| 5.      | Bhabha Atomic Research Centre, Mysore                                   | 1            |
| 6.      | Bharat Electronics Ltd., Bangalore                                      | 1            |
| 7.      | BMS College, Bangalore  | 1            |
| 8.      | Centre for Artificial and Intelligence Robotics, Bangalore              | 2            |
| 9.      | Centre for Development of Advanced Computing, Bangalore                 | 2            |
| 10.     | Defence Research Development Laboratory, Hyderabad                      | 4            |
| 11.     | Defence Research Development Organization, Hyderabad                    | 13           |
| 12.     | Defence Metallurgical Research Laboratory, Hyderabad                    | 3            |
| 13.     | Gas Turbine Research Establishment, Bangalore                           | 2            |
| 14.     | Hindustan Aeronautics Ltd., Bangalore                                   | 2            |
| 15.     | ISRO Satellite Centre, Bangalore  | 20           |
| 16.     | Indira Gandhi Centre for Atomic Research, Kalpakkam                     | 3            |
| 17.     | LRDE  | 1            |
| 18.     | National Aerospace Laboratory, Bangalore                                | 13           |
| 19.     | Vikram Sarabhai Space Centre, Trivandrum                                | 5            |
| 20.     | Central Mining Research Institute, Nagpur                               | 1            |
|         | <b>Private Organizations</b>  |              |
| 21.     | ABB Corporate Research Centre, Bangalore                                | 1            |
| 22.     | Agere Systems India Pvt. Ltd., Bangalore                                | 1            |
| 23.     | Analog Devices, Bangalore   | 2            |
| 24.     | APC – MGE   | 1            |
| 25.     | Crompton Greaves, Bangalore   | 1            |
| 26.     | FACT, Bangalore   | 1            |
| 27.     | Faurecia Emission Control Technologie                                   | 1            |
| 28.     | GE India Technology Centre Pvt. Ltd.                                    | 6            |
| 29.     | General Motors  | 4            |

| Sl. No. | Sponsors   | No. Admitted |
|---------|--|--------------|
| 30.     | Grindwell Norton, Bangalore                          | 1            |
| 31.     | Hewlett Packard, Bangalore                           | 3            |
| 32.     | Honeywell Tech. Solutions Lab., Bangalore            | 4            |
| 33.     | International Business Machine, Bangalore            | 3            |
| 34.     | Indian Farmers Fertilizer Cooperative Ltd. New Delhi | 1            |
| 35.     | Indian Institute of Information Technology           | 1            |
| 36.     | IIMB   | 3            |
| 37.     | Intel Tech India Pvt. Ltd., Bangalore                | 2            |
| 38.     | John Deere Tech Center, Pune                         | 3            |
| 39.     | Laboratory for Electro Optics Systems                | 1            |
| 40.     | Motorola, Bangalore                                  | 1            |
| 41.     | MICO, Bangalore                                      | 1            |
| 42.     | MSRIT  | 2            |
| 43.     | Microwave Tube Research and Development Centre       | 1            |
| 44.     | 3M India Limited                                     | 1            |
| 45.     | Philips, Bangalore                                   | 2            |
| 46.     | Pramati Tech., Hyderabad                             | 1            |
| 47.     | Reliance Communications, Bangalore                   | 1            |
| 48.     | Robert Bosch Engineering and Business Solutions Ltd. | 1            |
| 49.     | Saintgits College of Engineering, Kerala             | 1            |
| 50.     | Samsung India  | 1            |
| 51.     | Siemens, Bangalore                                   | 1            |
| 52.     | Schneider Electric India, Bangalore                  | 1            |
| 53.     | Symphony   | 1            |
| 54.     | Tata Motors, Pune                                    | 1            |
| 55.     | Tata Consultancy Services Limited                    | 1            |
| 56.     | Tata Research, Design and Development Centre, Pune   | 1            |
| 57.     | Technology Informatics Design Endeavour Bangalore    | 1            |
| 58.     | Texas Instruments, Bangalore                         | 10           |
| 59.     | Tech Park  | 2            |
| 60.     | Thermal System                                       | 3            |
| 61.     | TVS, Chennai   | 3            |
| 62.     | WIPRO, Bangalore                                     | 3            |
|         | <b>Total</b>   | <b>165</b>   |

## 5. Interactions and Outreach

### 5.1 Institute Lectures

The Institute has organized the following Centenary, Memorial, Endowment, Institute lectures during the year:

#### Centenary Lectures

**Cloud Flows** by Professor Roddam Narasimha, JNCASR, Bangalore 19 July 2013

**Random walk to Graphene** by Sir Andre Geim, University of Manchester, 6 December 2013

#### Golden Jubilee Lectures

**Study of Human Diseases at the Intersections of Engineering, Science and Medicine** by Professor Subra Suresh, President, Carnegie Mellon University, USA 12 March 2014

#### Sri M CT M Chidambaram Chettyar Memorial Lecture

**Performance & Promise in Vaccine Development** by Dr. M K Bhan, National Science Professor, Dept. of Science & Technology, New Delhi, 23 October 2013

#### C N R Rao Endowment Lecture

**Emergent Electron Science towards New Energy Revolution** by Professor Yoshinori Tokura, Director, RIKEN Center for Emergent Matter Science (CEMS), Japan, 16 September 2013

#### Institute Lectures

**Reflection on the Discovery of Pulsars** by Professor Jocelyn Bell Burnell, University of Oxford and Mansfield college, UK 9 January 2014

**Radical Mechanostereochemistry** by Sir Fraser Stoddart, Board of Trustees Professor of Chemistry, Northwestern university, Department of Chemistry, USA, 15 January 2014

**New Directions in Cancer Research** by Dr. Harold Varmus, Director, National Cancer Institute, USA, 21 January 2014

**Detecting Reaction Intermediates in Solution and Guiding Cancer Surgery using Mass Spectrometry** by Professor Richard N Zare, Marguerite Blake Wilbur Professor of Natural Science, Department of Chemistry, Stanford University, USA, 12 February 2014

### 5.2 Conferences/Seminars/Symposia/Workshops

A number of conferences, workshops, seminars and symposia are regularly organized at the Institute. A large number of scientists, engineers, educationists take advantage of these. The programmes conducted during the year were:

#### Division of Biological Sciences

- International Conference on Biomolecular Forms and Functions: A celebration of 50 years of the Ramachandran Map, 8-11 January, 2013, IISc (MBU)
- 5<sup>th</sup> Annual TAG Workshop, January, 2013 (CES)
- Indo-French seminar on Recent trends in Proteomics, 6-8 April, 2013 (MCB)
- Frontiers in Modern Biology, 15-16 June, 2013 (BC)
- Emerging Themes in Tuberculosis Research Creating a Network, 18-20 July, 2013, Biological Sciences, IISc
- Internet based Course – Environment Management, August-December, 2013 (Centre for Continuing Education & CES)
- Recent advances in computational drug design IISc and Schrodinger, 16-17, September, 2013 (BC & MBU).
- Recent Advances in Computational Drug Discovery, 16-17 September, 2013 (MBU)
- Alexander von Humboldt Alumni Meet: 20 September, 2013 (MBU)
- 5<sup>th</sup> Annual Meeting Proteomics Society of India, 28-30 November, 2013 (BC)
- Fifth Annual Meeting of Proteomic Society of India, 28-30 November, 2013 (MRDG)
- Quantitative Systems Biology – Winter School, Along with ICTS, Bangalore and ICTP, Trieste, 9<sup>th</sup> to 20<sup>th</sup>, December 2013 (BC)
- 3<sup>rd</sup> Annual Conference of the Society for Mitochondrial Research and Medicine (SMRM-2013), 19–20 December, 2013 (MRDG)



- Getting the measure of diversity: a macro-ecological perspective', Students Conference on Conservation Science (CES)
- Molecular Mechanisms Underlying Phosphatidylinositol-Specific Phospholipase C Mediated Regulation of Lipid Metabolism, 16<sup>th</sup> January, 2013 (CIDR)
- Being Social: an inter disciplinary Conference on social behaviour, 26-28 June, 2013 (CES)
- Sexual selection: ideas and evidence at Biological Science Auditorium, IISc, 8 July, 2013 (CES)
- Workshop on Molecular phylogenetics, 1-5 August, 2013 (CES)
- Indo-Japanese International Conference on Biodiversity Conservation, 12-16 September, 2013 (CES)
- Student Conference on Conservation Science, 26-28 September, 2013 (CES)
- Ethics in Human and Animal Research', Students Conference on Conservation Science, 26-28 September, 2013 (CES)
- Student Conference on Conservation Science, 26-28 September, 2013 (CES)
- Workshop on documenting biodiversity in Aghnashini estuary, 29-30 October, 2013, Hotel Vaibhav, Kumta taluk, Uttara Kannada (CES)
- Workshop on documenting biodiversity in Bedthi estuary, 31 October 2013, Ganga matha temple auditorium, Gangavali, Kumta Taluk, Uttara Kannada (CES)
- Satellite workshop "Build as you Learn and Learn as you Build – Confocal and TIRF building from parts", 22-23 November (CNSc)
- National Fluorescence Workshop – FCS2013, 24-28 November (CNSc)
- Workshop on Status of forest biodiversity in Shimoga and Chikamagalur districts, Organised jointly with Applied Botany department, Kuvempu University, 25 November, 2013 (CES)
- 3<sup>rd</sup> Bangalore Cognition Workshop Main organizers: SP Arun and Tom Albright (Salk Institute), 8-21 December, 2013 (CNSc)
- Second Indian Biodiversity Congress, 9-12 December 2012, J N Tata Auditorium, IISc Campus (CES)

#### Division of Chemical Sciences

- Multidimensional NMR and its applications, 7-9 March, 2013 (NMRRC)
- Indo-US Symposium on Molecular Materials, 15-17 July, 2013 (IPC/OC)

- National Workshop on computational nanoscience, 20-23 August, 2013 (SSCU)
- Development of advanced multifunctional materials for electrochemical energy devices, 4-5 November, 2013 (SSCU)
- Organiser of the theme session "Biomaterials", held during 51<sup>st</sup> National Metallurgists Day and the 67<sup>th</sup> Annual Technical Meeting of the Indian Institute of Metals 'NMD-ATM-2013' at Banaras Hindu University (BHU), Varanasi, 12-15<sup>th</sup> November, 2013 (MRC)
- Materials for Biomedical Applications", held during International Union of Materials Research Societies (IUMRS-ICA-2013), 16-20 December, 2013 (MRC)
- DST-JSPS sponsored International Symposium on Nanotechnology based innovation on Advanced Materials for Environmental, Energy & Biomedical Applications, 16-21 December, 2013 (MRC)
- FAPS-MACRO 2013 (NMRRC)

#### Division of Electrical Sciences

- A Short Course on Mechanism Design, 1-5, April, 2013 (CSA)
- Workshop on Program Analysis sponsored by Indo Indo-German Max-Planck for Computer Science, 17-20 September, 2013 (CSA)
- Workshop on High Dimensional Network Analytics, 16-19 December, 2013 (CSA)

#### Division of Mechanical Sciences

- International Workshop on Models and Theories of Design (IWMT'13), 4-5 January, 2013 (CPDM)
- International Conference on Research into Design (ICoRD'13), 7-9 Jan 2013 (CPDM)
- Understanding Climate Change- A joint event between DCCC and Grantham Institute for Climate Change, Imperial College, London, 11 January, 2013 (DCCC)
- Conference on "Metallurgy as a Human Experience", 16th January, 2013 (MT)
- 26th Annual Student Symposium, 17-18 January, 2013 (MT)
- ICTS Workshop on Clouds, Convection and Tropical Meteorology, 21-26 January, 2013 (CAOS/DCCC, ICTS-TIFR)
- Seminar-CISTUP Past Present Future, 31 January, 2013 (CISTUP)
- ICTS Workshop on Advanced Dynamical Core Modeling for Atmospheric and Oceanic Circulations, 18-23 February, 2013 (CAOS)
- Workshop on Mechanical Behaviour of Systems at Small Length Scales - 4, 24-28 February 2013 (MT)







- Fourth Jeremy Grantham Lecture on Climate Change, 25th February, 2013 (DCCC)
  - Training on Glacier Studies, Climate Change and Remote Sensing, 4-15 March, 2013 (DCCC)
  - Seminar – “Mobility 2013: Forum for Sustainable Bangalore”, 6 March, 2013 (CISTUP)
  - Panel Discussion on the Union Budget 2013-2014, 8<sup>th</sup> March, 2013 (MS)
  - Seminar – Governance and Design in Infrastructure public private partnerships: The Indian experience with the Bangalore International Airport Limited, 15 March, 2013 (CISTUP)
  - Workshop on “Air quality Monitoring, Modeling and Assessment”, 22 March, 2013 (CISTUP)
  - Lecture-Foundation day Annual lecture series, 26 March, 2013 (CISTUP)
  - Fifth Jeremy Grantham Lecture on Climate Change, 27 March, 2013 (DCCC)
  - One-Day Discussion Meeting on Materials for Gas Storage, April, 2013 (CH)
  - Energy Efficient Buildings Workshop Series on ‘Low Carbon Materials and Building Systems’, 1-6 April, 2013 (CiE/KSCST/CST)
  - Lectures on Numerical Weather Prediction, Climate Modeling and Tropical Meteorology, 1st April -12th April, 2013 (DCCC)
  - Training for capacity building in Himalayan Glaciology-Level I and II, 1-27 April, 2013 (JNU, Delhi/ DCCC)
  - Seminar- Engineering Growing Networks: Some Ideas, 16 May, 2013 (CISTUP)
  - Workshop on “ITS Sustainable Transportation System and Choices”, 28-29 May, 2013 (CiE)
  - CFD Application on water engineering, 1 June, 2013 (CiE)
  - NRC-M Summer Workshop on Principles and Techniques of X-ray Diffraction, 10-21 June, 2013 (MT)
  - Seminar – Reinforcing the associational value of a locality in the realm of globalization case: Malleshwaram, Bangalore, 21 June, 2013 (CISTUP)
  - Talk-Dynamic Incident Progression Curve for classifying Secondary Crashes, 05 July, 2013 (CISTUP)
  - Fluid Days, 18-20 July (CAOS)
  - IIScAANA Global Conference, Chicago, IL, 19-21 July, 2013 (MT)
  - International Workshop on Impact of Design Research on Practice (IDRP’13), 22-23 July, 2013 (CPDM)
  - Workshop on “Capacity Building Program on Sustainable Urban Transport Planning”, 22-26 July, 2013 (CiE)
  - Scientific Cruise, Bay of Bengal, August, 2013 (CAOS)
  - Workshop on “Water Quality : Threats, technologies and Options”, 13-14 August, 2013 (CiE)
  - Seminar-Sustainability and Rail Transit, 8 October, 2013 (CISTUP)
  - Fourth National Research Conference on Climate Change, 26-27 October, 2013 (IIT Chennai/DCCC)
  - The 5th International Conference on Population Balance Modelling, 11-13 September, 2013 (CH)
  - Workshop on “Water Resources Management using Microwave Remote Sensing”, 13 November, 2013 (CiE)
  - Workshop on Science Communication, 14 November, 2013 (CISTUP)
  - One day Workshop on Understanding Climate Change, 15th November, 2013 (DCCC)
  - The 13<sup>th</sup> Consortium of Students in Management Research, 15<sup>th</sup> & 16<sup>th</sup> November, 2013 (MS)
  - Faculty Development Programme for Faculty Members of Basaveshwar Engineering College, Bagalkot, November-December, 2013 (MS)
  - Student Development Programme for the PG students of Basaveshwar Engineering College, Bagalkot, December, 2013 (MS)
  - Workshop on “Sustainability of Soil & Water Management in Asia : LUC and CC in question”, 4-6 December, 2013 (CiE)
  - Orientation workshop for the Students from Bagalkot, 10 December, 2013 (CISTUP)
  - NRC-M Winter Workshop on Integrated Computational Materials Engineering, 23-27 December, 2013 (MT)
  - Seminar-Foundation day, 10 January, 2014 (CISTUP)
- ### Division of Physical and Mathematical Sciences
- Workshop on Limit Theorems in Probability, 2-8 January, 2013 (MATH)
  - Co-organizer for a Workshop ‘Limit theorems in probability’, 2-8 January, 2013 (MATH)
  - Co-organizer for Conference ‘Limit theorems in probability’, 9-11, January, 2013 (MATH)
  - Conference on Limit Theorems in Probability, Jan. 09 – 11, 2013 (MATH)
  - School on Stochastic Processes in Engineering, Mar. 11 - 15, 2013 (MATH)





- Conference on New Directions in Probability, May 30 – June 04, 2013 (MATH)
- US India Advanced Studies – Institute on Thermalization, 9-22 June 2013 (PHY)
- INSA-AASSA joint meeting on Women in Science, education and research, Delhi, 24-29 June, 2013 (CHEP)
- Member, International Advisory Committee, 26<sup>th</sup> International Symposium on Lepton Photon Interactions at High Energies, 24-29 June, 2013 (CHEP)
- Current Trends in Computational Methods for Partial Differential Equations, June 24 – July 7, 2013 (MATH)
- Organizer for Conference ‘NPDE and CIMPA Workshop’, June 24 – July 19, 2013 (MATH)
- Current Trends in Computational Methods for Partial Differential Equations, 8-19 July, 2013 (MATH)
- Member, International Advisory Board and Convener, Parallel session on ‘SUSYPhenomenology’ at the SUSY 2013: 21st International Conference on Supersymmetry and Unification of Fundamental Interactions, 26-31 August, 2013 (CHEP)
- Quantum Simulations (CQIQC), 1-4 Sep, 2013 (PHY)
- Indo-French Workshop on “Dynamics of Earth and Planetary Cores”, 23-26 September, 2013 (CEaS)
- Workshop on Transport and particles in turbulent flow experimental computational and Theoretical Investigations, 13-19, October, 2013 (PHY)
- Convener, Parallel session on Higgs Physics at PASCOS 2013, 19<sup>th</sup> International Conference on Particles, String and Cosmology, Taipei, Taiwan, 20-26 November, 2013 (CHEP)
- National Fluorescence Workshop, 22-28 Nov. 2013 (PHY)
- New Frontiers in Nanomaterials, 7-13 December, 2013 (PHY)
- International Workshop on Operator Theory and its Application (IWOTA), 16-20 December, 2013 (MATH)

## Centres

- CeNSE Annual Research Symposium, 18-19 January 2013 (CNScE)
- RBCCPS-IEE Japan Workshop on Technologies for Smart Cities, 19 February, 2014 (RBCCPS)
- One Day Workshop on Computational Science, 25 February, 2013 (SERC)
- First Annual Meeting of CeNSE with Industries, Strategic Sectors & Government Funding Agencies on Micro and Nano Sensors, Systems and Structures, 20-21 March, 2013 (CNScE)
- Indo-Canadian Workshop and Summer School on Nanotechnology, University of Alberta, 9-18 May, 2013 (CNScE)

- FICCI Healthcare Innovation Workshop, 28 May, 2013 (RBCCPS)
- Workshop on Peri-Urban Agriculture Status, Potentials and Technological Innovations, 31 May, 2013 (RBCCPS)
- Mini Familiarization Workshop (INUP), 17 June, 2013 (CNScE)
- Hands-on Training (INUP), 18 to 28 June, 2013 (CNScE)
- Centum Electronics signs up with CeNSE, IISc as the first Industry Affiliate Member, 16th August, 2013 (CNScE)
- Analog Devices (ADI) joins the CeNSE Industry Affiliate Program, 18 September. 2013 (CNScE)
- First Scientific Meeting on “Nanotechnology in Agriculture”, 25th September. 2013 (CNScE)
- DLT Talk: MEMS at Analog Devices by Dr. Bill Clark, ADI, 3rd October. 2013 (CNScE)
- Advanced Level Workshop on Stabilization Methods for Singularly Perturbed Differential Equations, 3-5 October, 2013 (SERC)
- Unilever joins the CeNSE Industry Affiliate Program, 18 October, 2013 (CNScE)
- DLT Talk: 3D Technology Overview by Dr. Mukta Farooq, IBM, 29 October, 2013 (CNScE)
- Digital Information Services in Academic and R&D Information Centers, 23 November, 2013 (JRDTML)
- IESA Interactive i2 Member Meet “Semiconductor Education: a new paradigm”, 14 December, 2013 (CNScE)
- Indo-US Workshop on High Performance Computing & Big Data Analytics, 15-18 December, 2013 (SERC)
- Nitride Electronics Symposium at IUMRS/ICA, 16-20 December, 2013 (CNScE)

## 5.3 Departmental Seminars and Colloquia

A large number of seminars and colloquia on various topics of current interest were organized by the Departments, Units and Centres. There were 478 speakers from other organizations and 332 speakers from within the Institute (Faculty and Students). The subjects generated a great deal of academic and scientific interest.

## 5.4 Visitors

A large number of distinguished and eminent scientists, engineers, technologists and intellectuals from reputed institutions within the country and overseas visited the Institute for short and long term interactions, enriching the environment on the campus. In all 890 visits (531 abroad and 359 India) were made to various departments.





## 5.5 Faculty: Other Professional Services

Members of the Faculty visited other institutions/ organizations on topics of current interest. In all, 661 visits (266 abroad and 395 India) were made and 733 lectures were delivered during these visits. While 584 faculty members participated in conferences, symposia etc. organized within India, 321 members participated abroad. Many of them presented papers at such conferences and also took an active part in technical/scientific discussions.

Many faculty members of the Institute participated in the academic activities of other universities and research institutions as Thesis Referees, Paper Setters, Valuators and Members of Expert Panels, Selection Committees and Advisory Committees. In all, **359** participations were reported during the year (247 - thesis referees, 31 - question paper setting, etc. and 473 as Chairman/Members in Advisory/Selection/Evaluation Committees etc.).

Scientific and Technical Journals play an important role in publishing research work and also for reference work. 323 members of the faculty served on Editorial Boards of various prestigious journals published in India and abroad.

## 5.6 Outreach

Extension Lecture Programme: The progress, prosperity and material welfare of the country depend very much on the scientific and technological base of its citizens. With this in mind, the Institute has been organizing Extension Lectures by the Faculty of the Institute, in Institutions of higher learning at the technical level and in schools and public/cultural organizations, Doordarshan, All India Radio, at the popular level. These extension lectures are of great help in the transfer of information on the latest scientific developments in this Institute and other organizations in India and abroad. They are intended to popularize science and through science educate the public in such a way as to bring about a transformation in their basic thinking - a transformation from traditional attitudes to a daring confidence in facing scientifically the challenges of modern times.

These lectures are arranged not only in Bangalore, but also in centers in the entire state of Karnataka and sometimes even outside the state. Even though the majority of these are in English, lectures are also arranged in regional languages like Kannada, if specific requests are received. Many of these lectures are supported by demonstrations, slides, transparencies and models.

## 5.7 International Relations Cell

The IRC oversees and coordinates all international programmes of the Institute. In particular, it is responsible for the following:

- Admissions of International students to Ph.D. and M.Sc (Engg) programs of the Institute.
- To facilitate the Institute's links with international partners.
- To promote academic collaborations and student and faculty exchange programmes with institutions and universities abroad.
- To formulate and help in signing MOUs between IISc and Institutions abroad for collaborative research and student exchange.
- Maintain a data base of international cooperation programmes at IISc, visits of foreign delegations, etc.
- Act as an advisory body to the growing number of foreign students and visitors at the Institute.

During the year many foreign delegations visited the Institute. Some of the delegations who visited our Institute to explore possible collaborations in specific areas of research and student and faculty exchange are listed below:

- Delegation from State of Victoria, Australia on 6<sup>th</sup> March, 2013.
- Delegation from European Secretary General ERC. Prof. Ding Well on 11<sup>th</sup> March, 2013.
- Delegation from University of Leeds Prof. Peter Jimack 13<sup>th</sup> March, 2013
- Delegation from Oklahoma State, Dr. Prasad, 14<sup>th</sup> March, 2013.
- Delegation from IHEST, Paris (around 55 members) 22<sup>nd</sup> April 2013.
- Delegation from University of Exeter, UK 23<sup>rd</sup> April, 2013.
- Delegation from Swedish Research Council, 23<sup>rd</sup> May, 2013.
- Brandeis University Amber Thacher, Program Manager, Prof. Usdan on 28<sup>th</sup> May 2013.
- Delegation from University of Birmingham Mr. Peter Clack on 17<sup>th</sup> July, 2013.
- Delegation from France Ms Ango Ela on 17<sup>th</sup> July, 2013.
- Delegation from China Ms. Bi Lianglian on 25<sup>th</sup> July, 2013.
- Delegation from Germany Dr. Manjula Mundakana on 25<sup>th</sup> July, 2013.





- Delegation from German (DFG) Mr. Alexander P. Hansen on 2<sup>nd</sup>, August, 2013.
  - Delegation from University of Liverpool Prof. Tom Soloman on 14<sup>th</sup> August, 2013.
  - Delegation from University of Hong kong Prof John Spinks on 19<sup>th</sup> August, 2013.
  - Delegation from University of Denmark Prof. Mikael Rondam on 22<sup>nd</sup>, August, 2013.
  - Delegation from Melbourne University Mr. Ashok Kumar, Prof. Janet Hergt on 1<sup>st</sup> October, 2013.
  - Delegation from IRD, France Video Conference on 1<sup>st</sup> October, 2013.
  - Delegation from Uganda Mr. Richard Tushemereirwe on 7<sup>th</sup> October, 2013.
  - Delegation from EMBL Director International Relations, Germany Dr. Silke Schumacher on 23<sup>rd</sup> October, 2013.
  - Delegation from Delft University Prof. Rob Fastenau, Dean of Engineering and Prof. Inald L. Lagendijk on 25<sup>th</sup> October, 2013.
  - Delegation from Oman, Government officials Sheikh Akhazami, Hamed albusaidi, Hassan, John B. Craig on 25<sup>th</sup> October, 2013.
  - Delegation from Taiwan, Science and Technology Division Shimane University Prof. Dr. Yasunori Ando on 5<sup>th</sup> November, 2013.
  - Delegation from UK, Durham University, Led by Prof. Dave Petley on 15<sup>th</sup> November, 2013.
  - Delegation from University of Melbourne Prof. Susan Elliott, Deputy Vice-Chancellor on 18<sup>th</sup> November, 2013.
  - Delegation from Sydney University of Technology UTS Prof. Bruce Milthorpe, Dean of Science faculty on 20<sup>th</sup> November, 2013.
  - Delegation from Kuwait Institute for Scientific Research Dr. Nji M. Al-Mutairi on 21<sup>st</sup> November, 2013.
  - Delegation from German Consulate ERC Lecture by Mr. Christof kuhstob on 22<sup>nd</sup> November, 2013.
  - Delegation from Netherland University of Groningen President, Mr. Nijdam, Prof. Knoester, Prof. Banerjee and Prof. Kooi on 29<sup>th</sup> November, 2013.
  - Delegation from UK Nobel Laureate Andre Geim (discoverer of grapheme) on 6<sup>th</sup> December, 2013.
  - Scientific attache to the Italian Embassy, Professor Anna Painelli and Dr. Lidia Szpyrkowic on 9<sup>th</sup> December, 2013.
  - AGH University, Poland. Prof M. Karbowniczek, Vice Rector on 2<sup>nd</sup> January 2014.
  - Japanese delegation, Mr. Natsu Yamaguchi, Chief Representative, New Komoeito Party, Japan on 10<sup>th</sup> January 2014.
  - Delegation from Bethlehem Lehigh University, Prof Mohamed El-Aasser Vice President on 13<sup>th</sup> January 2014.
  - Delegation from University of Massachusetts Amherst led by Chancellor Subbaswamy on 13<sup>th</sup> January 2014.
- The Institute has signed Memoranda of Understanding (MOUs) with several Institutions abroad for cooperation in research and exchange of students and faculty. During the year, the Institute signed Memoranda of Understanding with the following Universities and Institutes:-
- Technical University of Denmark, Mou and Agreement. Signed on 29<sup>th</sup> May, 2013.
  - The University of York. Signed on 4<sup>th</sup> June, 2013.
  - University of Lausanne, Switzerland. Signed on 19<sup>th</sup> June, 2013.
  - The University of Toronto, Canada. Signed on 21<sup>th</sup> July, 2013.
  - University of Bayreuth. Signed on 7<sup>th</sup> August, 2013.
  - Riken, JNCASR & IISC. Signed on, 16<sup>th</sup> September 2013.
  - Shimane University, Japan. Signed on 5<sup>th</sup> November 2013.
  - University of Groningen. Signed on 29<sup>th</sup> November, 2013.
  - Brandeis University, Waltham Massachusetts. Signed on 9<sup>th</sup> December, 2013.
  - Graduate School of Science and Technology, Nigata University Japan. Signed on 19<sup>th</sup> December, 2013.
- A detailed list of MOUs is available at the IRC website <http://irc.iisc.ernet.in/>





## 6. Centre for Continuing Education

Chairman: P Venkataram

The Centre for Continuing Education (CCE) has initiated and achieved progress with respect to a wide range of activities by utilising the resources of the faculty and facilities available at the Institute with the specific objective of promoting the cause of continuing education. These activities have been carefully structured to meet the requirements of different target groups ranging from high school science teachers to research scientists/engineers. The Centre conducted 13 National Programmes; 47 Industry Oriented Programmes.

### 6.1 National Programmes

**QIP (Quality Improvement Programme) - Leading to the Award of Degrees:** During the current year, under this programme, 8 teachers were admitted for Ph.D. and 10 for M.E/M.Tech. 5 persons were given advance admission for Ph.D for 2013-2014.

The following table gives the Institute contribution to the QIP Programme:

| During the Year   | At IISc |          |
|-------------------|---------|----------|
|                   | Ph.D    | ME/MTech |
| Students Admitted | 8       | 10       |
| Degrees Awarded   | 2       | 3        |
| On Roll           | 34      | 16       |

**QIP – Short Term Courses:** These courses are sponsored by Government agencies such as QIP, ISTE, UGC etc. and are primarily for teachers from engineering/science colleges. During the year one QIP short-term course was organised with a total participation of 20.

### 6.2 Industry Programmes

**PROFICIENCE:** Under the PROFICIENCE programme 2 semester-long, 32 evening courses were conducted and 875 participants attended. 450 participants successfully completed the course.

**Self-supporting Intensive Courses:** The Centre promotes various refresher/extension programmes to enable the participation of scientists and engineers working in different organisations. During this year, 15 such courses were organised for different organizations with a total participation of 300.

### 6.3 Curriculum Development Cell

The Curriculum Development Cell (CDC), sponsored by the AICTE, Government of India, has been functioning at the Institute since 1979. The Curriculum Development Cell provides financial assistance for book writing, preparation of laboratory manuals, holding of conferences, workshops, seminars, special lectures and panel discussions for the preparation of monographs and audio-visual aids for teaching etc. Since 1979, the Centre has provided financial assistance to 90 faculty members for book writing, and 50 books have been published/completed so far.

### 6.4 New Programmes

**Pedagogy Training Programme:** The Centre for Continuing Education conducts a pedagogy training programme every year. The duration of the course is for 2 days.

**Follow Up Programme:** The Centre for Continuing Education is offering a follow up Programme for the students who were awarded Ph.D degrees. This programme is to initiate research work at various engineering colleges.

**Competence Based Education (CBE):** CBE is defined as an instructional system in which a performance-based learning process is used. The learner demonstrates his/her level of attainment in subject-area skills contained in the Course of Study. CBE is conducted periodically through the Internet and class room interaction. CBE allows a student to present experimental



learning as a competency to be evaluated for credit towards a Certificate.

### 6.5 Services rendered to other Government/ Private organisations

**AICTE – TEQIP Phase II:** The Technical Education Quality Improvement Programme (TEQIP) was envisaged in 2003 as a long-term programme of about 10 to 12 years duration to be implemented in 3 phases for transformation of the Technical Education System with World Bank assistance. As per the TEQIP concept and design, each phase is required to be designed on the basis of lessons learnt from the implementation of an earlier phase. TEQIP I started a reform process in 127 Institutions. The reform process needs to be sustained and scaled up for embedding gains in the system and taking the transformation to a higher level. To continue the development activities initiated through TEQIP I, a sequel Project is planned as TEQIP II.

The project aims to scale up and support the ongoing efforts of the Government of India to improve the quality of Technical Education and enhance the existing capacities of institutions to become dynamic, demand driven, quality conscious, efficient and forward looking, and responsive to rapid economic and technological developments occurring at the local, State, National and International levels.

### 6.6 Engineering Education Quality Improvement

- One day pedagogy training was given for the teachers at the Siddaganga Institute of Technology, Tumkur.

- Actively participated and prepared a strategy for the implementation of the Quality Improvement Programme sponsored by the AICTE for the teachers of Don Bosco and Oxford Colleges.
- Discussion on the Quality of Engineering Education improvement, curriculum development and engineering ethics at MITS, Madanapalli

### 6.7 High School Science Teachers Programme

The High School Science Teachers Programme conducted in collaboration with the Department of Science Education, Research and Training, Government of Karnataka, has made a notable impact on science teachers working in high schools.

### 6.8 Hoysala House

CCE runs a guest house named after the famous **Hoysala Dynasty** which ruled ancient Karnataka. It has 60 self-contained and fully furnished single rooms. These are mainly intended for accommodating invitees to the Institute and participants in the programmes conducted under the CCE. However, subject to availability, accommodation is made available to other categories of participants in seminars, symposia and conferences, and persons visiting the Institute for academic work. During the year, **139** faculty members from other universities/research laboratories/colleges, who visited the Institute, stayed in the guest house and **324** participants for Short Term Courses and Workshops/Seminars stayed at the guest house. Accommodation is also made available to 57 post graduate students during the year.



# 7. Sponsored Research, Scientific and Industrial Consultancy

## 7.1 Centre for Sponsored Schemes & Projects

Advisor: R Mohan Das

Most research contributions from the Institute come from research and development sponsored by over a hundred agencies with a total of **917** projects, an outlay of **₹ 860.50** crores, and an annual cash flow of **₹179.75** crores. The primary sponsors are the Dept. of Science & Technology, Aeronautical Research & Development Board, Dept. of Biotechnology, Indian Space Research Organisation, Space Technology Cell, Council of Scientific & Industrial Research, Dept. of Atomic Energy, Ministry of Information Technology, Office of the Principal Scientific Advisor, European Union, Boeing Company and Ministry of Non-conventional Energy Source. The International sponsors include Wellcome Trust, IBM, Asian Office of Aerospace Research & Development, Indo-French Centre for Promotion of Advanced Research, Korea Institute of Science & Technology, European Union, The Swiss Agency for Development & UK-India Education and Research Initiative.

The Science departments received a total of **419** projects with a total outlay of **₹ 363.85** crores. The Engineering departments received **403** projects with a total outlay of **₹ 356.58** crores. There has been a changing trend in recent times in terms of the industrial relevance of the projects. In a few projects, industries are involved right from the beginning, are partially funded, identify technology transfer terms and mutually agree on when the research should mature. The table below shows the division wise breakup of projects and the financial outlay.

| Division                                       | # of Projects | Outlay (in Crores) |
|--|---------------|--------------------|
| Division of Biological Sciences                | 243           | 157.74             |
| Division of Chemical Sciences                  | 125           | 121.85             |
| Division of Electrical Sciences                | 101           | 120.79             |
| Division of Mechanical Sciences                | 302           | 235.79             |
| Division of Physical and Mathematical Sciences | 104           | 84.26              |
| Others   | 42            | 140.07             |
| <b>Grand Total</b>                             | <b>917</b>    | <b>860.50</b>      |

## Biochemistry

# Projects = 55

Value : 2,964 Lakhs

- Award of J.C. Bose Fellowship** : K Muniyappa DSTO, 6/1/2006 to 5/31/2016, 115.55 Lakhs
- J.C. Bose Fellowship to Prof. D.N. Rao** : D Narasimha Rao DSTO, 9/1/2008 to 8/31/2018, 60.50 Lakhs
- J.C. Bose Fellowship to Prof. H.S. Savithri** : H S Savithri DSTO, 9/1/2008 to 8/31/2018, 70.50 Lakhs
- Peroxisomal Targeting of Pichia Pastoris Cytochrome C: Understanding the Molecular Mechanism of Peroxisomal Targeting and Physiological Significance - Tata Innovative Fellowship 2009-10** : P N Rangarajan DBTO, 3/1/2010 to 2/28/2015, 37.00 Lakhs
- The Mechanism of Hoxii Chromosomal Translocation in T-Cell Leukemia** : Sathees C Raghavan CSIR, 4/1/2010 to 3/31/2014, 29.40 Lakhs
- Malarial Parasite Biology : An Avenue to Discover New Drug Targets** : G Padmanabhan DBTO, 8/19/2010 to 8/18/2015, 136.24 Lakhs
- Ramanujan Fellowship to Dr. Viswanathan Arun Nagaraj** : Srinivasan Natarajan DSTO, 11/1/2010 to 10/31/2015, 62.40 Lakhs
- Processing of DNA Double -Strand Breaks by Yeast Mre11- Rad50-Xrs2 Complex** : K Muniyappa CSIR, 4/1/2011 to 3/31/2014, 27.42 Lakhs
- The Role of DNA Processing Protein (Dpr) : Studies with a Conserved Bacterial Protein Involved in Natural Transformation** : D Narasimha Rao DAEO, 4/15/2011 to 3/31/2014, 23.97 Lakhs
- Exploration of Marine Actinomycetes for Bioactive Compounds** : H S Savithri DSTO, 4/26/2011 to 4/25/2014, 24.10 Lakhs
- Development of Biomarker(S) for Diagnosis of Trypanosoma Evansi Infection in Animals using Proteomic Approach** : Utpal S Tatu DBTO, 5/20/2011 to 5/19/2014, 38.47 Lakhs
- Establishment of National Database on Tuberculosis (Tb) - Phase II** : Nagasuma Chandra DBTO, 6/10/2011 to 6/9/2014, 55.96 Lakhs
- Molecular Analysis of the Role of Mms21 Mediated Sumoylation in Maintenance of Chromosome Stability in Saccharomyces Cerevisiae** : Shikha Laloraya DBTO, 6/29/2011 to 12/28/2014, 54.16 Lakhs
- Mechanism of Bcl6 Translocation in Diffuse Large B-Cell Lymphoma** : Sathees C Raghavan DBTO, 7/1/2011 to 1/31/2015, 69.40 Lakhs



15. **Mapping of Ligand Binding Sites to Protein Function Through Structural Analysis** : Nagasuma Chandra DSTO, 8/11/2011 to 8/10/2014, 17.40 Lakhs
16. **Infection with Japanese Encephalitis Virus(Jev) Role of Soluble Classical and Nonclassical Mhc-1 Molecules** : R Manjunath CSIR, 9/1/2011 to 3/31/2014, 19.89 Lakhs
17. **Feasibility of using Glycodelin in the Management of Graft Rejection**: Anjali a Karande DBTO, 9/22/2011 to 9/21/2014, 47.87 Lakhs
18. **Isolation & Structural Characterization of Tropane Alkaloids & Thrombin Inhibitors from Endophytic Fungi Isolated from Catharanthus Roseus & Datura Metel**: C Jayabhaskaran DBTO, 9/29/2011 to 9/28/2014, 71.39 Lakhs
19. **Exploiting Temporal Transcription Profiles, Computational Analysis & Post-Transcriptional Gene Silencing to Identify & Intercept Interactions Between Host & Dormant & Actively Replicating Mycobacterium Tuberculosis**: Nagasuma Chandra DBTO, 9/30/2011 to 9/29/2016, 42.62 Lakhs
20. **Characterization of Muts Homolog Protein Muts2 from Helicobacter Pylori**: D Narasimha Rao CSIR, 1/1/2012 to 3/31/2015, 27.02 Lakhs
21. **Mining Markers of Pregnancy in Cell Free Body Fluids of Buffaloes ( Bubalus Bubalis )** : Utpal S Tatu DBTO, 2/13/2012 to 2/12/2015, 15.56 Lakhs
22. **Rad51c Deficiency as a Therapeutic Target for the Treatment of Breast Cancer using Cytotoxic Parp Inhibitor** : Ganesh Nagaraju CSIR, 4/1/2012 to 3/31/2015, 29.28 Lakhs
23. **Uncovering the Central Role of Human Frataxin Gene in Cellular Iron Homeostasis** : 'Patrick D' Silva CSIR, 4/1/2012 to 3/31/2015, 30.92 Lakh
24. **Young Researcher Award(2012-17)-Uncovering the Role of Human Mitochondrial Heat Shock Protein 70 (Mthsp70) in Pathogenesis of Parkinson's Disease Bad Progression** : Patrick D' Silva Ltmt, 4/1/2012 to 3/31/2015, 24.00 Lakhs
25. **A Study on the Production of Bioactive Compounds from Endophytic Fungi.....Fermentation (Wos-a)** : Dr. Padmini Priya Chandrika DSTO, 4/17/2012 to 4/16/2015, 17.80 Lakhs
26. **Generation of Prototype Lateral Flow Assay Kit using Antigen Specific Hybridomas to Develop Rapid Diagnostic Test for Clinical Diagnosis of Malaria (Phase - I)** : Viswanathan Arun Nagaraj DBTO, 4/30/2012 to 10/29/2014, 18.48 Lakhs
27. **Elucidation of the Mechanism of Pairing of Meiotic Chromosomes and Recombination: The Role of Yeast Synaptonemal Complex Proteins**: K Muniyappa DSTO, 5/24/2012 to 5/23/2015, 78.93 Lakhs
28. **DNA Mismatch Repair in Prokaryotes : Beyond the E.Coli Paradigm** : D Narasimha Rao DBTO, 7/2/2012 to 7/1/2015, 34.50 Lakhs
29. **Deciphering the Functional Significance of Rab-Mediated Vesicular Trafficking Processes in Malaria Parasite**: P N Rangarajan DSTO, 7/23/2012 to 7/22/2015, 21.20 Lakhs
30. **Identification and Functional Characterization of Transcriptional Regulators Involved in Tropane Alkaloid Biosynthesis in Datura Metal - a Combination of Molecular Biology and Biophysical Studies**: C Jayabhaskaran DSTO, 8/9/2012 to 8/8/2015, 30.00 Lakhs
31. **Mechanism of Bcr-Abl Translocation in Chronic Myelogenous Leukemia**: Dr. Elizabeth Thomas DSTO, 9/26/2012 to 9/25/2015, 24.60 Lakhs
32. **Molecular Mechanism of Alternative Nhej during DNA Double-Strand Break Repair and Its Role in Chromosomal Translocations** : Sathees C Raghavan LSRB, 10/12/2012 to 10/11/2014, 30.00 Lakhs
33. **Characterization of a Novel, Alternative Single-Strand Break Repair Pathway and Its Relevance in Genetic Diseases**: Sathees C Raghavan DAEO, 12/5/2012 to 3/31/2015, 30.36 Lakhs
34. **Development of Insect based Bio Sensor Model for Detection of Common Explosives** : Anjali a Karande DRDO, 12/5/2012 to 6/3/2014, 39.90 Lakhs
35. **Add-on R&D Project li : Modelling and Simulation of Cytokine Networks** : Nagasuma Chandra DBTO, 1/21/2013 to 1/20/2016, 42.77 Lakhs
36. **Characterization of Rags as Structure-Specific Nuclease and Its Role in Cpg Associated Chromosomal Translocations**: Sathees C Raghavan DSTO, 2/5/2013 to 2/4/2016, 53.20 Lakhs
37. **The Role of Fanco/Rad51c in DNA Damage Signaling**: Ganesh Nagaraju DSTO, 3/25/2013 to 3/24/2016, 28.00 Lakhs
38. **Establishing Immunological Correlates of Protection Against Malaria Vaccine Candidate using Functional Bio-Assays and Proteomic Deciphering of Host-Parasite Interactions** : Utpal S Tatu DBTO, 3/26/2013 to 3/25/2017, 80.96 Lakhs
39. **Mechanism of DNA Breakage and Repair in Mitochondria** : Sathees C Raghavan CSIR, 4/1/2013 to 3/31/2016, 23.28 Lakhs
40. **Effect of Bacterial Infections on Th1/Th2/Th17 Balance during Pregnancy**: Dr.Vidya Devi DSTO, 5/7/2013 to 5/6/2016, 25.60 Lakhs
41. **Understanding Amyloidogenic Disorders by Examining the Assembly of Retinol Binding Protein with Transthyretin in the Endoplasmic Reticulum**: Utpal S Tatu DSTO, 6/26/2013 to 6/25/2016, 22.50 Lakhs
42. **Genomic and Proteomic Profiling of Preoptic Area(Poa) of the Female Rat Following Neonatal Administration of Estradiol-17  $\beta$** : Dr.a.Jagannadha Rao DSTO, 7/1/2013 to 6/30/2016, 55.00 Lakhs
43. **Transcriptional Regulation by Mxr1p in Pichia Pastoris**: P N Rangarajan DBTO, 7/3/2013 to 7/2/2016, 71.71 Lakhs
44. **Research Associateship in Biotechnology and Life**







**Sciences Programme for North East States :** K Muniyappa DBTO, 8/1/2013 to 7/31/2015, 50.53 Lakhs

45. **DBT Research Associateship Programme :** K Muniyappa DBTO, 8/1/2013 to 7/31/2015, 153.60 Lakhs
46. **Development of New Anticancer Agents from Endophytic Fungi and Their Mechanisms of Apoptosis In Cancer Cell Lines:** C Jayabhaskaran DSTO, 8/19/2013 to 8/18/2017, 9.50 Lakhs
47. **Uncovering Multifunctional Roles of Mitochondrial Heat Shock Proteins in Neurodegenerative Disorders and Cancer Progression Swarnajayanti Fellowship :** Patrick D' Silva DSTO, 8/26/2013 to 8/25/2018, 230.30 Lakhs
48. **Mechanism of Chromosomal Translocations in Leukemia and Lymphoma :** Sathees C Raghavan DBTO, 8/27/2013 to 8/26/2016, 9.00 Lakhs
49. **Characterization of Antibodies and Large Scale Screening of Herbal Compounds for the Development of Hcv Entry Inhibitors- Sub-Project 2.2 :** Anjali a Karande DBTO, 9/3/2013 to 9/2/2018, 44.71 Lakhs
50. **An Approach to Block Hepatitis C Virus Entry by Monoclonal Antibodies :** Anjali a Karande DBTO, 9/11/2013 to 9/10/2016, 33.64 Lakh
51. **Establishment of Human Ectopic Liver Tissue in Mice:** Anjali a Karande DBTO, 9/18/2013 to 9/17/2016, 17.36 Lakhs
52. **Development of Plant Virus-Like Particles (Vlps) as Nanocarriers and Study of Their Structural Dynamics:** H S Savithri DBTO, 10/1/2013 to 9/30/2016, 95.66 Lakhs
53. **Understanding Mrna Fate Decisions: Role of Arginine-Methylation in Functional Transitions of Rna-Protein Complexes(Mrnps):** Dr.Purusharth Rajyaguru WELT, 11/1/2013 to 10/31/2018, 356.98 Lakhs
54. **Understanding the Biology and Functions of Heat Shock Protein 90 (Hsp90) in Giardia Lamblia :** Utpal S Tatu DBTO, 1/6/2014 to 1/5/2017, 43.36 Lakhs
55. **Hsp90 as a Modulator of Pathogenicity, Virulence and Transmission in Veterinary Infections Caused by Theileria and Babesia Species:** Utpal S Tatu DBTO, 2/28/2014 to 2/27/2017, 59.23 Lakhs

#### Centre for Neuroscience

# Projects = 22

Value : 2750.24 Lakhs

56. **J.C. Bose Fellowship to Prof. Vijayalakshmi Ravindranath :** Vijayalakshmi Ravindranath DSTO, 4/1/2009 to 3/31/2017, 103.05 Lakhs
57. **Brain Cytochromes P-450 :** Vijayalakshmi Ravindranath NBRC, 7/20/2009 to 7/19/2014, 88.10 Lakhs
58. **Interdisciplinary Centre in Neuroscience At I.I.Sc., (This Is a Sub-Project of DSTO-943) :** Shyamala Mani DSTO, 3/30/2010 to 3/29/2015, 2.50 Lakhs

59. **Interdisciplinary Centre in Neuroscience at I.I.Sc., :** Aditya Murthy DSTO, 3/30/2010 to 3/29/2015, 17.40 Lakhs
60. **Interdisciplinary Centre in Neuroscience at I.I.Sc.,:** Vijayalakshmi Ravindranath DSTO, 3/30/2010 to 3/29/2015, 1328.90 Lakhs
61. **Neoranal Basis of Object Recognition :** Arun P Sripathi WELT, 4/1/2010 to 3/31/2015, 110.40 Lakhs
62. **Understanding Common Pathogenic Mechanisms in Parkinson's Disease using Genetic and Neurotoxin Induced Mouse Models:** Vijayalakshmi Ravindranath DBTO, 8/26/2010 to 8/25/2014, 50.63 Lakhs
63. **The Control of Sequential Movements by Basal Ganglia Networks:** Aditya Murthy DBTO, 10/6/2010 to 4/6/2014, 72.64 Lakhs
64. **Study of Basic Cortical Circuitry At Multiple Scales of Neural Integration to Understand the Neural Mechanisms Underlying Selective Attention :** Supratim Ray WELT, 7/1/2011 to 6/30/2016, 338.52 Lakhs
65. **The Role of Constraints in the Design of the Nervous System :** Biswa Sengupta WELT, 12/1/2011 to 11/30/2015, 131.62 Lakhs
66. **Ramanujan Fellowship to Dr.Balaji Jayaprakash :** Balaji J DSTO, 12/22/2011 to 12/21/2016, 73.00 Lakhs
67. **Computational Mechanisms of Visual Object Segmentation and Recognition:** Dr.Harish Katti DSTO, 9/25/2012 to 9/24/2014, 12.48 Lakhs
68. **Inspire Faculty Award to Dr. Naren P Rao (Ifa-Lsbm-36):** Narenrao DSTO, 1/1/2013 to 12/31/2017, 19.00 Lakhs
69. **Sub-Project of DBT365 :** Aditya Murthy DBTO, 1/30/2013 to 1/29/2016, 3.00 Lakhs
70. **Cognitive Control of Perception and Action :** Arun P Sripathi DBTO, 1/30/2013 to 1/29/2016, 79.87 Lakhs
71. **Project No. 4903-2- Study of Neural Development in Hips Models of Microcephaly:** Shyamala Mani IFCP, 3/1/2013 to 2/29/2016, 37.68 Lakhs
72. **Role of Centrosomes in Cell Fate Determination in Granule Neuron Precursors during Cerebellar Development :** Shyamala Mani DBTO, 5/1/2013 to 4/30/2016, 72.72 Lakhs
73. **Inhibitory Control in the Planning of Sequential Movements:** Aditya Murthy DSTO, 5/29/2013 to 5/28/2016, 20.25 Lakhs
74. **Contextual Influences on Object Categorization:** Arun P Sripathi DSTO, 6/14/2013 TO 6/13/2016, 15.39 Lakhs
75. **In vivo Imaging of Structural Correlates of Remote and Recent Events :** Balaji J DBTO, 10/17/2013 to 10/16/2016, 48.29 Lakhs
76. **Role of Nanoorganization in the Transmission and Plasticity of Excitatory Synapses:** Deepak Kumaran Nair DBTO, 10/24/2013 to 10/23/2018, 82.00 Lakhs
77. **Following the Hippocampal Trace during and After Systems Consolidation Through in Vivo Imaging:** Balaji J DSTO, 11/20/2013 to 11/19/2016, 42.80 Lakhs



## Molecular Reproduction, Development and Genetics

# Projects = 6

Value : 629.49 Lakhs

78. **Senior Fellowship Award - Role of Stress Activated Kinases in Self Renewal of Mammary Stem Cells :** Annapoorni Rangarajan WELT, 12/1/2010 to 11/30/2015, 471.94 Lakhs
79. **Sys Tb : a Network Program for Resolving the Intracellular Dynamics of Host Pathogen Interaction in Tb Infection:** Deepak Kumar Saini DBTO, 1/9/2012 to 1/8/2017, 24.87 Lakhs
80. **Production and Characterization of Recombinant Bovine and Bubaline Gonadotropins :** Rajan R Dighe DBTO, 3/6/2012 to 3/5/2015, 30.70 Lakhs
81. **Genetic Analysis of the Beta-Glucocerebrosidase Gene in South Indian Patients with Parkinson's Disease :** Arun Kumar DBTO, 6/4/2012 to 6/3/2015, 39.23 Lakhs
82. **Assessment of Differentiation Potential of Pluripotent Stem Cells (Pscs) from Egfp-Expressing Transgenic Green Mice : Involvement of Molecular Regulators of Defferentiation :** P B Seshagiri DBTO, 2/19/2013 to 2/18/2016, 39.26 Lakhs
83. **Comparison of Gene Expression Profiles of Oral Squamous Cell Carcinoma with Sub Mucous Fibrosis:** Paturu Kondaiah DSTO, 6/26/2013 to 6/25/2016, 23.50 Lakhs

## Centre for Ecological Sciences

# Projects = 34

Value : 1458.39 Lakhs

84. **Environmental Education Programme Based on Ecosystem Approach for Teachers, School Children and Community At Large :** T V Ramachandra COLO, 4/11/2002 to 11/30/2015, 17.03 Lakhs
85. **Development of Delivery Model with Open Access using Icts :** T V Ramachandra COLO, 3/31/2004 to 8/30/2015, 10.18 Lakhs
86. **Award of J.C.Bose Fellowship :** Raghavendra Gadagkar DSTO, 6/1/2006 to 5/31/2016, 115.55 Lakhs
87. **Envis Centre on Western Ghats Ecology - Phase II :** Chairman-BES DEEO, 4/1/2007 to 3/31/2015, 34.01 Lakhs
88. **Centre for Ecological Science Scheme II -Phase II :** R Sukumar DEEO, 4/1/2007 to 3/31/2015, 34.50 Lakhs
89. **Wildlife-Human Interactions:from Conflict to Co-Existence in Sustainable Landscapes :** R Sukumar NINA, 10/1/2007 to 6/30/2014, 121.80 Lakhs
90. **Ecology & Mechanics of Acoustic Communication in Tree Crickets :** Rohini Balakrishnan UKIE, 2/15/2008 to 3/31/2015, 41.36 Lakhs
91. **Addressing the 'Walleaceabn Shortfall' for Small Vertebrates in the Western Ghats Across Space and Time :** Kartik Shanker CEPE, 10/1/2009 to 6/30/2014, 53.49 Lakhs
92. **J.C.Bose Fellowship to Dr.Raman Sukumar :** R Sukumar DSTO, 8/3/2010 to 8/2/2015, 64.40 Lakhs
93. **Exploring the Dynamics of the Acoustic Landscape in Field Cricket Choruses using Microphone Arrays:** Rohini Balakrishnan CSIR, 12/15/2010 to 6/30/2014, 20.59 Lakhs

94. **Geo-Visualization of Local Hotspot of Biodiversity in Central Western Ghat :** T V Ramachandra DSTO, 3/29/2011 to 3/28/2015, 83.42 Lakhs
95. **Patterns of Distribution and Diversification in Select Snake Genera in the Western Ghats and Northeast India:** Kartik Shanker DBTO, 9/21/2011 to 9/20/2014, 28.24 Lakhs
96. **Improving Our Ability to Predict Plant Distributions Under Changed Climates : Incorporating Dispersal Into Predictions of Species and Community Distributions:** R Sukumar DSTO, 9/21/2011 to 9/20/2014, 59.41 Lakhs
97. **Investigating the Structure & Function of Vocal Mimicry in the Greater Racket-Tailed Drongo (Dicrurus Paradiseus) :** Rohini Balakrishnan DSTO, 2/28/2012 to 2/27/2015, 34.11 Lakhs
98. **Mobile Organisms to Patterned Vegetation: Investigation of Self-Organization in Ecological Systems :** Vishwesh Guttal DBTO, 4/1/2012 to 3/31/2017, 81.07 Lakhs
99. **Sacred Grove Ecosystem Service Assessment of Central Western Ghats in Karnataka :** T V Ramachandra MEFO, 4/16/2012 to 3/31/2017, 36.29 Lakhs
100. **Impacts of Climate Change Induced Bleaching on Coral Reefs of the Andaman: Do Population Demography & Marine Protected Areas Enhance Recovery of Coral Reefs :** Naveen Namboothri DSTO, 5/17/2012 to 5/16/2015, 20.73 Lakhs
101. **Studying Conversation Potential of Syzygium Travancoricum Gamble, Through Ecological Niche Modelling & Population Genetic Structure :** T V Ramachandra DSTO, 5/17/2012 to 5/16/2015, 24.58 Lakhs
102. **Molecular Phylogeographic Studies on Ranid Frogs of Western Ghats :** Dr. K. P. Dinesh DSTO, 5/24/2012 to 5/23/2015, 13.96 Lakhs
103. **Soil Nutrient Dynamics in the Tropical Dry Deciduous Forest (Mudumalai Wildlife Sanctuary) of Tamil Nadu, South India:** Shanmugam Mani DSTO, 7/13/2012 to 7/12/2015, 22.50 Lakhs
104. **Significance of the Indian Subcontinent in the Evolution of Asclepiadeae.:** Dr.S. Siddharthan DSTO, 7/23/2012 to 7/22/2015, 20.50 Lakhs
105. **Avian Frugivores-Understanding Patterns of Range and Richness in the Western Ghats.:** Kartik Shanker DSTO, 7/31/2012 to 7/30/2015, 16.46 Lakhs
106. **Fungus-Farming by Termites :** Renee M Borges CSIR, 11/1/2012 to 10/31/2015, 13.25 Lakhs
107. **Queen Succession in the Primitively Eusocial Wasp Ropalidia Marginata :** Raghavendra Gadagkar CSIR, 11/1/2012 to 10/31/2015, 13.79 Lakhs
108. **Diversification and Speciation in the Stream Dwelling Frog Genus Nyctibatrachus from the Western Ghats, India :** Kartik Shanker MCBT, 11/19/2012 to 5/31/2014, 1.20 Lakhs
109. **Development of Project Proposal for Scientific Research on Bees and Pollination Related Programme in Sirsi Region of Western Ghats:** Raghavendra Gadagkar EWO, 1/1/2013 to 3/31/2014, 1.00 Lakh



110. **Study of Biodiversity in the Castlerock-Kulem Region of Karnataka and Goa** : R Sukumar RVNL, 2/21/2013 to 2/20/2015, 24.00 Lakhs
111. **Urban Revolution:Urbanization Pattern and Environmental Sustainability Analysis of Major Cities of India** : T V Ramachandra ISTC, 4/1/2013 to 3/31/2016, 11.13 Lakhs
112. **Investigation of Spatial and Temporal Dynamics of Vegetation in Semi-Arid Ecosystems**: Vishwesha Guttal ISTC, 4/1/2013 to 3/31/2016, 12.28 Lakhs
113. **Novel Techniques to Map and Monitor Forest Degradation in the Nilgiri Biosphere Reserve**: R Sukumar ISTC, 4/1/2013 to 3/31/2016, 12.33 Lakhs
114. **Assessment of the Impact of the Mangrove Scheme in Honavar Forest Division,Uttara Kannada District Through Concurrent and Terminal Evaluation**: T V Ramachandra KFDO, 4/29/2013 to 7/28/2014, 1.00 Lakh
115. **Conservation of Carnivores and Ecosystem Services in Multiple-Use Rangelands**: Dr.Sumanta Bagchi DSTO, 7/25/2013 to 7/24/2016, 10.00 Lakhs
116. **Altitudinal Gradient in Vector-Mediated Blood Parasites Across Western Himalayan Birds**: Dr.Farah Ishtiaq WELT, 9/1/2013 to 8/31/2018, 356.84 Lakhs
117. **The Movement Ecology of Fig Wasps: How Fig Wasps Find Their Fig Targets using Plants Volatiles**: Renee M Borges DSTO, 12/16/2013 to 12/15/2016, 47.41 Lakhs

#### Bioinformatics Centre

# Projects = 5 Value : 108.31 Lakhs

118. **Study of Factors Affecting DNA Binding Properties of Zinc Finger Proteins Structures with C2h2 in Focus** : Debnath Pal DSTO, 12/29/2010 to 6/28/2014, 13.22 Lakhs
119. **Sub.Project.5 - Analysis of Hemoglobin Variants (Core Project Dbt324)** : Debnath Pal DBTO, 9/29/2011 to 9/28/2016, 13.42 Lakhs
120. **Algorithms Software and Database to Analyze Nuclei Acid Sequence and Protein Structure**: K Sekar MITO, 3/19/2012 to 3/18/2015, 27.37 Lakhs
121. **Development of Internet Computing Engines and Knowledgebase for the Analysis of Protein Sequences and Structures** : K Sekar DBTO, 5/7/2012 to 5/6/2015, 13.73 Lakhs
122. **Alternative Approaches to Antitubercular Drug Discovery** : Debnath Pal DBTO, 10/24/2013 to 10/23/2016, 40.57 Lakhs

#### Molecular Biophysics Unit

# Projects = 42 Value : 3129.79 Lakhs

123. **Collaborative Study Agreement** : Raghavan Vardarajan MERK, 8/6/2003 to 9/30/2016, 52.79 Lakhs

124. **Award of J.C.Bose Fellowship** : M R N Murthy DSTO, 6/1/2006 to 5/31/2016, 115.55 Lakhs
125. **Collaborative Study Agreement** : Raghavan Vardarajan MERK, 8/28/2006 to 8/27/2014, 67.79 Lakhs
126. **J.C.Bose Fellowship to Prof.Raghavan Varadarajan** : Raghavan Vardarajan DSTO, 8/1/2007 to 7/31/2017, 121.25 Lakhs
127. **J.C.Bose Fellowship to Prof.Dipankar Chatterji** : Dipankar Chatterji DSTO, 8/1/2007 to 7/31/2017, 121.25 Lakhs
128. **Structural Studies on Membrane Associated Molecular Machines Modulating Multiple Drug Resistance in Gram Positive Bacteria** : Sandeep Kumar Srivastava DBTO, 8/10/2009 to 8/10/2014, 52.52 Lakhs
129. **Development of An Inhibitor for Stringent Response:Control of Bacterial Growth in Stationary Phase** : Dipankar Chatterji DBTO, 9/17/2009 to 9/16/2014, 251.34 Lakhs
130. **Development of An Inhibitor for Stringent Response:Control of Bacterial Growth in Stationary Phase** : Dipankar Chatterji DBTO, 9/17/2009 to 9/16/2014, 251.34 Lakhs
131. **Development of Behavioral & Cell Biological Assays for Activity Guided Purification of Prospective Anti-Cancer and Behavior Modulating Molecules from Wasp Venoms** : P Balaram DSTO, 3/15/2010 to 9/30/2014, 39.37 Lakhs
132. **J.C.Bose Fellowship to Dr.Manju Bansal** : Manju Bansal DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs
133. **Deep Sequencing of Venom Duct Cdnas from Indian Cone Snails**: P Balaram DBTO, 8/20/2010 to 8/19/2014, 47.94 Lakhs
134. **Comparative Immunogenicity of Novel and South African Hiv-1 Subtype C Env Peptide and Recombinant Protein Constructs** : Raghavan Vardarajan DSTO, 4/21/2011 to 4/20/2015, 55.64 Lakhs
135. **National Bioscience Award for Career Development 2010**: B Gopal DBTO, 4/26/2011 to 4/25/2014, 9.00 Lakhs
136. **Structural Biology of Mycobacterial Secretion Systems: Mammalian Cell Entry (Mce) Transporter System and Esx (Type VII) Secretion System** : Vidya Chandran WELT, 11/1/2011 to 10/31/2016, 226.49 Lakhs
137. **Structural Studies of IlvM, the Regulatory Domain of E.Coli Ahas li & Determining the Structural Basis for Resistance to Inhibition by End-Products of the Metabolic Pathway**: Siddhartha P Sarma DBTO, 11/24/2011 to 11/23/2014, 35.57 Lakhs
138. **Award of J.C. Bose Fellowship to Prof . a. Surolia** : A Surolia DSTO, 1/2/2012 to 11/30/2015, 61.20 Lakhs
139. **Strategies for Preventing Protein Aggregation** : Raghavan Vardarajan DBTO, 2/22/2012 to 2/21/2015, 14.67 Lakhs
140. **Programme Support for Study of Molecular Structure and Intermolecular Interactions by NMR Spectroscopy**: Siddhartha P Sarma DBTO, 3/22/2012 to 3/21/2017, 234.67 Lakhs







141. **Design of Peptide Analogs of Secondary structural Elements and the B12 Binding Site of Hiv-1 Gp120 :** Raghavan Vardarajan Dbto, 3/27/2012 to 3/26/2015, 280.73 Lakhs
142. **Characterization of Cytotoxic Intermediates and Deciphering the Underlying Mechanism of Cell Toxicity in Transthyretin Related Amlodiosis :** a Surolia DBTO, 4/1/2012 to 11/22/2014, 4.30 Lakhs
143. **Inspire Faculty Award to Dr.Konkallu Hanumae Gowd (IFA-11LSBM-03) :** Konkallu Hanumae Gowd DSTO, 4/1/2012 to 3/31/2017, 21.20 Lakhs
144. **Structure Analysis of Aspartic Proteinases of Mycobacterium Tuberculosis & Exploring Their Potential as New Drug Targets by X-Ray Crystallography:** K Suguna DBTO, 4/30/2012 to 4/29/2015, 44.22 Lakhs
145. **Molecular Characterization of M.Tuberculosis Biotin Protein Ligase (Mtbpl) and Its Functional Significance to the Tubercular Organism:** a Surolia DBTO, 5/4/2012 to 5/3/2015, 90.59 Lakhs
146. **Calcium Store-Induced Intrinsic Plasticity in the Hippocampus :** Rishikesh Narayanan DBTO, 5/28/2012 to 5/27/2015, 50.86 Lakhs
147. **Understanding the Mechanism of Inter-Cell Communication in Staphylococcus Aureus.:** B Gopal DSTO, 7/31/2012 to 7/30/2015, 43.53 Lakhs
148. **Functional Characterization and Design of Inhibitors of Arginosuccinate Synthase (Argg) and Arginosuccinate Lyase (Agrh) from Mycobacterium Tuberculosis.:** a Surolia ICMR, 8/1/2012 to 7/31/2015, 49.98 Lakhs
149. **Complete Characterization of the Mycobacterial Dephosphocoenzymes a Kinase Ad Biotin Protein Ligase:** a Surolia DSTO, 8/9/2012 to 10/4/2014, 34.98 Lakhs
150. **Rapid Epitope Mapping of Neutralizing Antibodies and Other Entry Inhibitors of Hiv-1 :** Raghavan Vardarajan DBTO, 8/27/2012 to 8/26/2015, 85.33 Lakhs
151. **Structural & Related Studies on Selected Tb and Other Mycobacterial Proteins Involved in Maintaining Genome Integrity and Regulation of Gene Expression :** M Vijayan DBTO, 11/14/2012 to 11/13/2015, 117.89 Lakhs
152. **DBT'S Twinning Programme for the Ne : In-Silico Design and Evaluation of Sequences for Yd Crystalline Protein :** Prof. Saraswathi Vishveshwara DBTO, 1/4/2013 to 1/3/2016, 15.28 Lakhs
153. **Add-on R&D Project I : Evolutionary Conservation of Interactions and Large-Scale Modelling of Complexes Between Protein Modules :** N Srinivasan DBTO, 1/21/2013 to 1/20/2016, 27.27 Lakhs
154. **Mining Cancer Genome Sequencing Data to Study Mutations in Cancer:** Dr.Prathima Iengar DSTO, 6/1/2013 to 5/31/2016, 17.28 Lakhs
155. **Isolation & Characterization of Bioactive Peptides from Marine Fungi and Cone Snails:** Dr. Soorej M Basheer DSTO, 6/26/2013 to 6/25/2016, 9.00 Lakhs
156. **Exploration of Ampylation, a Novel Post-Translational Signaling Mechanism, in Mycobacterium Tuberculosis:** a Surolia DBTO, 6/28/2013 to 6/27/2016, 121.10 Lakhs
157. **Development of Anticancer Compounds from Ascidians:** Dr.R.P.Rajesh DSTO, 7/1/2013 to 6/30/2016, 9.00 Lakhs
158. **Potassium and Glutaminergic Channel Modulation to Relieve Neuropathic Pain and Obsessive Compulsive Disorder :** a Surolia CSIR, 8/1/2013 to 7/31/2018, 52.73 Lakhs
159. **Computational Docking Analysis of Natural Herbal Inhibitors of Hcv Non-Structural Protein 3(Ns3) and Design of Improved Inhibitors - Sub-Project 1.1 :** N Srinivasan DBTO, 9/3/2013 to 9/2/2018, 26.72 Lakhs
160. **Structural and Related Studies on Selected Plant and Microbial Lectins and Lectin-Like Molecules:** M Vijayan DSTO, 9/18/2013 to 9/17/2016, 81.00 Lakhs
161. **Molecular Dynamic Simulation Study on Human Guanosine Monophosphate Synthetase(Gmps) Enzyme and Their Hydrated Complex: a Theoretical Approach Towards the Design of Anticancer Agent:** Dr. Hridoy Ranjan Bairagya DSTO, 9/23/2013 to 9/22/2016, 6.00 Lakhs
162. **Biophysical and Electrochemical Characterization of G-Quadruplex and Small Molecules Binding:** Dr. Niki Sweta Jha DSTO, 11/1/2013 to 10/31/2016, 20.10 Lakhs
163. **Activity-Dependent Plasticity in the Hippocampal T-Type Calcium Current as a Putative Molecular Substrate for Learning and Memory:** Rishikesh Narayanan DSTO, 11/20/2013 to 11/19/2016, 51.00 Lakhs
164. **Structural and Functional Characterization of Small Heat Shock Proteins:** K Suguna DSTO, 3/3/2014 to 3/2/2017, 43.32 Lakhs

#### Microbiology & Cell Biology

# Projects = 56

Value : 4774.84 Lakhs

165. **Sub Project of DSTO-809 :** Kumaravel Somasundaram DSTO, 7/8/2008 to 3/31/2014, 55.34 Lakhs
166. **J.C.Bose Fellowship Prof.V.Nagaraj :** V Nagaraja DSTO, 9/1/2008 to 8/31/2018, 70.50 Lakhs
167. **J.C.Bose Fellowship to Prof.Umesh Varshney :** Umesh Varshney DSTO, 9/1/2008 to 8/31/2018, 70.50 Lakhs
168. **Establishment of Networking Resources Centre in Science Departments :** C Durga Rao UGCQ, 5/8/2009 to 3/31/2015, 499.10 Lakhs
169. **Catalytic Antibodies in Immune-Mediated Disorders :** V Nagaraja IFCP, 8/1/2009 to 4/30/2014, 42.40 Lakhs
170. **Biology of Gene-Deteted M.Tuberculosis Strains – Immunological Marker Profiling - Sub-Project of DBT-253 :** K N Balaji DBTO, 9/17/2009 to 9/30/2014, 30.09 Lakhs







171. **Biology of Gene-Deleted M.Tuberculosis Strains – Immunological Marker Profiling – Sub-Project of DBT0253** : Umesh Varshney DBTO, 9/17/2009 to 9/30/2014, 33.10 Lakhs
172. **Biology of Gene-Deleted M.Tuberculosis Strains- Immunological Marker Profiling** : V Nagaraja DBTO, 9/17/2009 to 9/30/2014, 209.18 Lakhs
173. **Functional Analysis of Gene Regulatory Networks during Flower and Seed Development in Rice** : Usha Vijayaraghavan DBTO, 9/18/2009 to 9/17/2014, 107.01 Lakhs
174. **Mechanisms of Protein Synthesis and Ribosome Targeting Antibiotic Drugs in Mycobacteria** : Umesh Varshney DBTO, 9/22/2009 to 6/21/2014, 94.43 Lakhs
175. **Development of Rnai Technology to Improve Yield and Quality of Leafy Vegetables - Lettuce as a Case Study** : Utpal Nath DBTO, 5/21/2010 to 5/19/2014, 72.60 Lakhs
176. **Approaches to Develop An Effective Hcv Vaccine** : Saumitra Das DBTO, 7/7/2010 to 1/5/2015, 105.52 Lakhs
177. **J.C.Bose Fellowship to Dr.Usha Vijayaraghavan**: Usha Vijayaraghavan DSTO, 8/4/2010 to 8/3/2015, 68.00 Lakhs
178. **Characterization of Tarani, a Locus Involved in Controlling Biological Surface Curvature**: Utpal Nath DBTO, 8/31/2010 to 8/30/2014, 50.47 Lakhs
179. **'Dissecting Deregulated Micrnas Network in Glioblastoma' - Team Leader's Project 2** : Kumaravel Somasundaram DBTO, 9/9/2010 to 9/8/2015, 60.70 Lakhs
180. **'Role of Epigenetic Modification in Astrocytoma Development : Genome -Wide Methylation Profiling of Glioblastoma' – Team Leader's Project 1** : Kumaravel Somasundaram DBTO, 9/9/2010 to 9/8/2015, 85.92 Lakhs
181. **Multi-Institutional Network Programme on Molecular Neuro-Oncology- Core Project** : Kumaravel Somasundaram DBTO, 9/9/2010 to 9/8/2015, 348.90 Lakhs
182. **Role of Hermansky-Pudlak Syndrome Associated Protein Complexes in Organelle Biogenesis** : Subbarao Gangisetty WELT, 10/1/2010 to 9/30/2015, 350.96 Lakhs
183. **More Medicines for Tuberculosis (Mm4tb)** : V Nagaraja EUCO, 2/1/2011 to 1/31/2016, 69.06 Lakhs
184. **Au-Rich Element-Binding Proteins (Are-Bps) and Regulation of Rotavirus Gene Expression in Virus-Infected and Viral Gene-Transfected Mammalian Cells**: C Durga Rao DSTO, 3/14/2011 to 3/13/2015, 49.97 Lakhs
185. **National Bioscience Award for Career Development 2010**: Dipshikha Chakravorty DBTO, 4/26/2011 to 4/25/2014, 6.00 Lakhs
186. **Elucidation of Hiv/Cd4t Cell Interaction Pathways for Novel Therapeutic and Biomarker Discovery** : Dr. Annapurna Vyakarnam DBTO, 1/9/2012 to 1/8/2017, 26.00 Lakhs
187. **Sys Tb : a Network Program for Resolving the Intracellular Dynamics of Host Pathogen Interaction in Tb Infection** : V Nagaraja DBTO, 1/9/2012 to 1/8/2017, 156.13 Lakhs
188. **Role of Host-Virus Interaction in Cocksackievirus B3 Infection** : Saumitra Das DBTO, 3/14/2012 to 3/13/2015, 43.78 Lakhs
189. **Structure and Functional Analysis of Mom - Anti Restriction Gene of Phage Mu** : V Nagaraja DSTO, 3/27/2012 to 3/26/2015, 52.83 Lakhs
190. **Identification and Characterisation of Transcripts and Promoters of Nucleoside Diphosphate Kinase Gene, Ndk, of Mycobacterium Smegmatis**: P Ajit Kumar CSIR, 4/1/2012 to 3/31/2015, 22.00 Lakhs
191. **Role of Gas6 Protein in Inflammatory Respiratory Disease** : Dr. William Rasican Surin DSTO, 5/17/2012 to 5/16/2015, 10.25 Lakhs
192. **Screening of Medicinal Plants for Antiviral Properties Against Hepatitis-C Virus** : Dr.Uma Reddy DSTO, 5/18/2012 to 5/17/2015, 15.00 Lakhs
193. **Functional Characterisation of Novel Genes of Mycobacterium Tuberculosis & Their Role in Immunomodulation of Host Immune Responses.** : Dr. Balla Venkata Kranthi DSTO, 5/28/2012 to 5/27/2015, 24.17 Lakhs
194. **J C Bose Fellowship**: Kumaravel Somasundaram DSTO, 8/16/2012 to 8/15/2017, 68.00 Lakhs
195. **Studies on Translational Control of P53 Isoforms** : Saumitra Das DBTO, 9/7/2012 to 9/6/2015, 74.51 Lakhs
196. **Genome Wide Screening to Dissect Glioma Sensitivity to Temozolomide - Core Grant of DBT356** : Kumaravel Somasundaram DBTO, 9/20/2012 to 9/19/2015, 48.48 Lakhs
197. **Genome -Wide Rnai Screen to Understand Endoplasmic Reticulum Proteostasis Pathways - Core Grant of DBT356** : Subbarao Gangisetty DBTO, 9/20/2012 to 9/19/2015, 52.36 Lakhs
198. **Genome-Wide Rnai Screens : Understanding of Proteostasis, Cellular Senescence and Chemoresistance - Core Grant** : Subbarao Gangisetty DBTO, 9/20/2012 to 9/19/2015, 196.80 Lakhs
199. **Imaging and Biochemical Analysis of Subversion of Innate Immune Cells by Glycoproteins of Pathogenic Mycobacteria** : S Vijaya DBTO, 9/28/2012 to 9/27/2015, 70.23 Lakhs
200. **Delineation of Hedgehog Signaling in Macrophages and Dendritic Cells Upon Infection with Pathogenic Mycobacteria** : K N Balaji DBTO, 9/29/2012 to 9/28/2015, 61.95 Lakhs
201. **Molecular Mechanisms of Immune Evasion by M. Tuberculosis** : K N Balaji IFCP, 10/1/2012 to 9/30/2015, 32.58 Lakhs
202. **Physiological Importance of the Nudix Box Proteins in Maintenance of the Genomic Integrity in Mycobacteria** : Umesh Varshney CSIR, 11/1/2012 to 10/31/2015, 21.63 Lakhs
203. **Studies on Activation of Wnt-Beta-Catenin Signaling in Macrophages Upon Infection with Pathogenic Mycobacteria** : K N Balaji DBTO, 11/16/2012 to 11/15/2015, 73.16 lakhs
204. **Micrna Turnover Complexes-'Mirnasomes':the Potential Core Constituents of the Micrna Turnover Pathway in**





- Caenorhabditis Elegans:** Dr.Saibal Chatterjee WELT, 1/2/2013 to 1/1/2018, 381.42 Lakhs
205. **Exploring the Role of the Frame-Shifted Non Structural Protein Nsi 'in Flaviviral Rna Synthesis:** S Vijaya DSTO, 2/21/2013 to 2/20/2016, 35.56 Lakhs
206. **Project No.4903 - 1 - "Control of Melanosome Biogenesis by Small Gtpases :** Subbarao Gangisetty IFCP, 3/1/2013 to 2/29/2016, 66.65 Lakhs
207. **Unraveling Glioma Development and Progression Through Whole-Exome Sequencing :** Kumaravel Somasundaram DBTO, 5/6/2013 to 5/5/2016, 99.72 Lakhs
208. **Enterovirus 3a : Identification of Novel Interacting Partners and Study of Their Role in Virus Replication :** C Durga Rao DBTO, 5/9/2013 to 5/8/2016, 48.67 Lakhs
209. **Rational Design and Functional Analysis of Inhibitors for the Essential Cell Division Protein, Ftsz, of Mycobacterium Tuberculosis :** P Ajit Kumar DBTO, 5/13/2013 to 5/12/2016, 39.40 Lakhs
210. **Use of Heterologous Factors from Human Mitochondria to Understand the Mechanism of Initiation and Ribosome Function in Escherichia Coli and Mammalian Cells :** Umesh Varshney DBTO, 7/25/2013 to 7/24/2016, 76.83 Lakhs
211. **Understanding the Gene Regulatory Network of Mycobacterium Tuberculosis:** V Nagaraja DSTO, 8/8/2013 to 8/7/2015, 6.77 Lakhs
212. **Identification and Characterization of the Protein Factor That Regulates Ftsa Gene Expression in Escherichia Coli:** P Ajit Kumar DAEO, 8/20/2013 to 3/31/2016, 21.67 Lakhs
213. **Evaluation of the Potential Antiviral Agents (Mabs/Peptides) in Infectious Hcv Cell Culture System - Sub-Project 2.3 :** Saumitra Das DBTO, 9/3/2013 to 9/2/2018, 41.32 Lakhs
214. **Studies on Delivery of Antiviral Agents in Liver Cells - Sub-Project 3.3 :** Saumitra Das DBTO, 9/3/2013 to 9/2/2018, 41.32 Lakhs
215. **Further Characterization of the Specific Antiviral Agents Against Hcv Infection- Sub-Project 1.3 :** Saumitra Das DBTO, 9/3/2013 to 9/2/2018, 69.28 Lakhs
216. **Centre of Excellence for Research on Hepatitis C Virus - Phase II :** Saumitra Das DBTO, 9/3/2013 to 9/2/2018, 163.50 Lakhs
217. **To Study the Role of Hcv Proteins in Immunoregulation and Hepatocarcinogenesis :** Saumitra Das DBTO, 9/17/2013 to 9/16/2016, 55.42 Lakhs
218. **Analysis of the Role of Gnra Motifs Within the Ires in the Internal Translation Initiation and the Cellular Protein Binding of Live Attenuated Strains of Coxsackievirus:** Saumitra Das DSTO, 10/18/2013 to 10/17/2016, 14.49 Lakhs

219. **Organization of India-Uk Seminar At Ilsc from January 29-31st of 2014:** Dr.Annapurna Vyakarnam DSTO, 1/10/2014 to 1/9/2015, 4.10 Lakhs
220. **Understanding Protein Synthesis in Mycobacteria with High Impact for Directed Drug Discovery:** Umesh Varshney DBTO, 2/11/2014 to 2/10/2017, 79.15 Lakhs

#### Central Animal Facility

# Projects = 2 Value : 119.76 Lakhs

221. **Understanding the Mechanisms of Viral Induced Axonal Loss & Demyelination in An Experimental Animal Model:** S G Ramachandra DBTO, 9/1/2011 to 8/31/2014, 17.75 Lakh
222. **Development of Diagnostic Kits for Health Monitoring of Experimental Animals:** S G Ramachandra DBTO, 11/18/2011 to 11/17/2014, 102.01 Lakhs

#### Centre for Cryogenic Technology

# Projects = 7 Value : 283.08 Lakhs

223. **Experimental Studies & Characterization of Adsorbers Down to 4.2k for Development of Cryosorption Pumps At Ipr. :** Upendra Behera BRFS, 9/9/2009 to 6/30/2014, 116.77 Lakhs
224. **Development of Helium Recondensation Systems Based on Two Stage Pulse Tube Cryocoolers :** Upendra Behera DAEO, 4/1/2011 to 9/30/2014, 19.33 Lakhs
225. **Thermal Conductivity Studies of Cryopanel Coated with Adhesives & Activated Carbon Adsorbents Down to 4.5k :** Upendra Behera BRFS, 5/2/2012 to 3/31/2015, 23.89 Lakhs
226. **Development & Study of a Cryocooler Based Cryosorption Pump Operating At 4.5k. :** Upendra Behera BRFS, 5/2/2012 to 3/31/2015, 73.26 Lakhs
227. **Study of Tribological Properties of Poly tetrafluoroethylene(Ptfe) At Cryogenic Temperatures:** D S Nadig ISTC, 4/1/2013 to 3/31/2015, 15.23 Lakhs
228. **Studies on Vortex Tubes for In-Flight Lox Collection:** Upendra Behera DSTO, 8/6/2013 to 8/5/2017, 30.50 Lakhs
229. **Design and Fabrication of the Flexure Spring of the Self-Regulating Joule Thomson Cooler :** Subhash Jacob DRDO, 11/5/2013 to 11/4/2014, 4.10 Lakhs

#### Centre for Earth Sciences

# Projects = 14 Value : 1606.13 Lakhs

230. **Research, Education & Manpower Development in the Discipline of Earth Processess :** D.Nagesh Kumar MESO, 10/16/2009 to 10/15/2014, 1132.47 Lakhs
231. **Revisiting the Source Zone of the 1819 Rann of Kachchh Earthquake to Constrain the Deformation Characteristics :** Kusala Rajendran MESO, 5/12/2011 to 5/11/2014, 9.20 Lakhs





232. **Setting Up Operation and Maintenance of Gps Stations At Selected Locations by Various Viz, Ilsc:** Kusala Rajendran MESO, 8/4/2011 to 8/3/2014, 16.45 Lakhs
233. **India's Paleoclimate Evolution during Late Cretaceous-Early Paleogene : Unravelling the Effects of Enso-Like Situation in a Greenhouse World :** Prosenjit Ghosh DSTO, 10/21/2011 to 10/20/2014, 35.94 Lakhs
234. **Characterization of the Seismic Cycle in the Central Himalayan Seismic Gap using Precise U-Th Dating of Deformed Speleothems :** Kusala Rajendran DSTO, 10/24/2011 to 10/23/2014, 27.23 Lakhs
235. **Palaeoseismic History of the North Andaman from Coral Records :** Kusala Rajendran MESO, 12/2/2011 to 12/1/2014, 15.33 Lakhs
236. **Source of Black Carbon in of Particulate Fraction in Himalayan Snow using Stable Isotope Analyses:** Prosenjit Ghosh ISTC, 4/1/2012 to 3/31/2015, 18.84 Lakhs
237. **Paleo-Geographic Reconstruction: Development of a New Gis Based Methodology:** Sajeew Kirishnan ISTC, 4/1/2012 to 3/31/2015, 23.86 Lakhs
238. **Constructing Earth Like Dynamo Models. — Swarna Jayanthi Fellowship :** Dr. Binod Sreenivasan DSTO, 8/31/2012 to 8/30/2017, 85.77 Lakhs
239. **Petrographical, Chemical and Computational Studies on Concrete At High Temperatures:** Sajeew Kirishnan DAEO, 12/17/2012 to 3/31/2015, 44.12 Lakhs
240. **Evaluating Earthquake/Tsunami Recurrence Along the Andaman Arc from Study of Shallow Cores:** C.P. Rajendran INCO, 4/1/2013 to 3/31/2016, 23.22 Lakhs
241. **Major, Trace Element and Chromium Isotopic Study of the Lunar Impact Crater, India:** Dr. Ramananda Chakrabarti ISTC, 4/1/2013 to 3/31/2015, 18.69 Lakhs
242. **Tectonic and Climatic Implication during Deposition of Tertiary Sediments in NW Himalayan Foreland Basin, India:** Dr. Seema Singh DSTO, 5/24/2013 to 5/23/2016, 22.35 Lakhs
243. **Setting Up a Broadband Seismic Observatory At the New Ilsc Campus At Challakere, Karnataka:** Kusala Rajendran MESO, 6/5/2013 to 6/4/2016, 28.42 Lakhs
244. **Iron Formations and Its Associates: An Inquiry into Early Earth Dynamics:** Sajeew Kirishnan DSTO, 6/18/2013 to 6/17/2016, 3.34 Lakhs
245. **Major, Trace Element and Calcium Stable Isotopic Study of Carbonatites and Associated Alkaline Silicate Volcanic: Tracking Carbonate Metasomatism & Major Element Recycling in the Mantle:** Dr. Ramananda Chakrabarti DSTO, 6/26/2013 to 6/25/2016, 6.00 Lakhs
246. **Evolution of Upper Ramganga Valley and Its Catchment Erosion during Quaternary:** Dr. Shipra Chaudhary DSTO, 7/2/2013 to 7/1/2016, 8.70 Lakhs
247. **Seismotectonic History, Plate Boundary Deformation and State of Stress in Andaman-Sumatra Subduction Zone and Its Adjoining Areas:** Kusala Rajendran INCO, 7/18/2013 to 3/31/2016, 30.06 Lakhs
248. **Geological Linkage Between Southern India and Antarctica: a Probe on Crustal Processes from Archaean to Proterozoic India-Japan Research Project :** Sajeew Kirishnan DSTO, 8/13/2013 to 8/12/2015, 3.00 Lakhs
249. **The Heat Source for Ultrahigh-Temperature Lower Crust, a Case Study on Central Madurai Bloc, Southern India to Test the Available Models :** Sajeew Kirishnan CSIR, 10/1/2013 to 9/30/2016, 6.50 Lakhs
250. **Paleo-Temperature Determination using Elemental Concentration Ratios and Non-Traditional Stable Isotopes (Ca, Sr and Clumped Isotope Systematics):** Dr. Ramananda Chakrabarti DSTO, 10/23/2013 to 10/22/2016, 26.90 Lakhs
251. **High Temperature Lower Crust of East Central Gondwana: Emphasis to Southern Indian and Sri Lankan Geology-Indo-Srilankan Project :** Sajeew Kirishnan DSTO, 1/1/2014 to 12/31/2016, 18.75 Lakhs
252. **Mechanical Strength of the Nilgiri and Billigirirangan Hills in the Southern Granulite Terrain and Its Correlation with Tecto-Magmatic Processes:** Sajeew Kirishnan KSTE, 2/21/2014 to 2/20/2016, 1.00 Lakhs

#### Centre for Excellence in Hypersonics

# Projects = 9

Value : 2010.12 Lakhs

253. **Establishment of a Research Centre Centre of Excellence in High Speed Aerodynamics:** G. Jagadeesh DRDO, 6/12/2011 to 6/11/2021, 1240.00 Lakhs
254. **Establishing the Cfd Process for Design/Analysis of Aerodynamic Configurations in Hypersonic Flows-Sub.Proj of DRDO622 :** N. Balakrishnan DRDO, 4/1/2013 to 6/30/2014, 5.50 Lakhs
255. **Multidisciplinary Optimization of Air Breathing Hypersonic Vehicles - Sub. Proj of DRDO622 :** S N Omkar DRDO, 4/1/2013 to 3/31/2015, 21.33 Lakhs
256. **Design of Hypersonic Waveriders - Subproj of DRDO622 :** G. Jagadeesh DRDO, 4/1/2013 to 6/30/2014, 32.00 Lakhs
257. **Establishing Fem Process for Design/Analysis of Air Breathing Hypersonic Vehicles - Sub.Proj. of DRDO622 :** Debiprosad Roy Mahapatra DRDO, 4/1/2013 to 6/30/2014, 40.84 Lakhs
258. **Flame Stabilization And Blowoff Mechanism in Ramjet and Scramjet Relevant Steady and Intermittently Unsteady High Speed Flows :** Swetaprovo Chaudhuri DRDO, 9/1/2013 to 12/31/2014, 95.45 Lakhs
259. **Study of Mach 8.0 Flow in the Newly Established 0.5m Hypersonic Wind Tunnel - ( Sub-Proj of DRDO622):** B Vasudevan DRDO, 2/1/2014 to 1/31/2015, 10.00 Lakhs
260. **Establishment of Design Hub Dedicated to Hypersonic Technology Development ( Sub-Project-DRDO622) :** G. Jagadeesh DRDO, 2/1/2014 to 1/31/2016, 265.00 Lakhs







261. **Aerothermodynamic Testing of Generic Hypersonic Configurations – Sub-Proj of DRDO622** : K P J Reddy DRDO, 2/1/2014 to 1/31/2016, 300.00 Lakhs

#### Centre for Nano Science and Engineering

# Projects = 20

Value : 6159.96 Lakhs

262. **Development of Surface Micromachined Mems Vibratory Gyroscopes** : Rudra Pratap NPMA, 12/23/2008 to 12/31/2014, 86.23 Lakhs
263. **Software Development and Scientific Computing for Micro and Nano Engineering (Parc#3:9)** : Anantha Suresh G K NPMA, 8/11/2009 to 7/31/2014, 312.28 Lakhs
264. **Materials and Mechanical Characterization Facility for Microsystems** : Rudra Pratap NPMA, 10/8/2009 to 3/31/2014, 782.67 Lakhs
265. **Propeller Shaped Nano-Particles and Nano-Structured Surfaces for Applications in Biotechnology** : Ambarish Ghosh DBTO, 5/21/2010 to 5/20/2014, 146.79 Lakhs
266. **Transistor Embedded Sensor Technology Platform** : Navakant Bhatt DAEO, 1/25/2011 to 3/31/2015, 82.08 Lakhs
267. **Unit on Nanoscience At the Indian Institute of Science, Bangalore (Nanoscale Hybrid Assemblies: An Integrated Approach to Probing Nanoscale Phenomena: S Sampath** DSTO, 3/31/2011 to 3/30/2016, 905.45 Lakhs.
268. **Optical Investigation of Nano-Structured 3d Plasmonic Crystals** : Ambarish Ghosh ISTC, 4/1/2011 to 3/31/2014, 10.35 Lakhs
269. **Centres of Excellence of Nanoelectronics - Phase II** : Navakant Bhatt MITO, 1/1/2012 to 12/31/2016, 1939.59 Lakhs
270. **Physics and Technology of Nano Assemblies** : P.S.Anil Kumar DSTO, 1/3/2012 to 1/2/2017, 1238.62 Lakhs
271. **Design, Development, Fabrication, Packaging, Qualification Testing of Pressure Sensors for Aerospace Applications** : Rudra Pratap NPMA, 5/18/2012 to 12/31/2014, 222.00 Lakhs
272. **Mass Spectrometry using Carbon Nano Tubes - Proj #-1.26** : Akshay Naik NPMA, 12/19/2012 to 12/18/2014, 39.05 Lakhs
273. **Thermodynamic Analysis for the Deposition of Oxides,Nitrides,Oxy-Nitrides and Suphides**: Sukanya Dhar DSTO, 1/2/2013 to 1/1/2016, 18.90 Lakhs
274. **Cense-Industry Affiliate Program: Chairman** IISC, 6/5/2013 to 6/5/2018, 24.00 Lakhs
275. **Compact Instrument for High-Resolution Refractive Index Measurements using Diffractive Microstructured Thin Film Interferometers**: Manoj Varma DSTO, 9/18/2013 to 9/17/2015, 25.37 Lakhs
276. **Frequency Stability of Graphene Based Nanoelectromechanical Devices**: Akshay Naik DSTO, 10/18/2013 to 10/17/2016, 22.44 Lakhs

277. **Characterization Facility Operation for Npmass Projects** : Rudra Pratap NPMA, 1/1/2014 to 12/31/2014, 15.00 Lakhs

278. **Particle/Cell Counting and Characterization on a Droplet Based Microfluidic Platform**: Prosenjit Sen DSTO, 1/10/2014 to 1/9/2017, 42.43 Lakhs

279. **Indian Nanoelectronics Users Programme (Inup) - Phase II** : Navakant Bhatt MITO, 3/1/2014 to 2/28/2019, 37.01 Lakhs

280. **Investigation of Interactions and Excitations of Charge Carriers in Two Novel Quantum Fluid Systems**: Ambarish Ghosh DSTO, 3/18/2014 to 3/17/2017, 59.70 Lakhs

281. **Design Development, Fabrication, Packaging and Qualification Testing of Pressure Sensors for Aerospace Applications for Ada**: Rudra Pratap NPMA, 3/21/2014 to 3/20/2015, 150.00 Lakhs

#### Centre for High Energy Physics

# Projects = 3 Value : 373.88 Lakhs

282. **J.C.Bose Fellowship to Prof.Rohini M Godbole** : R M Godbole DSTO, 9/1/2008 to 8/31/2018, 124.90 Lakhs

283. **J.C. Bose Fellowship to Prof. Diptiman Sen** : Diptiman Sen DSTO, 2/23/2011 to 2/22/2016, 68.00 Lakhs

284. **Advanced Centre for Applications of Quantum Field Theory** : B.Ananthanarayan DSTO, 1/10/2012 to 1/9/2017, 180.98 Lakhs

#### Centre for Infectious Disease Research

# Projects = 2 Value : 287.13 Lakhs

285. **Innate Predictors of Adaptive Bcg and Hbv Vaccine-Induce Responses in Bangalore Adolescents** : Dr.Annapurna Vyakarnam DBTO, 10/22/2013 to 10/21/2015, 102.98 Lakhs

286. **Programme Support for Research in Hiv-Tb Co-Infection - Biomarker Discovery and Validation of Blood Immune Responses Following Hiv-Tb Co-Infection** : Dr.Annapurna Vyakarnam DBTO, 10/28/2013 to 10/27/2016, 184.15 Lakhs

#### Inorganic & Physical Chemistry

# Projects = 33

Value : 2702.57 Lakhs

287. **Precision Chemical Engineering** : S Sampath BCOO, 4/10/2007 to 12/31/2015, 1.30 Lakhs

288. **Sub Project of DSTO809** : a R Chakravarthy DSTO, 7/8/2008 to 3/31/2014, 22.00 lakhs

289. **Metal Complexes as Structure Breakers of Biomolecules: Quest for Metal-Based Drugs in Cancer Therapy.** : A G Samuelson DSTO, 7/8/2008 to 3/31/2014, 519.16 Lakhs

290. **J.C. Bose Fellowship to Prof. K.L. Sebastian**: K L Sebastian DSTO, 9/1/2008 to 8/31/2018, 56.90 Lakhs







291. **J.C. Bose Fellowship to Prof. A.R. Chakravarty Dept. of I.P.C. : a R Chakravarty** DSTO, 9/1/2008 to 8/31/2018, 70.50 Lakhs
292. **J.C. Bose Fellowship to Dr.S. Umapathy** : S Umapathy DSTO, 8/4/2010 to 8/3/2015, 68.00 Lakhs
293. **Programme Support for Research in Biophotonics and Biomedical Instrumentation:** S Umapathy DBTO, 9/17/2010 to 9/16/2015, 668.22 Lakhs
294. **Development of Novel Raman Spectroscopic Techniques Like Sers and Sors for Detection of Explosives:** S Umapathy ARBO, 1/24/2011 to 7/23/2014, 297.27 Lakhs
295. **Novel Diboracycle as a Chemosensor for Anions:** P Thilagar CSIR, 5/1/2011 to 3/31/2014, 18.25 Lakhs
296. **Development of Selenazole Drugs as a Novel Class of Anti-Cancer Agents Targeting the Immune Regulator Enzyme Indoleamine2,3-Dioxygenase:** G Mugesh DBTO, 6/10/2011 to 12/9/2014, 105.66 Lakhs
297. **Organic and Organic-Inorganic Hybrid Solar Cells: Optimization of Materials Properties, Bulk Heterojunction Morphology and Device Efficiencies (Oisc/Largecells):** S Sampath DSTO, 8/24/2011 to 8/23/2014, 157.86 Lakhs
298. **J.C. Bose Fellowship to Dr.S. Ramakrishnan :** S Ramakrishnan DSTO, 10/10/2011 to 10/9/2016, 68.00 Lakhs
299. **Astrazeneca Excellence in Chemistry Award for the Year 2011 to Dr. G. Mugesh :** G Mugesh AZIP, 3/1/2012 to 7/31/2014, 25.05 Lakhs
300. **Peptide Aggregation in Neurodegenerative Diseases: Metal Mediated Tyrosine and Histidine Modifications in Amyloid B-Peptides. :** G Mugesh DSTO, 3/8/2012 to 3/7/2015, 53.67 Lakhs
301. **Inspire Faculty Award to Dr. Bhalamurugan Sivaraman (IFA-11ch-11) :** Bhalamurugan Sivaraman DSTO, 3/14/2012 to 3/13/2017, 21.20 Lakhs
302. **Ferrocene-Conjugated Complexes as Photo Chemotherapeutic Agents :** a R Chakravathy CSIR, 4/1/2012 to 3/31/2015, 12.14 Lakhs
303. **Organic and Metal-Organic Hybrid Assemblies for Sensing, :** Partha Sarathi Mukherjee ISTC, 4/1/2012 to 3/31/2015, 13.23 Lakhs
304. **Conformational Control in Macromolecules:** S Ramakrishnan DSTO, 2/7/2013 to 2/6/2016, 54.56 Lakhs
305. **Rate Capability Behaviour of Li1.2 Ni0.13mn0.54fe0.13o2 :** Munichandraiah RNTB, 2/13/2013 to 8/31/2014, 10.72 Lakhs
306. **Project No.4905-1-Kinetics and Spectroscopy in Extreme Environments : Applications to Astrophysics and Astrochemistry :** E. Arunan IFCP, 3/1/2013 to 2/29/2016, 22.65 Lakhs
307. **Biocompatible Metal Carbonyl Complexes as Probes for Cell Imaging by Ir and Raman Microspectroscopy:** Dr. M. Velayudham DSTO, 3/18/2013 to 3/17/2016, 3.50 Lakhs
308. **Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors:** Munichandraiah DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs
309. **Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors:** S Sampath DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs
310. **Laboratory Low Temperature Astrochemistry:** Dr.B.Sivaram ISTC, 4/1/2013 to 3/31/2014, 16.68 Lakhs
311. **Electrochemical Investigations on Graphene and Lithium Phthalocyanine as Catalysts for Reversible Oxygen Reduction Reaction in Li-O2 Cells:** Munichandraiah AOAD, 4/25/2013 to 4/24/2015, 27.82 lakhs
312. **J.C. Bose Fellowship to Dr. E.D. Jemmis:** E D Jemmis DSTO, 7/1/2013 to 6/30/2016, 15.00 Lakhs
313. **Triarylborane Conjugates of Polyarylimides: Opto-Electronic Materials and Anion(F-/Cn) Sensing :** P Thilagar DSTO, 7/16/2013 to 7/15/2017, 37.50 Lakhs
314. **Organic Materials as Electrodes for Li-Ion Batteries:** S Sampath AOAD, 8/1/2013 to 7/31/2015, 53.25 Lakhs
315. **Molecular Architectures Towards Sensors and Molecular Vessels for Catalytic Reactions in Their Confined Nanospace-Swarnajayanthi Fellowship :** Partha Sarathi Mukherjee DSTO, 10/17/2013 to 10/16/2018, 216.35 Lakhs
316. **Gas Phase Infrared Spectroscopy of Aromatic Hydrocarbons:** P K Das CSIR, 11/1/2013 to 3/31/2016, 10.25 Lakhs
317. **Synthesis of Colloids of Monodisperse Lanthanide Element Nanoparticles by the Solvated Metal Atom Dispersion Method:** Balaji Rao Jagirdar CSIR, 11/1/2013 to 3/31/2016, 11.25 Lakhs
318. **Synthesis of Luminescent Supramolecular Metal-Organic Frameworks for Sensing of Nitroaromatic Explosives:** Dr.Nidhi Goel DSTO, 11/20/2013 to 11/19/2016, 25.00 Lakhs
319. **Exploitation of Carbon Nanostructure-Organic Supramolecular Electrodes for Lithium-Ion Batteries:** S Sampath DSTO, 1/1/2014 to 12/31/2015, 13.64 Lakhs
- Centre for Infrastructure Transportation & Urban Planning**
- # Project = 3                      Value : 866.91 Lakhs
320. **Centre for Infrastructure Transportation and Urban Planning:** J M Chandra Kishen CIST, 10/1/2009 to 9/30/2019, 847.18 Lakhs
321. **The Impact of Special Parameters on Ghg Emission: a Comparative Study Between Cities in China & India:** T V Ramachandra TUMO, 3/31/2011 to 9/30/2015, 9.80 Lakhs
322. **Future Proof Design of Transportation Systems-Optimisation of Ksrct/Bmtc Bus Schedules Under Uncertain Demands:** T G Sitharam HSMI, 3/15/2013 to 3/14/2015, 9.93 Lakhs



## Materials Research Centre

# Projects = 17

Value : 2475.94 Lakhs

323. **The Operating Expenses for Parc #1 – (R&D) :** S B Krupanidhi NPMA, 7/24/2008 to 3/31/2015, 10.45 Lakhs
324. **Algan/Gan High Electron Mobility Transistors: Material and Device Development (Project: Balram) :** Srinivasan Raghavan SPLO, 2/6/2009 to 7/8/2014, 377.41 Lakhs
325. **J.C. Bose Fellowship to Prof. S.B. Krupanidhi:** S B Krupanidhi DSTO, 3/1/2009 to 2/28/2019, 130.20 Lakhs
326. **III/V Compound Semiconductor Based Quantum Dots Technology:** S B Krupanidhi MITO, 4/10/2010 to 4/9/2015, 845.99 Lakhs
327. **Interfacial Engineering in Nanostructures and Hybrids for Energy Harvesting Applications - (Swarnajayanthi Fellowship):** N Ravishankar DSTO, 1/11/2011 to 1/10/2016, 304.30 Lakhs
328. **Modelling and Experimental Investigation on Influence of Electric Field on in Vitro Cell-Materials Interaction and Subsequent Osseointegration in Vivo:** Bikramjit Basu DSTO, 7/28/2011 to 7/27/2014, 31.00 Lakhs
329. **Nanoscale Heterostructures for Catalysis and Photovoltaic Applications:** N Ravishankar DSTO, 9/22/2011 to 9/21/2014, 30.90 Lakhs
330. **Computational Design of Magnetic Shape Memory Alloys:** Abhishek Kumar Singh NPMA, 11/17/2011 to 8/31/2014, 62.91 Lakhs
331. **Design of Metallacarborane Based Mofs for Room Temperature Hydrogen Storage:** Abhishek Kumar Singh DAEO, 12/13/2011 to 3/31/2014, 19.14 Lakhs
332. **Fabrication of Designed Biomaterials with Gradient/Uniform Porosity using 3d Printing Route and Their in Vitro and in Vivo Biocompatibility Evaluation:** Bikramjit Basu DBTO, 3/5/2012 to 3/4/2015, 21.80 Lakhs
333. **Inspire Faculty Award to Dr.Tiju Thomas (Ifa-Ph-07):** Tiju Thomas DSTO, 4/16/2012 to 4/15/2017, 21.20 Lakhs
334. **Ligand Engineering for the Surface Modification of Molecular Scale Au Nanowires for Biomedical Applications:** N Ravishankar DSTO, 4/30/2012 to 4/29/2015, 2.00 Lakhs
335. **Design of Carbon-Based Artificial Setfor Si Anode for High Performance Li-Ion Battery:** Abhishek Kumar Singh KIST, 10/1/2012 to 12/31/2014, 27.19 Lakhs
336. **Dynamical Approach to Instabilities in Plastic Deformation: Radiation Induced Effects, Shearing of Precipitates and Other Plastic Instabilities:** G Ananthakrishna DAEO, 10/10/2012 to 3/31/2015, 28.72 Lakhs
337. **Dynamic Approach to Instabilities in Plastic Deformation: Radiation Induced Effects, Shearing of Precipitates and Other Plastic Instabilities:** G Ananthakrishna DAEO, 10/10/2012 to 3/31/2015, 30.52 Lakhs
338. **Designed Biomaterial Devices for Limb Salvage Implant for Distal Femur, Proximal Tibia and Proximal Femur:** Bikramjit Basu DSTO, 5/17/2013 to 5/16/2015, 76.82 Lakhs

339. **A Central X-Ray Diffraction facility For (I) Temperature Induced Study of Materials and (II) Characterization of Thin Films:** a M Umarji DSTO, 1/7/2014 to 1/6/2019, 455.40 Lakhs

## Organic Chemistry

# Projects = 11

Value : 465.02 Lakhs

340. **J.C.Bose Fellowship to Prof.Uday Maitra:** Uday Maitra DSTO, 9/1/2008 to 8/31/2018, 68.10 Lakhs
341. **J.C.Bose Fellowship to Prof.Santanu Bhattacharya:** Santhanu Bhattacharya DSTO, 9/1/2008 to 8/31/2018, 71.33 Lakhs
342. **Compaction of Dna/Sirna with Novel Gemeini Lipids: Transaction Formulations for Use in Gene Therapy:** Santhanu Bhattacharya DSTO, 7/1/2010 to 6/30/2014, 41.27 Lakhs
343. **Transition Metal Catalyzed Reactions (Chiral & Achiral) : Design, Synthesis & Applications in Organic Synthesis:** Prabhu K R CSIR, 10/1/2010 to 3/31/2014, 24.88 Lakhs
344. **Smart Bombing of Cancer Stem Cells using Aptamer-Guided Nanoliposomal S/Rna:** Santhanu Bhattacharya DSTO, 4/21/2011 to 4/20/2014, 77.54 Lakhs
345. **Development of Catalytic Enantioselective Transformations Based on Chiral Counteranion Directed Asymmetric Induction:** Santanu Mukherjee CSIR, 5/1/2011 to 3/31/2014, 26.45 Lakhs
346. **Synthesis and Applications of Mesoporous Materials:** Divya Jyothi DSTO, 9/7/2011 to 9/6/2014, 22.40 Lakhs
347. **Biomimetic Self-Assembly of Functional Materials Via the Gel Route:** Uday Maitra DSTO, 7/12/2012 to 7/11/2015, 83.00
348. **Project No.4805-1 – Supra-Molecular Approach to Composite Materials for Advanced Technologies:** Uday Maitra IFCP, 1/1/2013 to 12/31/2015, 19.44 Lakhs
349. **J.C.Bose Fellowship to Dr.Tushar Kanti Chakraborty:** Dr.T.K.Chakraborty DSTO, 1/2/2014 to 1/1/2018, 1.90 Lakhs
350. **Advanced Drug Delivery System:** Santhanu Bhattacharya CSIR, 1/31/2014 to 1/30/2015, 28.72 Lakhs

## NMR Research Centre

# Projects = 8 Value : 1584.79 Lakhs

351. **Study of Structure and Dynamics of Biological Systems by Novel Nmr Methods:** K V Ramanathan DSTO, 1/24/2011 to 1/23/2016, 1394.88 Lakhs
352. **Structure-Based Design of Malaria Vaccines: Application to the Intrinsically Disordered Antigen Msp2:** H.S. Atreya DBTO, 6/10/2011 to 6/9/2014, 48.30 Lakhs
353. **Peptide Conformations: Solid State Nmr Study At Natural Abundance :** S Raghothama CSIR, 1/1/2012 to 1/31/2015, 21.39 Lakhs



354. **Novel Nmr Methods for Structural Studies of Large Proteins in Solution:** H.S. Atreya DAEO, 4/1/2012 to 3/31/2015, 15.24 Lakhs
355. **Structural Investigations of Amyloid Peptide Fragments Implicated in Alzheimer's Disease:** S Raghothama DSTO, 7/16/2012 to 7/15/2015, 23.95 Lakhs
356. **Exploring New and Weak Aligning Media for the Enantiodiscrimination of Water Soluble Chiral Molecules and Determination of Rdc's for Structure Refinement:** N Suryaprakash DSTO, 7/24/2012 to 7/23/2015, 45.00 Lakhs
357. **Exploring New Resolving Agents for Unraveling Constitutional Isomers and Complex Mixtures by Matrix Assisted Diffusion Ordered Spectroscopy:** N Suryaprakash DAEO, 5/9/2013 to 3/31/2016, 17.03 Lakhs
358. **Inspire Faculty Award to Dr. Kousik Chandra (Ifa13-Ch-106):** Dr.Kousik Chandra DSTO, 1/20/2014 to 1/19/2019, 19.00 Lakhs

#### Solid State & Structural Chemistry Unit

# Projects = 46

Value : 5735.75 Lakhs

359. **Award of J.C. Bose Fellowship:** Biman Bagchi DSTO, 6/1/2006 to 5/31/2016, 115.55 lakhs
360. **Award of J.C. Bose Fellowship:** S Ramasesha DSTO, 7/1/2006 to 6/30/2016, 118.60 Lakhs
361. **Award of J.C. Bose Fellowship:** D D Sarma DSTO, 12/1/2008 to 5/3/2016, 92.72 Lakhs
362. **Local Structure, Function and the Exotic Properties of Transition Metal Pervoskites:** D D Sarma DSTO, 3/31/2009 to 9/30/2014, 17.67 Lakhs
363. **J.C. Bose Fellowship to Prof. Desiraju:** G R Desiraju DSTO, 5/15/2009 to 5/14/2016, 65.46 Lakhs
364. **Stint Workshop:** D D Sarma UUOO, 1/20/2010 to 7/19/2014, 29.20 Lakhs
365. **Polymer Microcapsules for Drug Delivery:** Satish Patil DRDO, 3/11/2010 to 3/10/2015, 48.37 Lakhs
366. **Dynamics of Correlated Electron Systems:** D D Sarma VTSK, 6/1/2010 to 12/31/2016, 4.05 Lakhs
367. **New Materials for Energy Applications:** Srinivasan Natarajan DSTO, 8/10/2010 to 7/7/2014, 36.39 Lakhs
368. **Indo-Italian Beamline At Elettra Synchrotron Radiation Source Trieste, Italy:** D D Sarma DSTO, 10/1/2010 to 9/30/2015, 2353.50 Lakhs
369. **J.C. Bose Fellowship to Prof. T.N. Guru Row:** T N Guru Row DSTO, 2/23/2011 to 2/22/2016, 63.00 Lakhs
370. **Synthesis, Structure and Properties of Inorganic-Organic Hybrid Compounds:** Srinivasan Natarajan CSIR, 7/14/2011 to 3/31/2014, 9.14 Lakhs
371. **Award of Ramanna Fellowship to Prof. S. Yashonath:** S Yashonath DSTO, 8/19/2011 to 8/18/2014, 34.80 Lakhs
372. **Novel Conjugated Polymers for Solar Cells :** Satish Patil DSTO, 8/19/2011 to 8/18/2014, 39.46 Lakhs
373. **Organic Flourine, a Copious Reserve for Futuristic Materials:** T N Guru Row DSTO, 3/16/2012 to 3/15/2015, 14.07 Lakhs
374. **Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors:** A K Shukla DSTO, 3/28/2012 to 3/27/2015, 625.06 Lakhs
375. **Utilizing Ionic Liquid Electrolytes to Synthesize Polymer Electrolytes for Lithium- Ion Batteries:** Aninda Jiban Bhattacharyya ISTC, 4/1/2012 to 3/31/2015, 21.94 Lakhs
376. **Electronic Origin of Cr Poisoning in Ceramic Fuel Cell Cathodes:** D D Sarma DSTO, 4/30/2012 to 4/29/2015, 18.24 Lakhs
377. **Study of Nucleation and Growth during Phase Transformation in Condensed Matter:** Biman Bagchi DSTO, 7/5/2012 to 7/4/2015, 54.96 Lakhs
378. **International Year of Crystallography - Iycr2014 :** G R Desiraju IUCR, 7/30/2012 to 7/29/2014, 2.97 Lakhs
379. **Facile Synthesis and Physical Properties Study of ZnO Nanostructures and Their Graphene Nanocomposites for Solar Cell Application:** Dr.Bharati Panigrahy DSTO, 8/9/2012 to 8/8/2015, 6.50 Lakhs
380. **Access to the Beamlines of the Elettra Synchrotron Light Laboratory by the Indian Institutions:** D D Sarma DSTO, 8/14/2012 to 8/13/2015, 87.20 Lakhs
381. **Rational Control of Functional Oxides:** D D Sarma IUSF, 8/23/2012 to 8/22/2014, 18.91 Lakhs
382. **High Anisotropy Molecular Magnets : Synthesis and Modelling:** S Ramasesha IFCP, 9/1/2012 to 8/31/2015, 28.74 Lakhs
383. **Development of Nanopillar-Based Photovoltaic Cells-Process Development to Deposit Thin Films of High Quality Cdte and Cds.:** T N Guru Row DSTO, 9/11/2012 to 9/10/2014, 34.53 Lakhs
384. **Thematic Unit of Excellence on Computational Material Science:** D D Sarma DSTO, 9/14/2012 to 9/13/2017, 1207.26 Lakhs
385. **Development of Nanostructured Semiconductor Nanocrystals for Quantum Dot Sensitized Solar Cells (Qdscs) and Dye-Sensitized Solar Cells (Dsscs):** Aninda Jiban Bhattacharyya CSIR, 11/1/2012 to 10/31/2014, 9.16 Lakhs
386. **Crystal Engineering Studies on Supramolecular Synthon Hierarchy in Cocrystals:Halogen Bond Vs Halogen... Halogen Interaction:** Dr. Rajput Lalit Kumar DSTO, 1/21/2013 to 1/20/2016, 6.73 Lakhs
387. **Inspire Faculty Award for Dr.Chilukoti Srilakshmi:** Dr.Chilukoti Srilakshmi DSTO, 2/1/2013 to 1/31/2018, 35.92 Lakhs
388. **Inspire Faculty Award to Dr. Bharati Panigrahy (Ifa-Eng-20):** Dr. Bharati Panigrahy DSTO, 3/1/2013 to 2/28/2018, 23.25 Lakhs
389. **Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors:** Aninda Jiban Bhattacharyya DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs
390. **Synthesis and Electro-Optical Studies of Core/Shell Semiconductor Nanocrystals for Energy Applications:** Prof. Anshu Pandey ISTC, 4/1/2013 to 3/31/2016, 12.37 Lakhs







391. **Experimental Investigation of Interaction of Carbon Fiber and Carbon Carbon Composites with High Enthalpy Test Gases in a Shock Tube:** V Jayaram JATP, 4/1/2013 to 3/31/2015, 4.68 Lakhs
392. **Inspire Faculty Award to Dr.Suman Mandal [Ph-40]:** Dr.Suman Mandal DSTO, 5/16/2013 to 5/15/2018, 19.00 Lakhs
393. **J.C.Bose Fellowship to Prof.Srinivas Natarajan:** Srinivasan Natarajan DSTO, 6/11/2013 to 6/10/2018, 68.00 Lakhs
394. **Synthesis, Structure, Magnetic and Catalytic Behaviour of New Framework Compounds:** Srinivasan Natarajan DSTO, 6/18/2013 to 6/17/2016, 38.55 Lakhs
395. **Computational Study of Interaction of Metalloporphyrins of Au and Ag with Amino Acids and DNA Bases:** Dr. Y. Anusooya Pati DSTO, 6/28/2013 to 6/27/2016, 18.90 Lakhs
396. **Molecular Simulation Studies of Adsorption and Diffusion of Hydrocarbons in Zeolites and Metal Organic Framework:** Dr. Chitra Rajappa DSTO, 6/28/2013 to 6/27/2016, 18.90 Lakhs
397. **Development of Advanced Multifunctional Materials for Electrochemical Energy Devices:** Aninda Jiban Bhattacharyya DSTO, 7/10/2013 to 7/9/2016, 6.06 Lakhs
398. **Theoretical Studies of the Correlated Electronic Structure of Graphene:** S Ramasesha IUSF, 7/16/2013 to 7/15/2015, 12.65 Lakhs
399. **Ramanujan Fellowship to Dr. Karthik Venkataraman:** Dr. Karthik Venkataraman DSTO, 8/12/2013 to 8/11/2018, 73.00 Lakhs
400. **Charge Density Based Topological Analysis in Co-Crystals: Quantitative Inputs for Better Drug Design:** T N Guru Row DSTO, 9/18/2013 to 9/17/2016, 48.00 Lakhs
401. **Weak Intermolecular Interactions: Consequences in Crystal Packing, Polymorphism and Properties of Organic Small Molecules and Apis:** Dr. Sumy Joseph DSTO, 10/1/2013 to 9/30/2016, 11.50 Lakhs
402. **Development of a Robust, High Performance and Field Ready Rural Lighting Solution using Rapidly Rechargeable Hybrid Ultra Capacitors (Rhuc):** A K Shukla DSTO, 11/1/2013 to 6/30/2015, 78.98 Lakhs
403. **Project on India's Contribution to the International Year of Crystallography:** G R Desiraju DSTO, 1/1/2014 to 12/31/2014, 63.82 Lakhs
404. **Low Temperature, Spatio-Temporal Spectroscopy of Nanocrystals and Multifunctional Nanoassemblies:** D D Sarma DSTO, 3/10/2014 to 3/9/2019, 35.00 Lakhs

#### Centre for Theoretical Studies

# Projects = 3

Value : 204.40 Lakhs

405. **Ramanujan Fellowship:** Sudhir K Vempati DSTO, 11/4/2009 to 11/3/2014, 73.00 Lakhs
406. **Ramanujan Fellowship to Dr. Justin R. David:** Dr. Justin R David DSTO, 12/7/2010 to 12/6/2015, 58.40 Lakhs

407. **Ramajunan Fellowship to Dr. Aninda Sinha:** Aninda Sinha DSTO, 12/7/2010 to 12/6/2015, 73.00 Lakhs

#### Computer Science and Automation

# Projects = 17

Value : 394.16 Lakhs

408. **Ibm Faculty Award 2008:** K V Raghavan IBM, 2/25/2009 to 2/28/2015, 4.00 Lakhs
409. **Ibm Faculty Award 2008 :** K Gopinath IBM, 2/25/2009 to 2/24/2016, 4.00 Lakhs
410. **General Motors:** Y Narahari GMOO, 11/24/2009 to 12/31/2014, 10.00 Lakhs
411. **Ibm Faculty Award - 2009,:** Y Narahari IBM, 2/1/2010 to 12/31/2014, 4.00 Lakhs
412. **Interdisciplinary Centre in Neuroscience At I.I.Sc., (Sub-Project of DSTO-943):** C E Veni Madhavan DSTO, 3/30/2010 to 3/29/2015, 2.50 Lakhs
413. **J.C.Bose Fellowship to Dr.Y.Narahari:** Y Narahari DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs
414. **Ramanujan Fellowship to Dr.Shivani Agarwal:** Shivani Agarwal DSTO, 7/14/2011 to 7/13/2016, 73.00 Lakhs
415. **Research Group Under Impecs on Programme Analysis and Applications:** Y N Srikant DSTO, 8/18/2011 to 8/17/2016, 37.95 Lakhs
416. **Probabilistic Models for Clustering with User Preferences and Side Information:** Chiranjib Bhattacharyya DSTO, 2/15/2012 to 2/14/2015, 32.28 Lakhs
417. **Algorithmic Analysis of Software Compatibility:** Aditya Sunil Kanade DSTO, 2/17/2012 to 2/16/2015, 8.40 Lakhs
418. **Advanced Research in Machine Learning, Game Theory & Optimization:** Shivani Agarwal IUSF, 4/10/2012 to 3/31/2015, 43.48 Lakhs
419. **Financial Inclusion Based Upon Rural Mobiquitous Services Technology Platform - Project No.7115:** C E Veni Madhavan IFCP, 9/1/2012 to 8/31/2015, 24.33 lakhs
420. **Geometry and Topology-Driven Analysis and Visualization of Scalar Fields,:** Vijay Natarajan DSTO, 9/7/2012 to 9/6/2015, , 24.14 Lakhs
421. **Efficient Algorithms for Optimization and Control in Stochastic Systems :** Shalabh Bhatnagar DSTO, 9/7/2012 to 9/6/2015, 27.09 Lakhs
422. **Inspire Faculty Award to Dr. Neeldhara Mishra (Ifa12-Eng-31):** Dr. Neeldhara Mishra DSTO, 3/1/2013 to 2/28/2018, 21.00Lakhs
423. **Real- Time Scheduling Schemes for Multicore Operating Systems :** R C Hansdah JATP, 4/1/2013 to 3/31/2015, 5.00 Lakhs
424. **Parallelizing Compiler and Runtime Technology for Hybrid Multicore System :** Uday Kumar Reddy B CDAC, 6/1/2013 to 6/30/2014, 5.00 Lakhs

#### Electrical Communication Engineering

# Projects = 24

Value : 1451.13 Lakhs

425. **Microelectronics & Vlsi Research:** Navakant Bhatt EDNO, 12/5/2006 to 3/31/2015, 4.56 Lakhs







426. **IBM Faculty Award:** Navakant Bhatt IBMC, 7/6/2007 to 3/31/2015, 3.50 Lakhs
427. **Infra Structure & Human Resource Development - Parc #2:** Navakant Bhatt NPMA, 7/1/2008 to 3/31/2015, 34.00 Lakhs
428. **Upgrading Facilities for Mems Design Activities at National Resource Centres:** K J Vinoy NPMA, 3/31/2009 to 12/31/2014, 54.90 Lakhs
429. **Interdisciplinary Centre in Neuroscience at I.I.Sc. (Sub-Project of DSTO-943):** D Narayana Dutt DSTO, 3/30/2010 to 3/29/2015, 2.50 Lakhs
430. **Development of Spectrally Efficient Communication Link using Large-Mimo Technology (Dea-101)- Sub-Project of DEAL001:** Vinod Sharma DEAL, 9/3/2010 to 11/5/2014, 15.90 Lakhs
431. **Development of Spectrally Efficient Communication Link using Large-Mimo Technology (Dea-101)- Sub-Project of DEAL001:** B Sundar Rajan DEAL, 9/3/2010 to 11/5/2014, 21.50 Lakhs
432. **Development of Spectrally Efficient Communication Link using Large-Mimo Technology (Dea-101):** A Chokalingam DEAL, 9/3/2010 to 11/5/2014, 250.00 Lakhs
433. **J. C. Bose Fellowship to Prof. Anurag Kumar, :** Anurag Kumar DSTO, 2/23/2011 to 2/22/2016, 68.00 Lakhs
434. **The Jed-I Project Challenge:** K V S Hari LIMB, 3/25/2011 to 4/30/2015, 6.49 Lakhs
435. **Secure Multiparty Computation:** Navin Kashyap HEPA, 8/22/2011 to 8/21/2014, 10.00 Lakhs
436. **Network Resource Allocation in the Presence of Strategic Users:** Rajesh Sundaresan DSTO, 10/11/2011 to 10/10/2014, 16.45 Lakhs
437. **Coding for High-Capacity Data Storage Devices:** Navin Kashyap DSTO, 1/24/2012 to 1/23/2015, 20.44 Lakhs
438. **Wireless Sensor Networks for Protecting Wildlife & Humans:** P Vijay Kumar MITO, 7/10/2012 to 7/9/2014, 81.00 Lakhs
439. **Building a Cyber Physical System for Healthcare Applications Over a Managed 6lowpan Network using Wearable Devices - Part I:** Malati Hegde MITO, 11/8/2012 to 11/7/2014, 19.00 Lakhs
440. **India-Uk Advanced Technology Centre (Iu-Atc-Phase 2) of Excellence in Next Generation Networks Systems and Services:** Chandra R Murthy DSTO, 11/9/2012 to 5/9/2015, 15.27 Lakhs
441. **India-Uk Advanced Technology Centre(Iu-Atc-Phase 2) of Excellence in Next Generation Networks Systems and Services:** Neelesh B Mehta DSTO, 11/9/2012 to 5/9/2015, 15.27 Lakhs
442. **India-Uk Advanced Technology Centre (Iu-Atc-Phase 2) of Excellence in Next Generation Networks Systems and Services:** K V S Hari DSTO, 11/9/2012 to 5/9/2015, 19.42 Lakhs
443. **Energy Harvesting Antenna Study :** K J Vinoy BOCO, 3/12/2013 to 12/31/2014, 13.21 Lakhs
444. **Interferometer on a Phone : A Micro-Diffractive Thin Film Interferometer with Cmos Camera Read - Out for Portable Biochem-Sensing :** Manoj Varma JATP, 4/1/2013

to 3/31/2014, 2.00 Lakhs

445. **Technology Verification Via Deployment of a Small-Scale Pir-Based Wireless Sensor :** P Vijay Kumar DRDO, 4/22/2013 to 10/21/2014, 62.47 Lakhs
446. **Tunable Photonic Bandgap Resonators by Applying Mechanical Force :** T. Srinivas DRDO, 5/3/2013 to 5/2/2016, 216.87 Lakhs
447. **Design and Characterization of Cmos Based Millimeter-Wave Components for 60-Ghz Integrated Broadband Transceivers :** Gaurab Banerjee MITO, 10/1/2013 to 9/30/2016, 488.11 Lakhs
448. **Project No. 5100 - Iti- Monte Carlo and Learning Schemes for Network Analytics:** Rajesh Sundaresan IFCP, 3/31/2014 to 3/30/2017, 10.29 Lakhs

#### Electronic Systems Engineering

# Projects = 22

Value : 1529.54 Lakhs

449. **Unity Project:** H S Jamadagni TIPL, 7/11/2006 to 12/31/2014, 31.29 Lakhs
450. **Technology for Conservation:** H S Jamadagni NCFO, 9/13/2006 to 12/31/2014, 38.32 Lakhs
451. **Image Capture Systems for Biomedical Applications:** H S Jamadagni PEIL, 11/1/2006 to 12/31/2014, 6.00 Lakhs
452. **Aerospace Network Research Consortium (Anrc):** H S Jamadagni BOCO, 1/1/2008 to 12/31/2014, 412.84 Lakhs
453. **Non Invasive Cockpit Monitoring- Ref.BOCO1:** H S Jamadagni BOCO, 1/21/2010 to 12/31/2014, 6.86 Lakhs
454. **Power Line Carrier for Data Transfer in Airports- Ref.BOCO01:** H S Jamadagni BOCO, 1/21/2010 to 12/31/2014, 6.86 Lakhs
455. **CEDT - Epfl Joint Programme - 2010:** K Gopakumar EPFO, 5/18/2010 to 5/17/2014, 28.26 Lakhs
456. **Smart Car Racing Competition:** Haresh Dagale FSIP, 9/1/2010 to 8/31/2014, 28.50 Lakhs
457. **Embedded Systems At Cedt,:** H S Jamadagni INTL, 10/14/2010 to 12/31/2014, 30.22 Lakhs
458. **National Hub for Healthcare Instrumentation Development by Anna University:** N S Dinesh AUOO, 7/15/2011 to 7/14/2016, 141.23 Lakhs
459. **Design of a Compliance Monitored Clubfoot Brace for Management of Clubfoot Deformity in Children:** N S Dinesh DSTO, 1/24/2012 to 9/30/2014, 19.89 Lakhs
460. **Ramanna Fellowship to Prof. Santanu Mahapatra:** Santanu Mahapatra DSTO, 3/8/2012 to 3/7/2015, 34.80 Lakhs
461. **Development of Important Functional Modules for Drug Delivery System - Parc # 4.13:** N S Dinesh NPMA, 3/16/2012 to 10/31/2014, 66.50 Lakhs
462. **Design and Development of a Constant Switching Frequency Hysteresis Pwm Controlled Motor Drive for Variable Speed Electric Vehicle Application, with Fast Dynamic Performance:** K Gopakumar CIST, 4/16/2012 to 4/15/2014, 5.00 Lakhs





463. **Eu-India Fostering Cooperation in Computing Systems:** H S Jamadagni EUOO, 4/19/2012 to 4/18/2014, 10.29 Lakhs
464. **Building a Cyber Physical System for Healthcare Applications Over a Managed 6lowpan Network using Wearable Devices - Part II:** Haresh Dagale MITO, 11/8/2012 to 11/7/2014, 17.00 Lakhs
465. **Performance Evaluation Of(Mos)2 Fet Through Novel Device Simulator Development:** Santanu Mahapatra DSTO, 12/27/2012 to 12/26/2015, 28.93 Lakhs
466. **Implementation of Design Clinic Scheme for Design Expertise to Micro, Small & Medium Enterprises:** H S Jamadagni MSME, 3/31/2013 to 7/5/2016, 500.00 Lakhs
467. **Classic and Quantum Low Density Parity Check Codes: Construction and Performance Bounds:** Dr. Shayan G Srinivasa ISTC, 4/1/2013 to 3/31/2016, 20.15 Lakhs
468. **Development of Indigenous Poc Device Micro Channel/ Fluidic Device for Estimation of Lipid Profile in Human Plasma/Serum:** N S Dinesh NPMA, 6/5/2013 to 3/4/2015, 19.00 Lakhs
469. **Timing Recovery Techniques & Architectures for Two-Dimensional Data Storage Channels:** Dr. Shayan G Srinivasa DSTO, 9/18/2013 to 9/17/2016, 35.73 Lakhs
470. **Rfid Based Aircraft Inventory System (Rais):** H S Jamadagni BOCO, 1/1/2014 to 12/31/2015, 41.86 Lakhs

#### Electrical Engineering

# Projects = 13      Value : 1390.78 Lakhs

471. **Interdisciplinary Centre in Neuroscience At I.I.Sc. (This Is a Sub-Project of Dsto-943):** Chandra Sekhar Seelamantula DSTO, 3/30/2010 to 3/29/2015, 2.50 Lakhs
472. **Development of Online Handwriting Recognition System for Indian Language (Ohwr)-Phase II - Deployment of An Application & Improvement of Engine Performance:** A G Ramakrishnan MITO, 5/1/2010 to 4/30/2015, 1057.91 Lakhs
473. **Development of Robust Document Image Understanding System for Documents in Indian Scripts (Ocr) - Phase II:** A G Ramakrishnan MITO, 7/1/2010 to 6/30/2015, 109.25 Lakhs
474. **Video Algorithms Development System. Sub Project of Dst879:** K R Ramakrishnan DSTO, 12/27/2011 to 12/31/2014, 48.05 Lakhs
475. **Development of Text to Speech System in Indian Languages Phase II:** Chandra Sekhar Seelamantula MITO, 2/29/2012 to 2/28/2015, 37.27 Lakhs
476. **Robust and Efficient Signal Processing Techniques for Multicomponent Fm Signal Parameter Estimation:** Chandra Sekhar Seelamantula ISTC, 4/1/2012 to 3/31/2015, 13.09 Lakhs
477. **Development of Off Line & Real Time Simulator for Electric Vehicle/ Hybrid Electric Vehicle Systems:** G Narayanan. DHIO, 10/12/2012 to 10/11/2015, 9.55 Lakhs

478. **Inspire Faculty Award to Dr. Prasanta Kumar Ghosh (Ifa-Eng-18):** Dr. Prasanta Kumar Ghosh DSTO, 12/18/2012 to 12/17/2017, 35.92 Lakhs
479. **Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors:** Vinod John DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs
480. **Development and Deployment of Fss Miniature Models in Educational Institutes:** G Narayanan. CDAC, 5/17/2013 to 5/16/2016, 13.93 Lakhs
481. **Development of Low-Cost Photoacoustic Imaging System for the Noninvasive Identification of Sentinel Lymph Node during Breast Cancer Staging:** Dr. Manojit Pramanik DAEO, 5/21/2013 to 3/31/2016, 16.84 Lakhs
482. **Separation of Biosignals Sensors in Medical Applications – Gift Donation:** Chandra Sekhar Seelamantula HEPA, 7/24/2013 to 7/23/2014, 5.87 Lakhs
483. **Photoacoustic Imaging with Clinical Ultrasound System:** Dr. Manojit Pramanik DSTO, 8/1/2013 to 7/31/2016, 37.60 Lakhs

#### Supercomputer Education & Research Centre

# Projects = 29      Value : 4385.23 Lakhs

484. **Enabling Technology for Future High Performance Computing Applications in India:** R Govindarajan INTL, 1/1/2005 to 3/31/2015, 21.70 Lakhs
485. **Research in Information Science:** N Balakrishnan MSCI, 3/1/2005 to 12/31/2015, 25.66 Lakhs
486. **Information Security Education and Awareness (Isea) Project:** N Balakrishnan MITO, 3/16/2007 to 3/31/2014, 569.14 Lakhs
487. **J.C.Bose Fellowship to Prof. N. Balakrishnan:** N Balakrishnan DSTO, 5/1/2007 to 4/30/2017, 121.10 Lakhs
488. **National Telecom Test Bed:** N Balakrishnan MITO, 8/1/2007 to 3/31/2015, 2150.00 Lakhs
489. **High Attitude Programme:** N Balakrishnan DSTO, 10/23/2008 to 3/31/2014, 40.00 Lakhs
490. **IBM Faculty Award 2008:** R Govindarajan IBMC, 2/25/2009 to 3/31/2017, 4.00 Lakhs
491. **Creation of a Centre for Strategic Initiatives Under Security Technology Initiatives at IISC:** N Balakrishnan DSTO, 5/11/2009 to 3/31/2015, 696.30 Lakhs
492. **High Performance Computing Research in India:** R Govindarajan AITP, 2/26/2010 to 3/31/2015, 2.29 Lakhs
493. **Compiling Open Cl for Amd Platforms:** R Govindarajan AMDO, 5/1/2010 to 3/31/2015, 43.95 Lakhs
494. **Indian Language to Indian Language Machine Translation System (Lmt) Phase II:** N Balakrishnan MITO, 5/1/2010 to 12/31/2014, 90.48 Lakhs
495. **Tightly Coupling Keyword Query Interfaces with Structured Database Repositories:** Jayanth R Haritsa DSTO, 11/1/2010 to 4/30/2014, 41.66 Lakhs
496. **Complex Networks in Cyber-Security:** N Balakrishnan DSTO, 11/1/2010 to 10/31/2014, 58.24 Lakhs





497. **Development of Novel Algorithms for Three Dimensional Near Infrared Tomographic Imaging of Breast,:** Phaneendra Kumar Yalavarthy DAEO, 1/6/2011 to 3/31/2014, 14.69 Lakhs
498. **Donation for Data Base System Lab @ Serc:** Jayanth R Haritsa IIS, 4/1/2011 to 3/31/2031, 50.41 Lakhs
499. **Face Recognition on a Coarse Grain Reconfigurable Architecture:** S K Nandy DRDO, 9/30/2011 to 9/29/2014, 213.21 Lakhs
500. **Computational Methods for Control of Multiscale Dynamics:** Soumyendu Raha NRBO, 1/11/2012 to 1/10/2015, 24.90 Lakhs
501. **Setting Up Test Bed Facility At Ilsc. Bangalore:** N Balakrishnan MITO, 9/25/2012 to 9/24/2015, 18.00 Lakhs
502. **A Genome Scale Metabolic Reconstruction and Flux Balance Analysis of Bifidobacterium Animalis Strain Longum Bbm68:** Debnath Pal DSTO, 10/20/2012 to 10/19/2015, 21.65 Lakhs
503. **A Robust Middleware for Job Management in Supercomputer Systems:** Sathish S. Vadhiyar DSTO, 12/27/2012 to 12/26/2015, 28.37 Lakhs
504. **Feasibility Study of Method of Moments-Based Analysis and Design of Conformal Phrased Array Antenna Placed on a Stealty Flying Platform:** N Balakrishnan ADAO, 1/9/2013 to 12/31/2014, 7.25 Lakhs
505. **Image Analytics using Feature-Match Technique:** Venkatesh Babu R JATP, 4/1/2013 to 3/31/2015, 5.34 Lakhs
506. **A Framework for Efficient Executions of Irregular Applications on Hybrid Systems:** Sathish S. Vadhiyar CDAC, 6/1/2013 to 6/30/2014, 5.19 Lakhs
507. **Accelerating Diffuse Optical Tomographic Image Reconstruction using Graphics Processing Units and Multicore Architectures (Rgyi):** Phaneendra Kumar Yalavarthy DBTO, 6/3/2013 to 6/2/2016, 18.34 Lakhs
508. **Stability Issues in Computation of Stiff Stochastic Differential Equation Systems:** Soumyendu Raha DSTO, 6/5/2013 to 6/4/2015, 2.95 Lakhs
509. **Development of Novel Computational Methods for Optical Molecular Tomographic Imaging:** Phaneendra Kumar Yalavarthy DBTO, 9/13/2013 to 9/12/2016, 22.26 Lakhs
510. **Modeling of the Processes of Fabrication, Deformation and Fracture of Structures and Materials:** N.K. Gupta DSTO, 11/20/2013 to 11/19/2015, 17.21 Lakhs
511. **Indo-Us Workshop on 'High Performance Computing, Applications and Big Data Analytics during 15-18 Dec' 2013:** N Balakrishnan IUSE, 12/6/2013 to 6/30/2014, , 15.00 Lakhs
512. **Virtualization and Security Aware Multi-Core Architecture:** S K Nandy MITO, 12/20/2013 to 12/19/2015, 55.95 Lakhs
514. **Low Energy Domestic Grey Water Treatment Device for Rural and Peri Urban India:** H N Chanakya DSTO, 3/31/2011 to 12/31/2014, 17.82 Lakhs
515. **Dynamics of Sharks and Migratory Cycle in West Coast of India:** D Sanna Durgappa ISTC, 4/1/2012 to 3/31/2014, 12.13 Lakhs
516. **Assessing Resource and Energy Demand Attributed to Modern Urbanizing Transitions in Rural Dwellings:** Monto Mani CIST, 4/16/2012 to 6/30/2014, 5.32 Lakhs
517. **Evaluation for Improved Management of the Coastal Zone & Its Biodiversity & Participatory Monitoring:** D Sanna Durgappa DSTO, 7/5/2012 to 7/4/2015, 15.00 Lakhs
518. **Climate Change Mitigation and Adaptation in Forest Plantation Sector – An Ecological and Economic Assessment for India:** N H Ravindranath CICE, 9/3/2012 to 9/2/2014, 62.73 Lakhs
519. **Pilot Testing and Design Improvement of Small Biogas Plants for Household Urban Solid Wastes:** H N Chanakya CIST, 4/15/2013 to 4/14/2014, 4.30 Lakhs
520. **Carbon Sequestration Assessment and Population Status of Threatened Mangroves in Bhitarkanika National Park, Odisha, India-Implications for Conservation and Management:** Dr. Sudam Charan Sahu DSTO, 7/2/2013 to 7/1/2016, 20.00 Lakhs
521. **National Project Coordination and Management Rhees-6 Sub Project of DSTO1260:** P. Balachandra DSTO, 9/2/2013 to 9/1/2016, 45.26 Lakhs
522. **Village Level Demonstration of Rhees in South India-Biomethanation and VapRhees-4-Subproject of DSTO1260:** H N Chanakya DSTO, 9/2/2013 to 9/1/2016, 54.57 Lakhs
523. **Village Level Demonstration of Rhees in South India-Biomass GasifierRhees-5 -Subproject of DSTO 1260:** S Dasappa DSTO, 9/2/2013 to 9/1/2016, 120.67 Lakhs
524. **R&D on Small-Scale Biomethanation and Livelihood (Value Added Products) Potential of Rural Residues-Rhees-1 Sub Project of DSTO1260:** H N Chanakya DSTO, 9/2/2013 to 9/1/2016, 126.66 Lakhs
525. **R&D on Biomass Gasifier for Fuel Cell and Village Level Energy Applications-Rhees-2-Subproject of DSTO1260:** S Dasappa DSTO, 9/2/2013 to 9/1/2016, 162.19 Lakhs
526. **Rural Hybrid Energy Enterprise Systems (Rhees):** H N Chanakya DSTO, 9/2/2013 to 9/1/2016, 380.00 Lakhs

#### Instrumentation and Applied Physics

# Projects = 2 Value : 3191.19 Lakhs

#### Centre for Sustainable Technologies

# Projects = 14 Value : 1049.47 Lakhs

513. **Technology & Human Development – a Capability Approach:** Monto Mani DUTO, 1/1/2010 to 12/31/2014, 22.83 Lakhs
527. **Robert Bosch Centre for Research in Cyber Physical Systems:** SAsokan RBCO, 10/10/2011 to 10/9/2021, 3094.40 Lakhs
528. **Agatha-Advanced Grating for Thin Films Solar Cell:** S Asokan DSTO, 12/26/2012 to 12/25/2015, 96.79 Lakhs







## Interdisciplinary Centre for Energy

# Projects = 5 Value : 9578.93 Lakhs

529. **National Centre for Combustion Research & Development:** B N Raghunandan DSTO, 12/13/2011 to 12/12/2016, 3666.40 Lakhs
530. **Solar Power Generation & Research Centre At Challakere Campus:** K Chattopadhyaya GKOO, 8/28/2012 to 8/28/2014, 850.00 Lakhs
531. **Award of Pre-Project Grant - Solar Energy Research Institute for India and Us (Seriis):** K Chattopadhyaya IUSF, 8/28/2012 to 10/31/2017, 5017.53 Lakhs
532. **Inspire Faculty Award to Dr. Sanchita Sengupta (Cg-73):** Dr.Sanchita Sen Gupta DSTO, 7/22/2013 to 7/21/2018, 24.60 Lakhs
533. **Inspire Faculty Award to Dr. Upendra Kumar Pandey (Eng-27):** Dr.Upendra Kumar Pandey DSTO, 10/1/2013 to 9/30/2018, 20.40 Lakhs

## Indo-French Water Science Project

# Projects = 2 Value : 276.32 Lakhs

534. **An Integrated Study of Hydrology and Mineralogy for Assessment of Water Quality and Quantity in Sub-Catchment/Watershed:** M Sekhar IRDO, 3/14/2001 to 12/5/2014, 90.48 Lakhs
535. **Water Science Technology Cell:** M.S. Mohan Kumar IRDO, 3/14/2001 to 12/5/2014, 185.84 Lakhs

## Institute Nanoscience Initiative

# Projects = 1 Value : 189 Lakhs

536. **Creation of a State-Of-The-Art Analytical Electron Microscopy Facility Capable of High Resolution Imaging and Analysis in the Nanoscale as a National Facility At IISC:** K Chattopadhyaya DRDO, 11/3/2006 to 11/30/2014, 189.00 Lakhs

## Kishore Vaigyanik Protsahan Yojana

# Projects = 6 Value : 1491.20 Lakhs

537. **Visit of Indian Team to Participate in the 7th Asian Camp:** P K Das DSTO, 7/1/2013 to 6/30/2014, 19.88 Lakhs
538. **Kishore Vaigyanik Prothsahan Yojana (Kvpy), IISC:** P K Das DSTO, 7/1/2013 to 6/30/2017, 1324.24 Lakhs
539. **KVPY Operations:** P K Das IISC, 8/1/2013 to 7/31/2014, 25.00 Lakhs
540. **Vijoyshi-2013/Science Camp:** P K Das DSTO, 11/1/2013 to 10/31/2014, 52.00 Lakhs
541. **Kishore Vaigyanik Prothsahan Yojana (KVPY) Programme Under St Empowerment Initiative in Fy 2013-14:** P K Das DSTO, 1/3/2014 to 1/2/2015, 19.04 Lakhs
542. **Kishore Vaigyanik Prothsahan Yojana (KVPY) Programme Under Sc Empowerment Initiative in Fy 2013-14:** P K Das DSTO, 1/3/2014 to 1/2/2015, 51.04 Lakhs

## Aerospace Engineering

# Projects = 49 Value : 4666.48 Lakhs

543. **Joint Initiatives in Information Sciences(Jiis):** N Balakrishnan DRDO, 10/1/2001 to 3/31/2015, 330.00 Lakhs
544. **The Operating Expenses - Parc #3:** S Gopalakrishnan NPMA, 7/1/2008 to 3/31/2015, 10.00 Lakhs
545. **Advanced Biomass Research Centre (Abrc):** N K S Rajan MNRE, 3/15/2009 to 3/31/2014, 808.00 Lakhs
546. **Rapid Inspection of Aircraft Components using Laser Doppler Vibrometry and Computational Techniques:** Debiprosad Roy Mahapatra NPMA, 7/28/2009 to 6/30/2014, 427.30 Lakhs
547. **Applications of Biofuels for Aviation:** B N Raghunandan DSTO, 7/12/2010 to 5/30/2014, 12.15 Lakhs
548. **Computational Transonic Flutter Analysis of a Delta Wing:** Kartik Venkatraman ADAO, 12/16/2010 to 6/30/2014, 15.39 Lakhs
549. **Characterization of Fuel Sprays Discharged from Spray Nozzles using Biofuels -Part II:** B N Raghunandan PWCC, 5/31/2011 to 12/31/2014, 15.45 Lakhs
550. **Control Strategies for Guided Collective Motion:** D Ghose AOAD, 6/20/2011 to 10/31/2014, 21.24 Lakhs
551. **Wake Interaction Effects in Turbines & Compressors & Tip Clearance & Leakage Flows:** O.N.Ramesh GTRE, 9/1/2011 to 8/31/2014, 192.20 Lakhs
552. **A Software Framework for Ivhm Based on Fault Injection Across Various Subsystems:** S N Omkar NPMA, 9/27/2011 to 9/30/2014, 80.83 Lakhs
553. **Sample Preparation / Nucleic Acid Extraction from Biological Samples :** Debiprosad Roy Mahapatra BIGT, 10/3/2011 to 10/2/2014, 18.29 Lakhs
554. **Studies on Pulse Detonation Engine:** N K S Rajan JATP, 10/3/2011 to 10/31/2014, 16.00 Lakhs
555. **Piezo-Composite Mav Wing as Integral Structure and Actuators:** Dinesh Kumar Harur Sampath Dsto, 10/13/2011 to 10/12/2015, 76.16 Lakhs
556. **Development and Evaluation of Swarm Control Algorithms for Mavs:** D Ghose DSTO, 10/13/2011 to 10/12/2015, 82.76 Lakhs
557. **'Development of Sma-Composite Based Compliant Variable Area Plane-Forms:** Debiprosad Roy Mahapatra ARDB, 10/28/2011 to 10/27/2014, 18.25 Lakhs
558. **Cfd Analysis of Base Drag Reduction for Missile Configuration :** N. Balakrishnan JATP, 12/1/2011 to 9/30/2014, 9.88 Lakhs
559. **Development of Autonomous Mavs:** M Seetharam Bhat DRDO, 12/15/2011 to 6/14/2015, 263.93 Lakhs
560. **An Experimental & Computational Study of Laminar Separation Bubble Characteristics on a Turbomachinery Blade :** O.N. Ramesh ARDB, 3/1/2012 to 10/31/2014, 17.07 Lakhs







561. **Acecost Ph-Iii - Novel Nde Methods for Porosity & Moisture Content Determination:** M R Bhat ARDB, 3/21/2012 to 3/20/2017, 44.85 Lakhs
562. **Acecost Ph-Iii - Development of Computational Tool for Polymer-Composite Manufacturing Process Modelling & Analysis:** Suhasini Gururaja ARDB, 3/21/2012 to 3/20/2017, 85.18 Lakhs
563. **Acecost Ph-Iii - Development of Nano-Composite Structures with Enhanced Thermo-Mechanical Properties, Damping & Self-Sensing Capabilities:** Debiprosad Roy Mahapatra ARDB, 3/21/2012 to 3/20/2017, 171.83 Lakhs
564. **Experimental Studies of Flow Control using Passive Devices on Scaled Saras & Nm5-100 Models:** J Dey NALQ, 3/30/2012 to 3/31/2014, 35.17 Lakhs
565. **Acceleration Responses At Different Body Segments and Selected Body Orientations to Spacecraft Takeoff and Impact Landing:** S N Omkar ISTC, 4/1/2012 to 3/31/2014, 6.26 Lakhs
566. **Effect of Geometrical and Flow Parameters on Drop Size Distributions for Sprays from Gas-Centered Swirl Coaxial Atomizers:** D.Sivakumar ISTC, 4/1/2012 to 3/31/2014, 10.81 Lakhs
567. **Physics of Machining Advanced Composites:** Suhasini Gururaja ISTC, 4/1/2012 to 3/31/2014, 12.87 Lakhs
568. **Understanding Aeroacoustic Scattering of Supersonic Shrouded Jets:** Arnab Samanta ISTC, 4/1/2012 to 3/31/2015, 19.11 Lakhs
569. **Contamination Monitoring using Mobile Sensor Networks (Cm-Msn):** D Ghose UKIE, 4/1/2012 to 12/31/2014, 7.67 Lakhs
570. **Development of Hydroxyl Ammonium Nitrate (Han) Monopropellant System:** Charlie Oommen ISRO, 4/10/2012 to 4/9/2014, 19.37 Lakhs
571. **Development of Prototype Mpd Thruster:** T S Seshadri ISRO, 4/10/2012 to 4/9/2014, 24.86 Lakhs
572. **Processing of Multiscale Nanocomposites Via Functionalized Nanomaterials Based Scalable Coating Technique:** Suhasini Gururaja ARDB, 5/11/2012 to 5/10/2015, 17.20 Lakhs
573. **Transdisciplinary Shock Wave Research and Application:** G.Jagadeesh DRDO, 8/1/2012 to 7/31/2017, 1396.00 Lakhs
574. **Electro Active Polymer Flapping Wing for Dragon Fly Scale Micro Air Vehicle:** Ranjan Ganguli ARDB, 9/14/2012 to 9/13/2015, 17.98 Lakhs
575. **Aeronautic Analytical and Robot Design Optimization of Small Unmanned Composite Helicopter Rotor:** Ranjan Ganguli ARDB, 11/21/2012 to 11/20/2015, 32.10 Lakhs
576. **Integration of Non-Destructive Evaluation Based Ultrasonic Simulation (In-Deus):** Debiprosad Roy Mahapatra DSTO, 4/1/2013 to 3/31/2016, 132.00 Lakhs
577. **Sensor Intergrated Wireless Mote for Compressed Sensing and Health Monitoring:** Debiprosad Roy Mahapatra ISTC, 4/1/2013 to 3/31/2016, 10.44 Lakhs
578. **Modelling Primary Atomization of Liquid Jets using the Level-Set Method:** Dr.Santosh Hemachandra ISTC, 4/1/2013 to 3/31/2016, 18.42 Lakhs
579. **Vision Based Guidance in Occluded Terrains:** Dr. Ashwini Ratnoo JATP, 4/1/2013 to 3/31/2015, 4.00 Lakhs
580. **Qualitative Assessment of 3d Failure Criteria of Composite Laminae Based on Initiating Failure Mechanisms:** G Narayana Naik JATP, 4/1/2013 to 3/31/2015, 5.00 Lakhs
581. **Understanding Material Removal Mechanisms in Advanced Composites:** Suhasini Gururaja Dsto, 4/10/2013 to 4/9/2016, 28.89 Lakhs
582. **Relaxation to Equilibrium in Complex Turbulent Flows:** O.N. Ramesh JATP, 5/1/2013 to 4/30/2015, 3.00 Lakhs
583. **Evaluation of Armour Materials Subjected to Scaled Blast Loading using Shock Tube :** K P J Reddy DMRL, 6/26/2013 to 2/25/2015, 25.30 Lakhs
584. **Development of Integrated Software Architecture for Enabling Nde Based Shm, Condition Based Maintenance and Logistics:** Debiprosad Roy Mahapatra NPMA, 7/22/2013 to 7/21/2015, 60.00 Lakhs
585. **Consultancy Contract for Development of Tactics Algorithm for Survivability of Own Platform Under Torpedo Attack:** D Ghose NSTL, 9/17/2013 to 9/16/2014, 2.34 Lakhs
586. **Development Studies on Hydroxyl Ammonium Nitrate (Han) Monopropellant Micro Thrusters, Part-I :** Charlie Oommen ARDB, 10/24/2013 to 10/23/2015, 23.72 Lakhs
587. **Inspire Faculty Award to Dr.K.R.Jayaprakash (Ifa13-Eng-51) :** Dr. K.R. Jayaprakash DSTO, 10/31/2013 to 10/30/2018, 19.00 Lakhs
588. **Experimental Characterization of Aerodynamic Loading Aspects of a Scaled Radome on Carrier Aircraft for Surveillance Applications:** J Dey CABS, 11/30/2013 to 6/29/2014, 6.30 Lakhs
589. **Combustion Instability Studies in Solid Rocket Motors:** N K S Rajan DRDL, 12/13/2013 to 12/12/2015, 3.50 Lakhs
590. **AR & DB Aerodynamic Panel Coordinator's Grants:** G. Jagadeesh ARDB, 1/21/2014 to 1/20/2019, 0.74 Lakhs
591. **Wave Propagation Studies Through Multi-Scale Composites for Improved Energy Absorption in Aerospace Structures:** S Gopalakrishnan UKIE, 3/1/2014 to 2/29/2016, 7.69 Lakhs

#### Centre for Atmospheric & Oceanic Sciences

# Projects = 25

Value : 4181.01 Lakhs

592. **Estimation of Aerosol Radiative Forcing:** S.K. Satheesh ISRO, 8/20/2007 to 8/19/2014, 190.60 Lakhs
593. **Divecha Centre for Climate Change:** J Srinivasan GFPE, 1/1/2009 to 12/31/2018, 1995.88 Lakhs
594. **Retrieval of Aerosols Over Land using Multi-Satellite Data:** S.K.Satheesh ISRO, 1/28/2010 to 1/27/2015, 91.00 Lakhs





595. **J.C. Bose Fellowship to Dr.G.S. Bhat:** G S Bhat DSTO, 8/4/2010 to 8/3/2015, 68.00 Lakhs
596. **Monitoring Snow and Glaciers of Himalayan Region-Phase II:** Anil Kulkarni ISRO, 4/1/2011 to 3/31/2015, 20.85 Lakhs
597. **Cloud Microphysics Characteristics and Modelling Over the Indian Region using a Cloud Resolving Model:** Arindam Chakraborty MESO, 8/17/2011 to 8/16/2014, 18.89 Lakhs
598. **Impact of Bay of Bengal Cold Pool on the Seasonal and Intraseasonal Pattern of Rainfall:** Ravi S Nanjundiah MESO, 8/17/2011 to 8/16/2014, 26.76 Lakhs
599. **Development of a Prognostic Cloud Scheme for Global Climate Models:** Arindam Chakraborty MESO, 8/17/2011 to 8/16/2014, 27.75 Lakhs
600. **Underwater Radiation and Chlorophyll Measurements during Ctcz (2011-2012):** P.N.Vinaychandran MESO, 8/17/2011 to 8/16/2014, 34.15 Lakhs
601. **Surface Energy Balance and Atmospheric Structure Over the Ctcz Area : An Observational Study:** G S Bhat MESO, 8/17/2011 to 8/16/2014, 110.25 Lakhs
602. **Proposal for Ctcz Programme Office At the Centre for Atmospheric & Oceanic Sciences, Indian Institute of Science, Bangalore - 560 012:** G S Bhat MESO, 8/17/2011 to 8/16/2014, 141.90 Lakhs
603. **Assessment of Black Carbon Aerosols and Understanding the Influence of on Snow and Glacier Albedo:** J Srinivasan VSSC, 1/5/2012 to 1/4/2015, 148.20 Lakhs
604. **The Advection- Condensation Model and Water Vapour in the Atmosphere:** Jai Suhas Sukhatme ISTC, 4/1/2012 to 3/31/2015, 7.36 Lakhs
605. **Climate Research Facility At Challakere:** S.K. Satheesh LANS, 8/17/2012 to 8/16/2018, 103.65 Lakhs
606. **Climate Research Facility At the IISc Campus in Challakere Under Arfi Project of Isro-Gbp:** S.K. Satheesh ISRO, 12/12/2012 to 12/11/2017, 555.42 Lakhs
607. **Characterization of Atmospheric Boundary Layer (Abl) At Challakere Campus of IISc, Bangalore:** S.K. Satheesh ISRO, 12/27/2012 to 12/26/2015, 58.86 Lakhs
608. **Climate Modelling of Geoengineering:** Govindaswamy Bala DSTO, 3/19/2013 to 3/18/2016, 18.66 Lakhs
609. **Identification and Correction of Errors in Various Components of Dynamics and Physics of the Global Forecast System(Gfs) Model:** Arindam Chakraborty MESO, 3/21/2013 to 3/20/2016, 25.08 Lakhs
610. **Strengthening An Existing Centre of Excellence in Climate Change-Divecha Center for Climate Change:** J Srinivasan DSTO, 3/31/2013 to 3/30/2018, 350.78 Lakhs
611. **Understanding the Fine-Scale Duration Characterization of Tropical Rain Fall:** V Venugopal ISTC, 4/1/2013 to 3/31/2016, 10.95 Lakhs
612. **Demonstration of Renewable Energy Systems:** J Srinivasan MNRE, 4/1/2013 to 3/31/2014, 13.04 Lakhs

613. **Study of Glaciers in the Himalaya using Synthetic Aperture Radar Interferometry:** J Srinivasan DSTO, 5/30/2013 to 5/29/2014, 14.76 Lakhs
614. **Study of Teleconnections and Ocean-Atmosphere Coupling Over Indian Region using Aogcm?:** Ravi S Nanjundiah INCO, 8/1/2013 to 7/31/2017, 54.12 Lakhs
615. **Modeling Physical-Biological Interactions in the Indian Ocean:** P.N. Vinaychandran INCO, 8/1/2013 to 7/31/2017, 81.40 Lakhs
616. **Stochastic Parameterization and Forecasting of Wind Energy in India:** Arindam Chakraborty MESO, 3/1/2014 to 2/28/2017, 12.71 Lakhs

#### Chemical Engineering

# Projects = 20

Value : 857.43 Lakhs

617. **J.C. Bose Fellowship to Dr. V. Kumaran:** V Kumaran DSTO, 4/1/2007 to 12/31/2016, 121.05 Lakhs
618. **Investigation of Protein Nanoparticle Interaction with Supported Bilayer Membranes - (Sub-Project of DST-956):** K Ganapathy Ayappa DSTO, 6/13/2010 to 6/12/2015, 60.02 Lakhs
619. **Solubilities & Adsorption of Pharmaceuticals in Supercritical Carbon Dioxide:** M Giridhar CSIR, 5/1/2011 to 5/31/2014, 6.17 Lakhs
620. **Polymer Nanocomposites : Monolithic Encapsulation of Organic Devices:** M Giridhar DSTO, 8/24/2011 to 8/23/2014, 44.91 Lakhs
621. **Investigations and Development of Technology for Desiccated Coconut Industry Effluent Water Treatment,:** JR Mudakavi CDBO, 11/3/2011 to 10/31/2014, 13.17 Lakhs
622. **Nanoscale Chemoresistive Gas Sensor:** S Venugopal ISTC, 4/1/2012 to 3/31/2014, 13.69 Lakhs
623. **Solar-Uv Disinfection of Bacteria in Contaminated Water by using Tio2.:** Jayant Modak PIPO, 6/12/2012 to 7/31/2014, 13.78 Lakhs
624. **Hiv Recombination and Immune Escape:Combining Within Host Viral Dynamics with Epidemiological Transmission:** Narendra M Dixit DSTO, 9/10/2012 to 9/9/2014, 3.56 Lakhs
625. **Role of Allosteric in Viral Self Assembly Probed by Multiplexed Single Molecule Fluorescence Resonance Energy Transfer (Msmfret)Spectroscopy:** Rahulroy DSTO, 1/11/2013 to 1/10/2016, 55.00 Lakhs
626. **Rheology, Fabric Anisotropy and Constitutive Modeling of Dense Granular Materials and Suspensions:** Prabhu R. Nott DSTO, 3/20/2013 to 3/19/2016, 18.76 Lakhs
627. **Innovative Young Biotechnologist Award : Probing Virus-Host Membrane Fusion with Single Molecule Spectroscopy in Living Cells :** Rahulroy DBTO, 3/22/2013 to 3/21/2016, 41.81 Lakhs
628. **Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors:** Sudeep Punathanam DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs







629. **Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors:** Sanjeev Kumar Gupta DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs
630. **Fabrication of Nanostructured Strain Sensor:** S Venugopal CIST, 4/15/2013 to 4/14/2015, 4.50 Lakhs
631. **System Analysis of Virus-Host Interactions for Rational Optimization of Hepatitis C Treatment:** Narendra M Dixit DSTO, 6/18/2013 to 6/17/2016, 27.22 Lakhs
632. **Probing Replication by Rna-Dependent Rna Polymerases from Flaviviruses:** Rahulroy Welt, 9/1/2013 to 8/31/2018, 349.40 Lakhs
633. **To Develop Mathematical Models to Identify Protein-Protein Interactions Preceding Hcv Entry That Would Serve as the Most Potent Targets of Therapeutic and Preventive Intervention- Sub-Project 2.1;** Narendra M Dixit DBTO, 9/3/2013 to 9/2/2018, 11.32 Lakhs
634. **Treatment of Reject Water from Defluoridation Units That Are Based on Reverse Osmosis Units:** Kesava Rao K DSTO, 10/22/2013 to 10/21/2015, 17.82 Lakhs
635. **Inspire Faculty Award to Dr.Arghya Samanta[Ifa13-Eng-44];** Dr.Arghya Samanta DSTO, 11/6/2013 to 11/5/2018, 19.00 Lakhs
636. **DST-Anr Collaborative Research Programme-Dense Particulate Systems :** Prabhu R. Nott DSTO, 2/24/2014 to 2/23/2017, 30.26 Lakhs

#### Centre for Product Design and Manufacturing

# Projects = 4      Value : 178.92 Lakhs

637. **Sub.Project.2 - Patient Transfer Device (Core Project DBT324):** B Gurumoorthy DBTO, 9/29/2011 to 9/28/2016, 157.01 Lakhs
638. **Cad Representation of Systems Having Multiplicity of Length Scales:** B Gurumoorthy GMOO, 12/28/2011 to 12/31/2014, 10.00 Lakhs
639. **Dhm Based Precision Assembly Simulation of Mmic Packages:** Dibakar Sen ISTC, 4/1/2012 to 3/31/2014, 11.16 Lakhs
640. **Design of An Aluminium-Intensive Electric Car Prototype:** Anindya Deb MSME, 1/8/2014 to 1/7/2015, 0.75 Lakhs

#### Civil Engineering

# Projects = 45      Value : 2220.32 Lakhs

641. **IISC - IGCAR R&D Cell: C S Manohar** IGCA, 6/1/2004 to 12/31/2015, 3.00 Lakhs
642. **Development of Land Parameter Retrieval Techniques & Tools for Polarimetric Sar Data Analysis:** M Sekhar ISRO, 3/17/2010 to 3/31/2014, 27.80 Lakhs
643. **Vibration Based Condition Assessment & Reliability Analysis of Existing Engineering Structures:** C S Manohar DAEO, 5/5/2010 to 3/31/2014, 27.66 Lakhs
644. **Assessing the Ground Water Storage Changes & Sustainability Due to Climate Change in the Semi-Arid Watersheds of South India:** M Sekhar CSIR, 11/22/2010 to 3/31/2015, 23.20 Lakhs

645. **Lysimeter Based Sub-Surface Investigations to Assess the Transport Behaviour of Contaminants in the Vadoze Zone Surrounding Near Surface Disposal Facility At Kalpakkam:** Sudhakar M Rao AERB, 4/13/2011 to 9/30/2014, 18.41 Lakhs
646. **Evaluation of Psycho-Physical Traits of Drivers and Applicability of Its Based Traffic Law Enforcement for Improving Road Safety and Mobility in India;** Ashish Verma CSIR, 5/1/2011 to 3/31/2014, 45.55 Lakhs
647. **Strength and Fracture Properties of Cement Stabilized Rammed Earth and Its Application for Structural Walls:** K S Nanjunda Rao DSTO, 7/26/2011 to 12/31/2014, 24.00 Lakhs
648. **Exploratory Evaluation of Local Kinematics on Overall Deformation in Granular Media:** Tejas G. Murthy DSTO, 7/28/2011 to 12/27/2014, 45.48 Lakhs
649. **Modelling Hydrology of Mahanadi River Basin Considering Changes in Land-Use/Land-Cover:** V V Srinivas MESO, 8/17/2011 to 8/17/2014, 43.55 Lakhs
650. **Structural Safety Assessment of Large Structures using Spectral Stochastic Finite Element Method:** Debraj Ghosh DAEO, 11/19/2011 to 3/31/2014, 12.31 Lakhs
651. **Developing Design Guidance for Rammed Earth Construction'- Project#;-4608-1:** B V Venkatarama Reddy IFCP, 12/1/2011 to 11/30/2014, 81.97 Lakhs
652. **Hydrometeorological Feedback and Changes in Water Storage and Fluxes in Northern Indian Basins:** P P Mujumdar MESO, 12/30/2011 to 12/29/2015, 343.21 Lakhs
653. **Energy and Mass Exchange in Vegetative Systems:** M Sekhar ISRO, 1/25/2012 to 7/31/2014, 6.75 Lakhs
654. **Remediation of Chromium Contaminated Groundwater using Ferro- Particles Based Technology:** Sudhakar M Rao MDWS, 4/11/2012 to 10/10/2014, 11.51 Lakhs
655. **Evalution of Municipal Solid Waste (Msw) Characteristics of a Typical Landfill in Bangalore:** G L Sivakumar Babu CIST, 4/16/2012 to 4/15/2014, 4.98 Lakhs
656. **Retrofitting of Masonry in Compression, Flexure and Shear with Frp:** K S Nanjunda Rao CIST, 4/16/2012 to 7/31/2014, 5.28 Lakhs
657. **Ground Exploration using Surface Seismic Waves: Effect of Height of Fall/Weight of the Dropping Mass on the Influence Zone and Correlation with in situ Penetration Tests:** Jyant Kumar DSTO, 6/16/2012 to 6/15/2015, 30.00 Lakhs
658. **Making Performance based Structural Engineering for the Resistance Attainable:** C S Manohar UKIE, 6/22/2012 to 6/21/2014, 14.52 Lakhs
659. **Guidelines for the Use of Geocells in Flexible Pavements:** G L Sivakumar Babu DSTO, 8/31/2012 to 8/30/2015, 66.03 Lakhs
660. **Seismic Site Classification for Indian Shallow Soil Deposits:** Anbazhagan DAEO, 10/10/2012 to 3/31/2015, 93.38 Lakhs





661. **Uncertainty Quantification in Multiscale Analysis of Noncomposite Materials:** Debraj Ghosh DAEO, 10/11/2012 to 3/31/2015, 20.65 Lakhs
662. **Stochastic Modeling of Hydration Process in Concrete:Investigation Into Creep and Shrinkage:** Ananth Ramaswamy DAEO, 10/11/2012 to 3/31/2015, 28.32 Lakhs
663. **Determination of Shear Wave Velocity for Deeper Ground using Surface Wave Testing with the Use of Geophones:** Jyant Kumar DAEO, 10/26/2012 to 3/31/2015, 32.75 Lakhs
664. **Development of a Model for Evaluating Prestress Losses Considering Creep & Shrinkage Losses in Concrete and Relaxation Losses in Steel Over 100 Years:** Ananth Ramaswamy DAEO, 10/26/2012 to 3/31/2015, 32.76 lakhs
665. **Development of Probabilistic Design and Analysis Procedures in Radioactive Waste Disposal in Nsdf and Design of Nsdf Closure:** G L Sivakumar Babu DAEO, 11/5/2012 to 3/31/2015, 34.76 Lakhs
666. **Studies on Fatigue Crack Growth in Graphite:** J M Chandra Kishen DAEO, 11/5/2012 to 3/31/2015, 45.61 Lakhs
667. **Safety and Global Sensitivity Analyses of Structures with Alternative Uncertainty Models:** C S Manohar DAEO, 11/6/2012 to 3/31/2015, 31.70 Lakhs
668. **Stochastic Modeling of Groundwater Flow and Contaminant Transport Modeling At the Proposed Uranium Tailings Pond,:** M Sekhar DAEO, 12/20/2012 to 3/31/2015, 36.11 Lakhs
669. **Running of M.Tech Programme in Transportation and Infrastructure Engg.:** Chairman CIST, 1/1/2013 to 12/31/2017, 30.00 Lakhs
670. **Adaptation of Irrigated Agriculture to Climate Change - Project No.4700-W1:** M Sekhar IFCP, 2/1/2013 to 1/31/2016, 26.42 Lakhs
671. **Estimation of Soil Hydraulic Properties in a Catchment using Agro-Hydrological Models and Microwave Remote Sensing:** M Sekhar ISTC, 4/1/2013 to 3/31/2015, 7.75 Lakhs
672. **Seismic Vulnerability Assesment using High Resolution Remote Sensing Data for Disaster Management:** Anbazhagan ISTC, 4/1/2013 to 3/31/2015, 10.66 Lakhs
673. **Studies on Integration of Gps and Ins for Varying Coupling Architectures using Stochastic Filters;** Debasish Roy ISTC, 4/1/2013 to 3/31/2015, 11.27 Lakhs
674. **Assessment of Fatigue Crack Propagation in Concrete Beams and Columns of Bridges:** J M Chandra Kishen CIST, 4/15/2013 to 4/14/2015, 4.28 Lakhs
675. **675, Removal Efficiencies of Degraded Organic Contaminants Present in the Municipal Solid Waste (Msw)of Bangalore City After Treatment by Clays:** P V Sivapullaiah CIST, 4/15/2013 to 4/14/2015, 4.67 Lakhs
676. **Static and Cyclic Loading Characteristics of Geocell Reinforced Aggregates:** Madhavi Latha G CIST, 4/15/2013 to 4/14/2015, 7.88 lakhs
677. **Performance Evaluation of Public Transport Operations in Karnataka by using Multivariate and Non Parametric Techniques:** T G Sitharam CIST, 4/15/2013 to 4/14/2015, 9.98 Lakhs
678. **Organizing the Brns Review Meeting:** C S Manohar DAEO, 6/18/2013 to 3/31/2014, 4.00 Lakhs
679. **Software – Hardware System for Crack Resistance Characteristics Determination of Engineering Materials and Structures Under Mixed Mode Fracture:** J M Chandra Kishen DSTO, 11/20/2013 to 11/19/2015, 11.53 Lakhs
680. **2013 Ibm Faculty Award:** M S Mohan Kumar IBM, 1/30/2014 to 1/29/2015, 6.14 Lakhs
681. **Tsunami Modeling Challenges in the Indian Ocean: Computations,Inverse and Forward Problems, Uncertainty Qualification and Source Characterization:** Debasish Roy DSTO, 2/9/2014 to 3/31/2014, 1.60 Lakhs
682. **What Will the Future Be? Projecting Environmental Change in Warming World for Semiarid Landscapes:** M Sekhar DSTO, 2/14/2014 to 2/13/2017, 29.34 Lakhs
683. **IBM Shared University Research Award:** M.S. Mohan Kumar IBM, 2/18/2014 to 2/17/2015, 24.80 Lakhs
684. **New Particle Filtering and Stochastic Search Techniques Applied to the Single-and Multiple-Target Tracking of Slow Moving Objects in the Presence of Clutter :** Debasish Roy NRBO, 2/25/2014 to 2/24/2017, 23.98 Lakhs
685. **An Integrated Experimental & Computational Approach to Structural Design for Ballistic Impact & Blasts:** Debasish Roy DRDO, 3/28/2014 to 3/27/2018, 814.76 Lakhs

#### Mechanical Engineering

# Projects = 37

Value : 2874.23 Lakhs

686. **J.C.Bose Fellowship to Prof.J.Srinivasan:** J Srinivasan DSTO, 5/1/2007 to 9/26/2015, 100.45 Lakhs
687. **J.C.Bose Fellowship to Dr. R. Narasimhan:** R. Narasimhan DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs
688. **Ramanujan Fellowship to Dr. Namrata Gundaiah:** Namrata Gundaiah DSTO, 8/3/2010 to 8/2/2015, 73.00 Lakhs
689. **Experimental and Numerical Investigation on the Mechanical Behaviour of Micro-Sized Structural Elements:** M S Bobji DSTO, 8/31/2010 to 3/31/2014, 11.70 Lakhs
690. **Facility for Rheo Pressure Die Casting:** Pradip Dutta DSTO, 11/9/2010 to 9/30/2014, 18.96 Lakhs
691. **Above Knee (Trans-Femoral ) Prosthetic Design:** Rina Maiti SBMT, 12/16/2010 to 6/15/2014, 44.41 Lakhs
692. **Friction Stir Welding of Ti/Ai & Ai/Mg Dissimilar Metals:** Satish V Kailas DRDO, 1/31/2011 to 1/31/2015, 218.47 Lakhs







693. **Studies on Kerosene Spray Characterizations & Combustion in a Compact Trapped Vortex Combustor (Tvc) Rig:** R V Ravikrishna GTR, 2/19/2011 to 9/30/2014, 129.86 Lakhs
694. **Optical Diagnostics of Biofuel Spray Dynamics in a Premixer:** Saptarshi Basu CSIR, 4/1/2011 to 3/31/2014, 12.12 Lakhs
695. **Study on Propulsion from Flexible 3d Foils : Fish Like Propulsion:** Raghuraman N Govardhan NRBO, 4/21/2011 to 10/20/2014, 24.15 Lakhs
696. **A Study on Preparation of Billets of Ss 304l with Non-Dendritic Microstructure using a Cooling Slope Technique;** Pradip Dutta IGCA, 7/1/2011 to 6/30/2014, 18.83 Lakhs
697. **Drag Reduction by Gas Lubrication:** J H Arakeri NRBO, 7/11/2011 to 7/10/2014, 52.72 Lakhs
698. **Transonic Stall Flutter: Unsteady Flow Over Turbo-Machine Blades in the Transonic Regime:** Raghuraman N Govardhan GTR, 8/22/2011 to 8/9/2015, 165.71 Lakhs
699. **Novel in Situ Experimentation of Water Transport in a Pem Fuel Cell:** Saptarshi Basu DSTO, 9/8/2011 to 9/7/2014, 20.70 Lakhs
700. **Sub.Project.4 - Mechanobiology for Primary Er-Negative Breast Cancer Tumors (Core Project-DBT324);** Anantha Suresh G K DBTO, 9/29/2011 to 9/28/2016, 128.78 Lakhs
701. **Sub.Project.3 - Biomechanics of Arteries : Role of Microfibrillar Proteins & Tissue Elasticity ( Core Project DBT324):** Namrata Gundaiah DBTO, 9/29/2011 to 9/28/2016, 130.53 Lakhs
702. **Biodesign-Bioengineering Initiative - Core Project:** Anantha Suresh G K DBTO, 9/29/2011 to 9/28/2016, 1000.42 Lakhs
703. **Mechanics of a Composite Protein Rubber in Arteries:** Namrata Gundaiah DSTO, 10/10/2011 to 10/9/2014, 13.48 Lakhs
704. **Solar Cooling and Production of Potable Water with Two State Silica Gel-Water Adsorption System:** Pradip Dutta DSTO, 1/19/2012 to 1/18/2015, 189.84 Lakhs
705. **Study of Combustion Dynamics in Stratified Swirl Stabilized Burner :** Saptarshi Basu ARDB, 1/31/2012 to 1/30/2015, 24.19 Lakhs
706. **Mechanobiology of Endothelial Cells:** Namrata Gundaiah DSTO, 3/7/2012 to 3/6/2015, 18.50 Lakhs
707. **Organising Ar&Db's High Temperature Materials Workshop At IISc., Bangalore on 23 March 2012;** B Gurumoorthy ARDB, 6/18/2012 to 3/31/2014, 21.80 Lakhs
708. **Car-Fraunhofer Project Multijoin:** Satish V Kailas ARCI, 10/12/2012 to 10/11/2017, 128.00 Lakhs
709. **Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors:** J H Arakeri DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs
710. **Hybrid Isolator for Reaction/Momentum Wheel:** Ashitava Ghosal ISTC, 4/1/2013 to 3/31/2014, 9.50 Lakhs
711. **Development and Performance Evaluation of Pcm Coupled Heat Pipe:** Dr. Pramod Kumar ISTC, 4/1/2013 to 3/31/2016, 15.78 Lakhs
712. **Development and Characterization of Composite Coatings Based on Nano-Porous Aluminium Alloy Surfaces;** M S Bobji ISTC, 4/1/2013 to 3/31/2015, 16.95 Lakhs
713. **Unified Correlations for Bubble Dynamics and Bubble Visualization Within the Evaporator of Loop Heat Pipe and Performance Studies of Lhp:** Saptarshi Basu ISTC, 4/1/2013 to 3/31/2015, 18.71 Lakhs
714. **Study of Plant Origin Additives for Vegetable Oil (Indian) Based Eco-Friendly Cutting Fluid to Improve the Cutting Fluid Properties:** Satish V Kailas DBTO, 4/10/2013 to 4/10/2016, 29.85 Lakhs
715. **Feasibility Study of Exhaust Thermoelectric Generator for Urban Buses:** Dr. Himabindu M CIST, 4/15/2013 to 4/14/2014, 5.62 Lakhs
716. **Performance and Emission Characteristics of Hythane Operated Internal Combustion Engine for the Clean Transportation:** R.Thirumaleswara Naik CIST, 4/15/2013 to 4/14/2015, 7.00 Lakhs
717. **Acoustics of Ducts and Mufflers(Second Edition):** M L Munjal DSTO, 7/16/2013 to 7/15/2015, 9.66 Lakhs
718. **Fundamental Studies on Transport and Kinetics of Adsorption using Silica Gel as An Adsorbate;** Dr.Pramod Kumar DSTO, 9/23/2013 to 9/22/2016, 30.00 Lakhs
719. **Precipitation,Vaporization and Flow Physics of Levitated Functional Droplets;** Saptarshi Basu DSTO, 9/23/2013 to 9/22/2016, 30.00 Lakhs
720. **Study of Contact Conditions in a Continuous Variable Transmission (Cvt) :** Satish V Kailas RNTB, 9/30/2013 to 9/29/2014, 45.22 Lakhs
721. **Fracture Mechanics:Science,Technology and Applications – Workshop on 28-29 November 2013:** Namrata Gundaiah DAEO, 1/31/2014 to 1/30/2015, 1.00 Lakhs
722. **Design & Development of a Robotic Fish for Naval Applications;** Raghuraman N Govardhan NRBO, 2/10/2014 to 2/9/2017, 37.32 Lakhs

#### Management Studies

# Projects = 3      Value : 46.29 Lakhs

723. **Internationalization of Small & Medium Enterprises (Smes) in Karnataka: Objectives, Strategies & Achievements:** M H Balasubrahmanya UGCO, 2/1/2011 to 3/31/2014, 3.91 Lakhs
724. **Assesment of Construction Technologies in Transportation Infrastructure for Developing and Managing Transportation System in Bangalore:** K B Akilesh CIST, 4/15/2013 to 4/14/2015, 8.20 Lakhs





725. **Implementation Mechanism Integrating Community Participation, Business Enterprise Models and Enabling Policies and Institutions Rhees-3-Subproject of DSTO1260:** P. Balachandra DSTO, 9/2/2013 to 9/1/2016, 34.18 Lakhs

## Materials Engineering

# Projects = 45

Value : 3641.29 Lakhs

726. **Surface Chemical & Biogeochemical Aspects of Heavy Metal Dissolution & Transportation with Particular Reference to Mining & Its Effect on Water Quality:** S Subramanian IRDQ, 3/14/2001 to 12/5/2014, 74.01 Lakhs
727. **Award of J.C.Bose Fellowship:** K Chattopadhyaya DSTO, 6/1/2006 to 5/31/2016, 115.50 Lakhs
728. **Mineral Biotechnology for Mineral Beneficiation Metal Extraction and Mining Environmental Control - Ramanna Fellowship to Prof.K.a.Natarajan;** K A Natarajan DSTO, 1/1/2008 to 12/31/2014, 65.20 Lakhs
729. **Establishment of Networking Resource Centre in Science Departments:** K Chattopadhyaya UGCQ, 4/22/2008 to 3/31/2015, 900.00 Lakhs
730. **Mechanical Behavior of High Temperature Coating:** Vikram Jayaram DRDO, 2/11/2009 to 2/10/2015, 544.60 Lakhs
731. **Development of State of Art Analytical Electron Microscope Facility Capable of High Resolution Imaging and Analysis in the Nanoscale as a National Facility At IISC:** K Chattopadhyaya DAEO, 5/22/2009 to 3/31/2014, 188.00 Lakhs
732. **J.C.Bose Fellowship to Dr. Atul H.Chokshi;** Atul H Choksi DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs
733. **J.C. Bose Fellowship to Prof. Dipankar Banerjee;** Dipankar Banerjee DSTO, 2/23/2011 to 2/22/2016, 68.00 Lakhs
734. **Physical Modeling of the Acheson Process:** Govind S Gupta CSIR, 4/1/2011 to 3/31/2014, 12.65 Lakhs
735. **Synthesis, Dielectronic, Ferroelectric & Piezoelectric Characterization of New Ferroelectric Alloys Based on Biao3 Modification of Ferroelectric Perovskites:** Rajeev Ranjan CSIR, 4/1/2011 to 3/31/2014, 16.45 Lakhs
736. **Grain Boundary Sliding a Model Study with Bicrystals:** Atul H Choksi CSIR, 4/1/2011 to 3/31/2014, 19.24 Lakhs
737. **Evolution of Microstructure and Texture during High Temperature Deformation of Refractory Metals and Alloys,;** Satyam Suwas DAEO, 6/10/2011 to 3/31/2015, 53.92 Lakhs
738. **Mineralogical and Leaching Studies for the Recovery of Uranium, Niobium and Ree Values from Rasimalai Alkali Syenite Pluton, Tamil Nadu, India:** S Subramanian DAEO, 6/14/2011 to 12/31/2014, 27.42 Lakhs
739. **Growth and Diffusion Mechanism of Nb and V Based A15 Superconductor Intermetallic Compounds :** Alope Paul DSTO, 8/19/2011 to 2/18/2015, 47.48 Lakhs
740. **Friction Stir Processing of Steels for Surface Alloying & Wear Resistance(Joint Project):** K Chattopadhyaya NRBO, 9/30/2011 to 3/31/2014, 7.04 Lakhs

741. **Analysis and Engineering of Particle-To-Particle Composition Distribution for Chemically Synthesized Fept, Copt, Fepd and Mnai Nanoparticles:** Chandan Srivastava DSTO, 11/8/2011 to 11/7/2014, 34.14 Lakhs
742. **Exploration of Cost Effective High Temperature Shape Memory Alloys:** Dipankar Banerjee NPMA, 11/17/2011 to 12/31/2014, 275.00 Lakhs
743. **Nanomechanics of Advanced Materials:** U Ramamurthy DSTO, 11/25/2011 to 11/24/2014, 124.69 Lakhs
744. **Dr. Ramanujan Fellowship to Dr. Kaushik Chatterjee:** Kaushik Chatterjee DSTO, 12/22/2011 to 12/21/2016, 73.00 Lakhs
745. **Design and Fabrication of Membranes for Water Purification using Phase Separation in Polymeric Blends as a Tool:** Suryasarathi Bose DSTO, 1/25/2012 to 1/24/2015, 54.38 Lakhs
746. **Structure-Property Correlations in Magnetostrictive and Ferroelectric Thin Films:** Rajeev Ranjan DMRL, 3/28/2012 to 9/27/2014, 48.48 Lakhs
747. **Creep Mechanisms & Micro Structural Stability in Ni-Based Single Crystal Blade Alloys;** Karthikeyan DMRL, 3/28/2012 to 3/27/2015, 65.00 Lakhs
748. **Disorder-To-Order Transformation in Nano-Sized Particles :** Chandan Srivastava CSIR, 4/1/2012 to 3/31/2015, 12.00 Lakhs
749. **Electric Current Assisted Fracture in Mechanically Stressed Precracked Metallic Structures;** Praveen Kumar CSIR, 4/1/2012 to 3/31/2015, 20.64 Lakhs
750. **Bioinformetic Nanocomposite Scaffolds for Bone Tissue Engineering:** Kaushik Chatterjee DAEO, 4/1/2012 to 3/31/2015, 13.90 Lakhs
751. **Polymeric Nanocomposites Derived from Gelation of Carbon Nanotubes as Bipolar Plate Materials for Pem Fuel Cell:** Suryasarathi Bose DAEO, 4/1/2012 to 3/31/2015, 15.50 Lakhs
752. **Smart Materials; Development of High Temperature Shape Memory Alloys for Environmentally Friendly Aero Engines:** U Ramamurthy Rroo, 5/8/2012 to 5/7/2016, 40.91 Lakhs
753. **High Temperature Plasticity At Low Stresses in Lif:** Praveen Kumar NRBO, 5/16/2012 to 10/31/2014, 3.35 Lakhs
754. **Investigation of Particle Size Effect on the Phenomenon of Miscibility Gap in Nano-Sized Particles:** Chandan Srivastava DSTO, 7/13/2012 to 7/12/2015, 23.15 Lakhs
755. **Creep At Very High Temperature and Low Stresses:Transition in Creep Behaviour Due to Liquefaction of Low Melting Phase Constituent.;** Praveen Kumar DAEO, 7/25/2012 to 3/31/2015, 16.95 Lakhs
756. **Bi-Continuous Polymeric Blends Derived from Gelation of Carbon Nanotubes as Electromagnetic Shielding Materials:** Suryasarathi Bose DSTO, 8/3/2012 to 8/2/2015, 50.54 Lakhs





757. **High Strain Rate Mechanical Properties of Ti-6Al-4V At Room and Elevated Temperatures:** Karthikeyan GTRE, 8/10/2012 to 7/31/2014, 4.00 Lakhs
758. **J C Bose Fellowship:** Vikram Jayaram DSTO, 8/16/2012 to 8/15/2017, 68.00 Lakhs
759. **Effects of Structure & Chemistry of Hetero-Interfaces on Thermo-Electro-Mechanical Induced Response of Micro and Nano-Structures;** Praveen Kumar DSTO, 9/12/2012 to 9/11/2015, 50.48 lakhs
760. **Studying Colon Cancer in 3d Tissue Scaffolds;** Kaushik Chatterjee CSIR, 11/1/2012 to 10/31/2015, 12.08 Lakhs
761. **EMI Shielding in Carbon Nanotubes Based Polymer Composites :** Suryasarathi Bose JATP, 3/15/2013 to 3/14/2015, 10.00 Lakhs
762. **Polymer/Calcium Phosphate Nano Composites as Scaffolds for Tissue Engineering;** Kaushik Chatterjee DSTO, 3/18/2013 to 3/17/2016, 51.10 Lakhs
763. **Thermo Responsive Soft Conducting Composites Based on Multiwall Carbon Nano Tubes for Electrostatic Discharge Applications:** Suryasarathi Bose CSIR, 4/1/2013 to 3/31/2016, 14.18 Lakhs
764. **Processing of Novel Metallic Thermal Interface Materials using Liquid Phase Sintering Followed by Accumulative Roll-Bonding:** Praveen Kumar ISTC, 4/1/2013 to 3/31/2015, 22.41 Lakhs
765. **Development of Ag-Ni Based Coating for Anti-Corrosion and Anti-Microbial Application;** Chandan Srivastava JATP, 4/1/2013 to 3/31/2015, 8.00 Lakhs
766. **Novel 3d Nanocomposite scaffolds for Tissue Engineering :** Kaushik Chatterjee DBTO, 5/31/2013 to 5/30/2016, 62.00 Lakhs
767. **Chitosan Based Nano-Particles for Selected Delivery of Anti-Hcv Agents Into Animal Liver - Sub-Project 3.2:** Ashok M Raichur DBTO, 9/3/2013 to 9/2/2018, 36.69 Lakhs
768. **Development of Polydioxanone-Graphene Composites for Biomedical Applications;** Kaushik Chatterjee DSTO, 9/23/2013 to 9/22/2016, 53.24 Lakhs
769. **Structure-Microstructure-Property Correlations in Na<sub>1/2</sub>Bi<sub>1/2</sub>TiO<sub>3</sub> and BaTiO<sub>3</sub> Lead-Free Piezoelectrics:** Rajeev Ranjan DSTO, 11/26/2013 to 11/25/2016, 52.82 Lakhs
770. **Low Band-Gap Organic Bulk Heterojunction Organic Photovoltaics:** Praveen C Ramamurthy DSTO, 1/1/2014 to 12/31/2016, 117.14 Lakhs
771. **Elucidating the Physiological & Genomic Regulation Process of Follicular Development, Oocyte Maturation & Embryogenesis in Buffalo;** R Medhamurthy ICAR, 1/7/2008 to 3/31/2014, 105.08 Lakhs
772. **Investigation of Protein Nanoparticle Interaction with Supported Bilayer Membranes - ( Sub-Project of DST-956):** Sandhya S Visweswariah DSTO, 6/13/2010 to 6/12/2015, 75.80 Lakhs
773. **Genetic Analysis and Phenotype-Genotype and Genotype-Mri Correlations in Wilson's Disease from South Indian Cohort:** Arun Kumar DBTO, 7/5/2010 to 7/4/2014, 48.23 Lakhs
774. **Project : 1 Identification of Molecular Signatures Specific to Tumor Infiltrating Region Relative to Tumor Core using Magnetic Resonance Image (Mri) Guided Site Specific Biopsies- (Core Project DBT296):** Paturu Kondaiah DBTO, 9/9/2010 to 9/8/2015, 74.85 Lakhs
775. **Phosphotransfer Profiling of Two Component Signal Transduction Systems of Mycobacterium Tuberculosis & Establishing Their Inter-Communication Pathways;** Deepak Kumar Saini CSIR, 11/1/2010 to 10/31/2014, 27.26 Lakhs
776. **Cyclic Nucleotide Mediated Cell Signalling in Mycobacteria : Structure and Function:** Sandhya S Visweswariah DSTO, 5/9/2011 to 5/8/2014, 7.61 Lakhs
777. **Regulation of Map Kinase Transactivation by G Protein by Complex Translocation:** Deepak Kumar Saini DSTO, 8/25/2011 to 8/24/2014, 52.20 Lakhs
778. **Protein Aggregate Myopathies - a Clinical, Pathological, Immuno-Histochemical, Molecular Genetics and Proteomic Investigation;** Upendra Nongthomba DSTO, 10/20/2011 to 10/19/2014, 22.84 Lakhs
779. **Studies on Cellular and Molecular Principles Regulating Zonalysis during Mammalian Blastocyst Hatching:** P B Seshagiri DSTO, 3/2/2012 to 3/1/2015, 42.44 Lakhs
780. **Novel Approaches to Tackling Tuberculosis:** Sandhya S Visweswariah UKIE, 5/9/2012 to 11/14/2014, 10.17 Lakhs
781. **Generation of Biosensors for Studying Activation and Subcellular Localization of Two Component Signal Transduction System in Living Cells;** Deepak Kumar Saini DBTO, 6/28/2012 to 6/27/2015, 81.95 Lakhs
782. **Immunological Approach to Investigate the Structure-Function Relationship of Notch Receptors and Ligands:** Rajan R Dighe DSTO, 7/12/2012 to 7/11/2015, 57.11 Lakhs
783. **Molecular Changes in Primordial Follicle as a Function of Aging : A Study using Rodents and Livestock (Cows, Buffalo and Goats) as Model;** Rajan R Dighe DBTO, 7/16/2012 to 7/15/2015, 61.58 Lakhs
784. **Regulation of Corpus Luteum Function in the Buffalo Cow: Analyses of Signalin Pathways Following Stimulation of Function and Regression of Corpus Luteum:** R Medhamurthy DBTO, 7/23/2012 to 7/22/2015, 54.51 Lakhs
785. **The Role of Guanylyl Cyclase C in Regulating Colonic Cell Proliferation:** Sandhya S Visweswariah DSTO, 7/25/2012 to 7/24/2015, 40.80 Lakhs
786. **Structural Elucidation of Secondary Metabolites from Marine Sources and Evaluation of Their Anti Cancer Activity :** Paturu Kondaiah DRDO, 8/8/2012 to 8/7/2014, 5.83 Lakhs
787. **Identification of Genes Involved in Regulating DNA Damage Response, Cellular Senescence and Senescence Mediated Carcinogenesis - Core Grant of DBT356:** Deepak Kumar Saini DBTO, 9/20/2012 to 9/19/2015, 48.40 Lakhs







788. **Regulation of Innate Immune Responses and Longevity by the Nervous System in Caenorhabditis Elegans:** Dr.Varsha Singh WELT, 10/1/2013 to 9/30/2018, 338.43 Lakhs

#### ISRO-IISc Space Technology Cell

# Projects = 2 Value : 125 Lakhs

789. **IISC-ISTC Contribution;** Convener IIS, 3/31/2006 to 3/31/2016, 10.00 Lakhs
790. **Space Technology Cell:** Convener ISTC, 3/31/2006 to 3/30/2016, 115.00 Lakhs

#### Mathematics

# Projects = 22 Value : 1355.34 Lakhs

791. **J.C. Bose Fellowship to Prof.Gadadhar Misra;** Gadadhar Misra DSTO, 9/1/2008 to 8/31/2018, 56.90 Lakhs
792. **J.C.Bose Fellowship to Prof.Thangavelu.S:** Thangavelu S DSTO, 9/1/2008 to 8/31/2018, 56.90 Lakhs
793. **Rajaramanna Fellowship to Prof.Alladi Sitaram:** Alladi Sitaram DAEO, 12/1/2009 to 11/30/2014, 35.81 Lakhs
794. **Interdisciplinary Centre in Neuroscience At I.I.Sc., (This Is a Sub-Project of DSTO-943);** Govindan Rangarajan DSTO, 3/30/2010 to 3/29/2015, 2.50 Lakhs
795. **Swarnajayanthi Fellowship - Holomorphic Mappings and Intrinsic Metrics,;** Kaushal Verma DSTO, 2/8/2011 to 2/7/2016, 48.86 Lakhs
796. **J.C. Bose Fellowship to Prof. Govindan Rangarajan;** Govindan Rangarajan DSTO, 2/23/2011 to 2/22/2016, 68.00 Lakhs
797. **Quantitative Imaging using Ultrasound Assisted Optical Tomography : Mathematical & Numerical Implementation;** Nandakumaran A.K. CSIR, 4/1/2011 to 3/31/2014, 2.00 Lakhs
798. **Inspire Faculty Award to Dr. Koushik Saha (Ifa-Ma-04);** Koushik Saha DSTO, 3/1/2012 to 2/28/2017, 26.00 Lakhs
799. **National Mathematics Initiative (Nmi):** Govindan Rangarajan DSTO, 9/12/2012 to 9/11/2017, 351.59 Lakhs
800. **Inspire Faculty Award for Dr.Pooja Singla[Ifa-Ma-10];** Dr.Pooja Singla DSTO, 11/2/2012 to 11/1/2017, 35.00 Lakhs
801. **Asymptotic Behaviour of Rational Difference Equation and That of a Biological Application;** Dr.Esha Chatterjee Ghosh DSTO, 11/21/2012 to 11/20/2015, 18.72 Lakhs
802. **Inspire Faculty Award to Dr. Soumya Das[Ifa-Ma-13];** Dr. Soumya Das DSTO, 11/29/2012 to 11/28/2017, 19.00 Lakhs
803. **Indo-French Center for Applied Mathematics (Ifcam) at IISC;** Govindan Rangarajan DSTO, 1/23/2013 to 1/22/2017, 77.15 Lakhs
804. **Inspire Faculty Award to Dr.Mousumi Mandal[Ifa-Ma-12];** Dr. Mousumi Mandal DSTO, 2/25/2013 to 2/24/2018, 35.92 Lakhs

805. **Function Spaces on Product Domains(New Project Application);** Thirthankar Bhattachryya DSTO, 6/18/2013 to 6/17/2016, 4.67 Lakhs

806. **Inspire Faculty Award to Dr.Umesh V Dubey (Ifa13-Ma-25);** Dr.Umesh V Dubey DSTO, 10/22/2013 to 10/21/2018, 19.00 Lakhs

807. **Inspire Faculty Award to Dr.Jaban Meher,[Ifa13-Ma-28];** Dr.Jaban Meher DSTO, 10/31/2013 to 10/30/2018, 19.00 Lakhs

808. **National Network for Mathematical and Computational Biology;** Govindan Rangarajan DSTO, 11/26/2013 to 11/25/2016, 42.89 Lakhs

809. **National Network for Mathematical and Computational Biology-Joint Activities:** Govindan Rangarajan DSTO, 11/26/2013 to 11/25/2016, 138.92 Lakhs

810. **Convergence and Optimality of Adaptive Finite Element Methods and Applications;** Dr.Thirupathi Gudi DSTO, 11/28/2013 to 11/27/2016, 12.66 Lakhs

811. **DST Centre for Mathematical Biology Phase II;** Govindan Rangarajan DSTO, 12/10/2013 to 12/9/2018, 277.76 Lakhs

812. **Building Triangulations for Fast Topological Computing;** Basudeb Datta DSTO, 12/19/2013 to 12/18/2016, 6.10 Lakhs

#### Centre for Cryogenic Facility

# Projects = 1 Value : 16.27 Lakhs

813. **High Temperature Superconductor Based Liquid Level Probe for Lox System;** R Karunanithi ISTC, 4/1/2012 to 3/31/2014, 16.27 Lakhs

#### Instrumentation and Applied Physics

# Projects = 22 Value : 439.75 Lakhs

814. **Design and Characterization of Electrochromic Rear View Mirrors using Conducting Polymers;** Shivaprakash N.C DSTO, 11/16/2010 to 11/15/2014, 4.20 Lakhs

815. **Cantilever- Based Multiplex Detection Systems. Sub Project of DSTO879:** G R Jayanth DSTO, 12/27/2011 to 12/26/2014, 17.29 Lakhs

816. **Development of Radiation Detectors Based on Thick Gas Electron Multiplier (Thgem). Sub Project of DST879;** K Rajanna DSTO, 12/27/2011 to 12/26/2014, 46.00 Lakhs

817. **Fabrication of Hybrid Cnt Array for Electronic Nose Sensor Over Large Flexible Area. Sub Project of DST879:** Abha Misra DSTO, 12/27/2011 to 12/26/2014, 56.59 Lakhs

818. **Photoacoustic Imaging of Interphalangeal Joints in the Hand as a Primary- Line Examination Test for Rheumatoid Arthritis Diagnosis and Therapy Monitoring-Instrument Development and Pilot Clinical Study:** R M Vasu DSTO, 1/2/2012 to 1/1/2015, 28.58 Lakhs







819. **Aperture Engineering and Image Reconstruction Techniques for Nanoscale Imaging:** Partha Pratim Mondal DSTO, 3/2/2012 to 3/1/2015, 24.24 Lakhs
820. **Development of a Robust, Low Cost Traffic Measurement System:** G R Jayanth CIST, 4/16/2012 to 4/15/2014, 2.40 Lakhs
821. **Mechanically Flexible Sensor Tape/ Sticker with Analog Processor and Electronic Communication for Centralized Monitoring of Bus Diagnostics:** Sanjiv Sambandan CIST, 4/16/2012 to 4/15/2014, 3.91 Lakhs
822. **Carbon Nanotubes Based Flame Sensor:** Abha Misra CIST, 4/16/2012 to 4/15/2014, 4.00 Lakhs
823. **Development of Methodologies for Strain Monitoring of High Pressure Compressor Modules of Titanium Alloys Through Conformal Thin Film Sensors:** G Mohan Rao GTR, 3/30/2013 to 3/29/2015, 95.89 Lakhs
824. **Growth and Characterization of AgInS<sub>2</sub>/ZnS Thin Film Solar Cell using Ultrasonic Spray Pyrolysis:** J Nagaraju CSIR, 4/1/2013 to 3/31/2015, 5.50 Lakhs
825. **Self Healing Circuits-Implementing Open Fault Repair in Circuits using Micro-Particle Automotons:** Sanjiv Sambandan ISTC, 4/1/2013 to 3/31/2015, 8.46 Lakhs
826. **Amorphous Silicon Carbide Thin Films by Pulsed Dc Magnetron Sputtering for Micro Electro-Mechanical Systems(Mems) Applications;** G Mohan Rao ISTC, 4/1/2013 to 3/31/2015, 11.78 Lakhs
827. **A Novel Liquid-Droplet Based Bistable Mems Switch:** G R Jayanth ISTC, 4/1/2013 to 3/31/2016, 12.65 Lakhs
828. **Development Realization and Characterization of Nanoparticle Based Radiation Detectors for Space Applications;** K Rajanna ISTC, 4/1/2013 to 3/31/2015, 14.31 Lakhs
829. **Development of a Versatile Optofluidic-Microscope for Initiating Indian Space Research Programs in Biomedicine and Telepathology;** Dr. Sai Siva Gorthi ISTC, 4/1/2013 to 3/31/2015, 14.65 Lakhs
830. **Growth and Characterization of Solution Based Low-Cost Czts/Zns Heterojunction Thin Film Solar Cells;** J Nagaraju DSTO, 7/25/2013 to 7/24/2016, 10.00 Lakhs
831. **High Efficiency Nano-Generator for Energy Harvesting and Sensors Applications:** K Rajanna DSTO, 8/1/2013 to 7/31/2017, 22.40 Lakhs
832. **Brain Machine Interface for Thought Based Control;** Sanjiv Sambandan ARDB, 8/12/2013 to 8/11/2015, 14.35 Lakhs
833. **Self Assembled Nano Tips for Field Emission Display;** Sanjiv Sambandan DSTO, 8/12/2013 to 8/11/2015, 21.39 Lakhs
834. **Graphene-Carbon Nanotubes Based Hiearchical Structure for Lithiumion Battery Anode;** Abha Misra DSTO, 9/18/2013 to 9/17/2016, 17.92 Lakhs

835. **Process Design and Fabrication of Thin Film Strain Gauges :** G Mohan Rao DRDO, 1/8/2014 to 1/7/2015, 3.24 Lakhs

## Physics

# Projects = 44

Value : 3869.54 Lakhs

836. **Award of J.C. Bose Fellowship;** H R Krishnamurthy DSTO, 6/1/2006 to 5/31/2016, 115.55 Lakhs
837. **Award of J.C.Bose Fellowship;** Chandan Das Gupta DSTO, 7/1/2006 to 6/30/2016, 115.60 Lakhs
838. **J.C. Bose Fellowship to Prof.Rahul Pandit;** Rahul Pandit DSTO, 8/1/2007 to 7/31/2017, 121.25 Lakhs
839. **J.C. Bose Fellowship to Prof.Sriram Ramaswamy;** Sriram Ramaswamy DSTO, 8/1/2007 to 7/31/2017, 121.25 Lakhs
840. **Towards Fluctuation-Based Quantum Information Processing with Semiconductor Nanostructures;** Arindam Ghosh UKIE, 3/24/2008 to 5/31/2015, 43.92 Lakhs
841. **A Study of Electronic & Mechanical Properties of Nanoscale Systems with Integrated Experimental Techniques.(Swarnajayanth Fellowship):** Arindam Ghosh DSTO, 5/1/2009 to 4/30/2014, 228.50 Lakhs
842. **Photophysics of Nanosystems:** A K Sood DSTO, 3/18/2010 to 9/17/2014, 226.35 Lakhs
843. **Investigation of Protein Nanoparticle Interaction with Supported Bilayer Membranes:** Jaydeep K Basu DSTO, 6/13/2010 to 6/12/2015, 769.04 Lakhs
844. **Centre for Quantum Information and Quantum Computation (Cqiqc)(Sub-Project of DSTO-955);** Rahul Pandit DSTO, 6/15/2010 to 6/14/2015, 8.00 Lakhs
845. **Centre for Quantum Information and Quantum Computation (Cqiqc) (Sub-Project of DSTO-955):** Vasant Natarajan DSTO, 6/15/2010 to 6/14/2015, 38.00 Lakhs
846. **Centre for Quantum Information and Quantum Computation (Sub-Project of DSTO-955):** P.S.Anil Kumar DSTO, 6/15/2010 to 6/14/2015, 38.00 Lakhs
847. **Centre for Quantum Information and Quantum Computation (Sub-Project of DSTO-955):** Arindam Ghosh DSTO, 6/15/2010 to 6/14/2015, 66.00 Lakhs
848. **Centre for Quantum Information and Quantum Computation (Cqiqc);** Anil Kumar (Sr) DSTO, 6/15/2010 to 6/14/2015, 316.80 Lakhs
849. **Ramanujan Fellowship to Dr. Subroto Mukerjee:** Subroto Mukerjee DSTO, 7/2/2010 to 7/1/2015, 73.00 Lakhs
850. **J.C. Bose Fellowship to Dr.Arnab Rai Choudhuri:** Arnab Rai Choudhuri DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs
851. **Contract to Establish a Max Planck Partner Group of Microstructure Physics Called the Partner Group for Surface Magnetism:** P.S. Anil Kumar MPIM, 8/20/2010 to 3/31/2015, 11.33 Lakhs
852. **Design and Characterization of Electro Chromic Rear View Mirrors using Conducting Polymers:** P.S. Anil Kumar DSTO, 11/16/2010 to 11/15/2014, 10.92 Lakhs





853. **Theoretical Investigations of Systems with Strongly Correlated Fermions Outstanding Research Investigator Award**,; Vijay B Shenoy DAEO, 1/14/2011 to 3/31/2015, 87.12 Lakhs
854. **Optical Tweezer Based Near Field Raman Spectrometer At High Pressures**; D V S Muthu CSIR, 4/1/2011 to 3/31/2014, 22.94 Lakhs
855. **A Setup for the Study of Resistance Fluctuations in Magnetic Tunnel Junctions**; Aveek Bid ISTC, 4/1/2011 to 3/31/2014, 11.50 Lakhs
856. **Measuring Fundamental Properties of Compact Objects and Underlying Accretion Process**: Banibrata Mukhopadhyay ISRO, 4/20/2011 to 4/19/2015, 12.65 Lakhs
857. **Cryogenic Experiments in Low-Dimensional Solid State Physics At Indian Institute of Science**; Chandan Das Gupta DSTO, 8/24/2011 to 8/23/2016, 384.32 Lakhs
858. **Electronic Transport in Graphene Nanostructures**: Arindam Ghosh TOEL, 10/13/2011 to 10/12/2014, 171.78 Lakhs
859. **Studies on New Generation Multiferic Crystals**.: Suja Elizabeth DSTO, 10/27/2011 to 10/26/2014, 41.02 Lakhs
860. **Insights Into Dynamic Phase Transitions in Soft Hybrid Colloidal Materials from Novel Micro-Rheology Based Techniques**; Jaydeep K Basu DSTO, 10/27/2011 to 10/26/2014, 53.14 Lakhs
861. **Study of the Feasibility of using Graphene Monolayers as a Single Molecule Sensor & Radiation Sensor- Project Ref.#: 1:24**: Aveek Bid NPMA, 12/7/2011 to 11/30/2014, 18.50 Lakhs
862. **Design and Development of Nqr Detection System for Explosives. Sub Project of DST879**: K P Ramesh DSTO, 12/27/2011 to 12/26/2014, 47.18 Lakhs
863. **Structure Elucidation of Hu (Mycobacterium Tuberculosis) Through X-Ray Crystallography and Structure Based Design of Lead Molecules for Tb Therapy**: I S Ramakumar CSIR, 4/1/2012 to 3/31/2015, 28.92 Lakhs
864. **Development of 3-Dimensional Diffuse Optical Tomography System**; K Rajan DSTO, 8/18/2012 to 8/17/2015, 29.10 Lakhs
865. **Nanostructuring & Grain Boundary Engineering in Bulk Thermoelectric Material for High Temperature Applications**; Ramesh Chandra Mallik DSTO, 9/11/2012 to 9/10/2014, 5.11 Lakhs
866. **J.C. Bose Fellowship of Dr.A.K.Sood**,; A K Sood DSTO, 11/1/2012 to 10/31/2017, 68.00 Lakhs
867. **Solar and Stellar Dynamo Models**: Arnab Rai Choudhuri DSTO, 11/14/2012 to 11/10/2014, 1.87 Lakhs
868. **Preparation of Carbon Nitrides for Space Applications**: K.Ramesh ISTC, 4/1/2013 to 3/31/2015, 17.32 Lakhs
869. **Development of 3-D Gel/ Tissue Dosimetry System using Optical Tomographic Reconstructions**; K Rajan DAEO, 4/26/2013 to 3/31/2016, 20.29 Lakhs
870. **Search for Low-Dimensional Chaos in Time Series of Accreting Objects**: Banibrata Mukhopadhyay DSTO, 5/22/2013 to 5/21/2016, 12.15 Lakhs
871. **Synthesis of Nanostructured Carbon Nitrides**: K. Ramesh DSTO, 6/11/2013 to 6/10/2016, 5.00 Lakhs
872. **Coherent Population Trapping and Its Applications to Precision Measurements**: Vasant Natarajan DSTO, 8/6/2013 to 8/5/2016, 43.20 Lakhs
873. **Electron Correlation Effects in Topological Insulators**: Vijay B Shenoy DSTO, 8/20/2013 to 8/19/2016, 8.50 Lakhs
874. **Multi-Scale Modelling of Mechanical Properties of Biomaterials**: Prabal K Maiti DAEO, 9/1/2013 to 8/31/2018, 64.15 Lakhs
875. **Computational Studies of Gas in Galaxies and Clusters**: Dr.Prateek Sharma DSTO, 9/12/2013 to 9/11/2016, 30.00 Lakhs
876. **Gasb and Insb Nano Inclusion with Filled Skutterudite (Rx-C04sb12) Material for Thermoelectric Generator**: Ramesh Chandra Mallik DSTO, 11/6/2013 to 11/5/2017, 52.15 Lakhs
877. **Physical Ageing,Intermediate Phases and Phase Change Properties of Chalcogenide Glasses**: K. Ramesh DSTO, 11/6/2013 to 11/5/2017, 53.95 Lakhs
878. **Indo-Australian Joint Project the Role of Noise in Silicon Based Quantum Computing**: Arindam Ghosh DSTO, 1/8/2014 to 1/7/2017, 48.10 Lakhs
879. **Investigation of Interactions and Excitations of Charge Carriers in Two Novel Quantum Fluid Systems**: Aveek Bid DSTO, 3/18/2014 to 3/17/2017, 160.06 Lakhs



### List of Sponsors and Financial Outlay as on 31.03.2014

| Sl. No. | Sponsors  | No. | Outlay Rs. in Lakhs |
|---------|---|-----|---------------------|
| 1.      | Aeronautical Development Agency (ADAO)  | 2   | 22.64               |
| 2.      | Atomic Energy Regulatory Board (AERB)   | 1   | 18.41               |
| 3.      | Asian Technology Programme (AITP)   | 1   | 2.29                |
| 4.      | Advanced Micro Devices (AMDO)   | 1   | 43.95               |
| 5.      | Asian Office of Aerospace Research and Development (AOAD)                             | 1   | 102.31              |
| 6.      | Armament Research Board (ARBO)  | 1   | 297.27              |
| 7.      | International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI) | 1   | 128.00              |
| 8.      | Aeronautics Research and Development Board (ARDB)                                     | 13  | 489.25              |
| 9.      | Anna University (AUOO)  | 1   | 141.23              |
| 10.     | Astra Zeneca India Pvt. Ltd. Bangalore (AZIP)   | 1   | 25.05               |
| 11.     | British Council (BCOO)  | 1   | 1.30                |
| 12.     | Bigtec Private Limited (BIGT)   | 1   | 18.29               |
| 13.     | Boeing Company (BOCO)   | 5   | 481.63              |
| 14.     | Board of Research in Fusion Science and Technology (BRFS)                             | 3   | 213.92              |
| 15.     | Centre for Airborne System (CABS)   | 1   | 6.30                |
| 16.     | Centre for Development of Advanced Computer (CDAC)                                    | 3   | 24.12               |
| 17.     | Coconut Development Board (CDBO)  | 1   | 13.17               |
| 18.     | Critical Ecosystem Partnership Fund (CEPF)  | 1   | 53.49               |
| 19.     | Centre for International Climate and Environment Research (CICE)                      | 1   | 62.73               |
| 20.     | Centre for Infrastructure Transportation and Urban Planning (CIST)                    | 18  | 964.50              |
| 21.     | The Commonwealth of Learning (COLO)   | 2   | 27.21               |
| 22.     | Council of Scientific and Industrial Research (CSIR)                                  | 40  | 790.22              |
| 23.     | Department of Atomic Energy (DAEO)  | 36  | 1287.78             |
| 24.     | Department of Biotechnology (DBTO)  | 117 | 9933.85             |
| 25.     | Defence Electronics Applications Laboratory (DEAL)                                    | 3   | 287.40              |
| 26.     | Department of Environment (DECO)  | 2   | 68.51               |
| 27.     | Department of Heavy Industry (DHIO)   | 1   | 9.55                |

| Sl. No. | Sponsors   | No. | Outlay Rs. in Lakhs |
|---------|--|-----|---------------------|
| 28.     | Defence Metallurgical Research Laboratory (DMRL)                     | 3   | 138.78              |
| 29.     | Defence Research and Development Laboratory (DRDL)                   | 1   | 3.50                |
| 30.     | Defence Research and Development Organisation (DRDO)                 | 24  | 6360.86             |
| 31.     | Department of Science and Technology (DSTO)                          | 350 | 33996.19            |
| 32.     | Delft University of Technology (DUTO)                                | 1   | 22.83               |
| 33.     | Electron Device News (EDNO)  | 1   | 4.56                |
| 34.     | Ecole Polytechnique De Federal (EPFO)                                | 1   | 28.26               |
| 35.     | European Commission (EUCO)   | 1   | 69.06               |
| 36.     | European Union (EUOO)  | 1   | 10.29               |
| 37.     | Earth Watch Institute (EWO)  | 1   | 1.00                |
| 38.     | Freescale Semiconductor India Pvt. Ltd. (FSIP)                       | 1   | 28.50               |
| 39.     | The Grantham Foundation for The Protection of the Environment (GFPE) | 1   | 1995.88             |
| 40.     | Government of Karnataka Department of Science (GKOO)                 | 1   | 850.00              |
| 41.     | General Motors Technical Centre India Pvt. Ltd. (GMOO)               | 2   | 20.00               |
| 42.     | Gas Turbine Research Establishment (GTRE)                            | 5   | 587.66              |
| 43.     | Hewlett Packard (HEPA)   | 2   | 15.87               |
| 44.     | Human Settlement Management Institute (HSMI)                         | 1   | 9.93                |
| 45.     | International Business Machine Corporation (IBMC)                    | 7   | 50.44               |
| 46.     | Indian Council of Agricultural Research (ICAR)                       | 1   | 105.08              |
| 47.     | Indian Council of Medical Research (ICMR)                            | 1   | 49.98               |
| 48.     | Indo-French Centre for The Promotion of Advanced Research (IFCP)     | 11  | 393.14              |
| 49.     | Indira Gandhi Centre for Atomic Research (IGCA)                      | 2   | 21.83               |
| 50.     | Indian Institute of Science (IISc)                                   | 5   | 50.50               |
| 51.     | Indian National Centre for Ocean Information Services (INCO)         | 4   | 188.80              |
| 52.     | Intel Technologies India Pvt Ltd. (INTL)                             | 2   | 51.92               |
| 53.     | Institut De Recherche Pour Le Development, France (IRDO)             | 3   | 350.33              |

| Sl. No. | Sponsors  | No. | Outlay Rs. in Lakhs |
|---------|---|-----|---------------------|
| 54.     | Indian Space Research Organisation (ISRO)                           | 10  | 1008.16             |
| 55.     | ISRO-IISc Space Technology Cell (ISTC)                              | 42  | 688.31              |
| 56.     | International Union of Crystallograph (IUCR)                        | 1   | 2.97                |
| 57.     | Indo-US Science and Technology Forum ((IUSF)                        | 5   | 5107.56             |
| 58.     | Joint Advanced Technology Programme (JATP)                          | 11  | 72.90               |
| 59.     | Karnataka Forest Department (KFDO)                                  | 1   | 1.00                |
| 60.     | Korea Institute of Science and Technology (KIST)                    | 1   | 27.19               |
| 61.     | Kerala State Council for Science, Technology and Environment (KSTE) | 1   | 1.00                |
| 62.     | Los Alamos National Laboratory (LANS)                               | 1   | 103.65              |
| 63.     | Limberlink Technologies Pvt. Ltd. (LIMB)                            | 1   | 6.49                |
| 64.     | Life Science Research Board (LSRB)                                  | 1   | 30.00               |
| 65.     | Lady Tata Memorial Trust (LTMT)                                     | 1   | 24.00               |
| 66.     | Madras Crocodile Bank Trust (MCBT)                                  | 1   | 1.20                |
| 67.     | Ministry of Drinking Water and Sanitation (MDWS)                    | 1   | 11.51               |
| 68.     | Ministry of Environment and Forests (MEFO)                          | 1   | 36.29               |
| 69.     | Merck and Co. Inc. (MERK)   | 2   | 120.59              |
| 70.     | Ministry of Earth Science (MESO)                                    | 15  | 1986.10             |
| 71.     | Ministry of Information Technology (MITO)                           | 16  | 7543.07             |
| 72.     | Ministry of New and Renewable Energy (MNRE)                         | 2   | 821.04              |
| 73.     | Max Planck Institute of Microstructure Physics (MPIM)               | 1   | 11.33               |
| 74.     | Microsoft Corporation India (P.) Ltd. (MSCI)                        | 1   | 25.66               |
| 75.     | Microsmall Medium Enterprises (MSME)                                | 2   | 500.75              |
| 76.     | National Aeronautical Laboratory (NALO)                             | 1   | 35.17               |

| Sl. No. | Sponsors   | No.        | Outlay Rs. in Lakhs |
|---------|--|------------|---------------------|
| 77.     | National Brain Research Centre (NBRC)                                | 1          | 88.10               |
| 78.     | Nature Conservation Foundation (NCFO)                                | 1          | 38.32               |
| 79.     | Norwegian Institute of Nature Research (NINA)                        | 1          | 121.80              |
| 80.     | National Program on Micro and Smart System (NPMA)                    | 19         | 2726.62             |
| 81.     | Naval Research Board (NRBO)  | 7          | 173.46              |
| 82.     | Naval Science and Technologies Laboratory (NSTL)                     | 1          | 2.34                |
| 83.     | Philips Electronics India Ltd. (PEIL)                                | 1          | 13.78               |
| 84.     | Panasonic India Pvt. Ltd. (PIPO)                                     | 1          | 13.78               |
| 85.     | Pratt and Whitney Canada Corporation (PWCC)                          | 1          | 15.45               |
| 86.     | Robert Bosch Engineering and Business Solutions Limited (RBCO)       | 1          | 3094.40             |
| 87.     | Renault Nissan Technology and Business Centre India Pvt. Ltd. (RNTB) | 2          | 55.93               |
| 88.     | Rolls Royce (RRCO)   | 1          | 40.91               |
| 89.     | Rail Vikas Nigam Limited (RVNL)                                      | 1          | 24.00               |
| 90.     | Society for Biomedical Technology (SBMT)                             | 1          | 44.41               |
| 91.     | Solid State Physics Laboratory (SPLO)                                | 1          | 377.41              |
| 92.     | Texas Instruments Pvt. Ltd. (TIPL)                                   | 1          | 31.29               |
| 93.     | Tokyo Electron Limited (TOEL)  | 1          | 171.78              |
| 94.     | The University of Melbourne (TUMO)                                   | 1          | 9.80                |
| 95.     | University of Grants Commission (UGCO)                               | 3          | 1403.01             |
| 96.     | UK-India Education and Research Initiative (UKIE)                    | 6          | 125.32              |
| 97.     | Uppsala University (UUCO)  | 1          | 29.20               |
| 98.     | Vikram Sarabhai Space Center (VSSC)                                  | 1          | 148.20              |
| 99.     | Vetenskapsradet (VTSK)   | 1          | 4.05                |
| 100.    | The Wellcome Trust, UK (WELT)  | 11         | 3413.00             |
|         | <b>Grand Total</b>   | <b>879</b> | <b>91244.07</b>     |





## 7.2 Centre for Scientific and Industrial Consultancy

**Chairman:** J M Chandra Kishen

During the year under review, the Centre for Scientific and Industrial Consultancy (CSIC) strengthened faculty-industry interactions in the form of informal discussions and advice to formal projects involving the design, development and transfer of technology. The Centre has striven to enhance qualitatively and quantitatively, the nature of Institute - Industry linkages. The Centre has undertaken major consultancy projects of national significance involving scientific and technological challenges, with the ultimate goal of technology transfer for industrial development.

The range of professional consultancy services offered by the Institute faculty through CSIC include:

- Systems Design/analysis
- Software development
- Product Design/development
- Process Design/development
- Model investigations
- Advice on R & D
- Transfer of technology
- Evaluation/overview
- Diagnostics

The above services have been utilised by a wide range of clientele, comprising Educational/Research Institutions, Health/Pharmaceuticals Industries, Department of Space, Defence Laboratories/Organisations, Irrigation Departments, Electricity Boards, Electronics/Telecom Industries, Engineering Industries and Chemical Industries from both the Public and the Private Sector.

During the financial year starting from April 01, 2013 to March 31, 2014, 161 consultancy project proposals costing ₹7.24 crores were communicated to the clients. In the period above 131 consultancy projects with an outlay of ₹5.10 crores materialised. Receipts from consultancy projects, short projects, consultancy test projects and consultancy tests amounted to ₹ 6.83 crores.

### Molecular Reproduction, Development & Genetics

**# Projects: 1** **Value: 3.39 lakhs**

1. **Evaluation of ayurvedic formulations for anti-cancer and wound healing properties:** M/S. Divyasai Tej Ayurvedic Nutraceuticals Pvt Ltd, Bangalore: Prof. P Kondaiah: Rs. 3.39 Lakhs: 6 Months

### Ecological Sciences

**# Projects: 3**

**Value: 13.56 lakhs**

2. **Elephant census in Karnataka:** The Karnataka Forest Department, Bangalore: Prof. R Sukumar: Rs. 2.13 Lakhs: 1 Year.
3. **Documenting the traditional knowledge on coastal biodiversity:** M/S. GIZ, New Delhi: Dr. T V Ramachandra: Rs. 5.24 Lakhs: 6 Months.
4. **Traditional knowledge on coastal biodiversity in Aghnashini -Gangavalli estuarine ecosystem:** M/S. German Development Corporation, New Delhi: Dr. T V Ramachandra: Rs. 6.19 Lakhs: 12 Months.

### Inorganic and Physical Chemistry

**# Projects: 1**

**Value: 1.01 lakhs**

5. **Feasibility of assembling a photoacoustic detector:** M/ S. GE India Technology Centre Pvt Ltd, Bangalore : Prof. P K Das: Rs. 1.01 Lakhs: 1 Month

### Organic Chemistry

**# Projects: 2**

**Value: 16.50 lakhs**

6. **Synthesis of key intermediates for active pharmaceutical ingredients:** M/S. Ray Chemicals Private Limited, Bangalore: Dr. K R Prabhu: Rs. 8.50 Lakhs: 1 Year.
7. **Synthesis of glycosidase inhibitors from sugar oxepanes:** M/S. Astrazeneca India Pvt Ltd, Bangalore: Prof. N Jayaraman: Rs. 8.00 Lakhs: 3 Months.

### Materials Research Centre

**# Projects: 2**

**Value: 5.43 lakhs**

8. **Synthesis of Nanocrystalline Calcium Copper Titanate:** M/S. Bharath Heavy Eletricals Limited, Hyderabad: Prof. K B R Varma: Rs. 4.53 Lakhs: 15 Months.
9. **Technical advice on dielectric measurements:** M/S. Central Power Research Institute, Bangalore: Prof. K B R Varma: Rs. 0.90 Lakhs: 2 Months.

### NMR Research Centre

**# Projects: 1**

**Value: 26.97 lakhs**

10. **NMR investigations of Water-Surfactant-Oil (W-O-S):** Unilever Industries Pvt Ltd, Bangalore: Prof. Suryaprakash N: Rs. 26.97 Lakhs: 1 Year.





### Instrumentation and Applied Physics

# Projects: 2

Value: 3.97 lakhs

11. **Upgradation of computerized totalizers:** Bangalore Turf Club, Bangalore: Dr. S Ramgopal: Rs. 1.99 Lakhs: 1 Year
12. **Upgradation of totalizers:** Hyderabad Race Club, Hyderabad: Dr. S Ramgopal: Rs. 1.98 Lakhs: 1 Year

### Physics

# Projects: 1

Value: 6.31 lakhs

13. **Development of prototype PDMS devices for DNA purification and amplification:** Bigtech Labs, Rajajinagar, Bangalore: Prof.V Venkataraman: Rs. 6.31 lakhs: 6Months.

### Computer Science and Automation

# Projects: 3

Value: 13.14 lakhs

14. **Consultancy in compiler development:** Microchip Technology (I) Pvt. Ltd., Bangalore: Prof. Y N Srikanth: Rs. 1.35 Lakhs: 3 Months.
15. **Inlias database design audit:** Oriental Insurance Co Ltd, Bangalore: Prof.Jayant Haritsa: : Rs. 10.00 Lakhs: 3 Months
16. **Algorithms for data mining:** M/S. Airbus Engineering Centre India Pvt Ltd, Bangalore: Dr. V Susheela Devi: Rs. 1.80 Lakhs: 1 Week.

### Electrical Engineering

# Projects: 5

Value:16.13 lakhs

17. **Enhancement of speech in noise:** Canviasm Technologies Ltd, Bangalore: Dr. Chandra Sekhar Seelamantula: Rs. 6.52 Lakhs: 3 Months.
18. **Technical advice on silicon carbide device and converter:** Centre for Development Of Telematics, Trivandrum: Dr. Vinod John, Prof. G Narayanan: Rs. 5.00 Lakhs: 1 Year.
19. **Technical consultancy for development of 10KV power supply with solid state crowbar:** CDAC, Trivandrum: Dr. Vinod John: Rs. 1.99: 1 Year.
20. **Technical consultancy in the area of sensors for electric parameters measurements:** M/S. Electrohms Pvt Ltd, Bangalore: Dr. Vinod John: Rs. 2.40 Lakhs:1 Year.
21. **Technical advice on type tests on ceramic disc insulator:** BHEL-EPD, Bangalore: Dr. B Subba Reddy: Rs. 0.22: 2 Days

### Electrical Communication Engineering

# Projects: 5

Value: 19.68 lakhs

22. **Bandwith-and-access-efficient codes for distributed storage:** Netapp India Pvt. Ltd, Bangalore: Prof. P Vijaya Kumar: Rs. 13.50 Lakhs: 18 Months.
23. **Technical review of Netsim - network simulator:** TETCOS, Bangalore: Prof.Anurag Kumar: Rs. 1.25 Lakhs: 6 Months.
24. **Technical advice for s/w techniques for GPS augmentation solution for smartphones:** M/S. L G Soft India Pvt Ltd, Bangalore: Prof. K V S Hari: Rs. 2.43 Lakhs: 4 Months.
25. **Technical review of Netsim - network simulator:** TETCOS, Bangalore : Prof.Anurag Kumar: Rs. 1.25 lakhs: 4 Months
26. **Technical review of Netsim - network simulator:** TETCOS, Bangalore: Prof.Anurag Kumar: Rs. 1.25 Lakhs: 6 Months.

### Aerospace Engineering

# Projects: 8

Value: Rs31.12 lakhs

27. **Technical support for design development fabrication instrumentation and calibration of shock tube:** M/S.Terminal Ballistics Research Laboratory, Chandigarh: Prof. G Jagadeesh, Prof K P J Reddy: Rs. 6.09 lakhs: 18 Months.
28. **Characterization of Dula orifice fuel atomizer:** M/S. Honeywell Technology Solutions Lab Pvt Ltd, Bangalore :Prof. D Sivakumar: Rs. 4.50 lakhs: 3 Months.
29. **Performance improvement studies on a selected class of two wheelers:** M/S. TVS Motor Company Limited, Hosur: Mr. V SurendraNath, Prof. J Dey, Dr. S B Kandagal: Rs. 11.21 lakhs: 6 Months.
30. **Dynamic performance evaluation of poly urethane bearing pads:** M/S. Polymer Products Of India, Bangalore: Dr.M R Bhat: Rs. 2.69 lakhs: 3 Months.
31. **Formulating the requirements for VVIP helicopters based on DGCA guidelines:** DPAR Govt. of Karnataka, Bangalore: Dr. S N Omkar: Rs. 0.56 lakhs: 2 Weeks.
32. **Vibration characterization simulation and correlation of circular forms with dry concrete mixes:** M/S. GCI Exports Pvt Ltd, Bangalore: Dr.S B Kandagal: Rs. 2.58 lakhs: 1 Month.





33. **Neural network implementation of characteristics of engine:** M/S. Tech Mahindra, Bangalore: Dr. S N Omkar: Rs. 1.20 lakhs: 1 Month.
34. **Pratt & Whitney Centre convener honorarium:** M/S. Pratt & Whitney Corporation, USA: Prof. S Gopalakrishnan: Rs. 2.29 lakhs: 1 Year.

#### Chemical Engineering

# Projects: 3

Value: 7.23 lakhs

35. **Third party inspection report of high pressure odour control atomization system:** BBMP, Bangalore: Dr. J R Mudakavi, Dr K R Prabhu: Rs. 0.29 Lakhs: 1 Week.
36. **Development of a screen printing lacquer equivalent to 7300:** M/S. SJS Enterprises Pvt Ltd, Bangalore: Dr. J R Mudakavi: Rs. 4.92 Lakhs: 3 Months.
37. **Molecular simulation of electrolytes in batteries and super capacitors:** CSTEP, Bangalore: Dr.Sudeep Punnantham: Rs. 2.02 Lakhs: 6 Months.

#### Mechanical Engineering

# Projects: 4

Value:10.09 lakhs

38. **Design of silencers:** M/S. P R Acoustical & Engineering Works (P) Limited, Trichy: Prof. M L Munjal: Rs. 2.36 Lakhs: 1 Year
39. **Droplet size characterization of ultrasonic atomizer:** M/S. Robert Bosh Engineering & Business Solutions Ltd, Bangalore: Prof. R V Ravikrishna: Rs. 7.07 Lakhs: 4 Months.
40. **Consultancy advice:** M/S. Bannari Amman Institute Of Technology, Satyamangla: Prof. Satish V. Kailas: Rs. 0.05 Lakhs: 1 Week.
41. **Checking acoustic design of the Mundayad stadium complex:** M/S. S A V Interiors, Cochin: Prof. M L Munjal: Rs. 0.61: 2 Weeks.

#### Materials Engineering

# Projects: 5

Value: 8.34 lakhs

42. **Scanning electron microscopy of automotive samples:** M/S. Toyota Kirloskar Motor Pvt Ltd, Bidadi: Prof. Vikram Jayaram: Rs. 3.08 Lakhs: 1 Year.
43. **Consultancy advice:** M/S. Polyhydron Systems Pvt Ltd, Belgaum: Prof. U Ramamurthy: Rs. 0.51 Lakhs: 1 Week.
44. **Technical advice:** M/S. Emco Energy Limited, Chandrapura: Prof. U Ramamurthy, Dr. M R Bhat: Rs. 0.84 Lakhs: 1 Week.

45. **Technical advice:** M/S. Sundram Fasteners Limited, Hosur: Prof. U Ramamurthy: Rs. 3.07 Lakhs: 1 Week.

46. **Technical advice:** M/S. IFBIndusgtries Ltd, Bangalore: Prof. U Ramamurthy: Rs. 0.84 Lakhs: 1 Week

#### Product Design and Manufacturing

# Projects: 1

Value: 1.22 lakhs

47. **Generation of wheel profile for grinding of rake face of helical hot:** M/S. Kennametal India Limited, Bangalore: Prof.Dibakar Sen: Rs. 1.22 Lakhs: 2 Months.

#### Civil Engineering

# Projects: 75

Value: 251.76 lakhs

48. **Design of soil retention system for excavations:** M/S. MantriConrnerstone Holding Pvt Ltd, Bangalore: Prof. G L SivakumarBabu: Rs. 2.02 lakhs: 1 Month.
49. **Feasibility study stability analysis and design of height raising of tailing dam at sk mine:** M/S. Hindustan Zinc Limited, Dariba: Prof. T G Sitharam: Rs. 18.20 lakhs: 6 Months.
50. **Advice on the access road to MSR holdings area adjacent to bial land:** M/S. M S R Holdings, Bangalore: Prof. T G Sitharam: Rs. 0.67 lakhs: 1 Week.
51. **Consultancy service for initial wedge failure analysis - proof checking:** M/S. Afcons Infrastructure Ltd, Mumbai: Prof. G MadhaviLatha, Prof. T G Sitharam: Rs. 6.00 lakhs: 5 Months.
52. **Stability analysis abutment slopes in Chenab bridge project:** M/S. Afcons Infrastructure Ltd, Mumbai: Prof. T G Sitharam: Rs 3.00 lakhs: 2 Years.
53. **Proof checking of the ETA report for the proposed Tadadi port submitted by Neeri:** M/S. K S I I & D C Ltd, Bangalore: Prof. T G Sitharam: Rs. 4.32 lakhs: 2 Months.
54. **Transient analysis for cooling water system of NCC PP at Nellore AP:** M/S. Jyoti Limited, Vadodara: Prof. M M Allam, Mr P Raghuvveer Rao: Rs. 5.22 lakhs: 10 Weeks.
55. **Transient analysis for cooling water system NTPC Solapur:** M/S. Kirloskar Brothers Ltd, Pune : Mr. P Raghuvveer Rao, Prof. M M Allam: Rs. 5.22 lakhs: 10 Weeks.
56. **Dynamic analysis of turbo generator foundation pertaining to RPCL thermal power project:** Ms/. Raichur Power Corporation Limited, Bangalore: Prof. C S Manohar, Prof. J M Chandra Kishen: Rs. 9.94 lakhs: 2 Months.





57. **Scheme to lift water from Kabini river near Alambur village to fill 20 tanks for drinking water:** M/S. Megha Engineering & Infrastructure Ltd, Bangalore: Mr. P Raghuveer Rao, Prof. M S Mohan Kumar: Rs. 1.50 lakhs: 1 Month.
58. **Surge analysis for the HNSS phase 1:** Megha Engineering & Infrastructure Ltd, Bangalore: Mr. P Raghuveer Rao, Prof. M S Mohan Kumar: Rs. 7.6 lakhs: 1 Month.
59. **Technical advice:** M/S. South Western Railway, Bangalore: Prof. G Madhavi Latha: Rs. 0.28 lakhs: 1 Week.
60. **Surge analysis for enhancement of 26 MLD to Ramanagar-Chanapattanam water supply scheme:** M/S. Karnataka Urban Water Supply And Drainage Board, Bangalore: Prof. M M Allam, Mr. P Raghuveer Rao: Rs. 1.80 lakhs: 4 Weeks.
61. **Surge analysis for GDWSS package 1 and GLIS phase 3:** M/S. Megha Engineering And Infrastructures Limited, Hyderabad: Prof. M M Allam, Mr. P Raghuveer Rao: Rs. 3.60 lakhs: 3 Weeks.
62. **Proof checking of structural designs of road over bridge on NH207 at chainage:** M/S. Transstory (India) Limited, Devanahalli: Prof. Ananth Ramaswamy, Prof. J M Chandra Kishen: Rs. 3.45 lakhs: 2 Weeks.
63. **Proof checking of structural design of road over bridge on NH-207 chainage:** M/S. Transstory (India) Limited, Devanahalli: Prof. Ananth Ramaswamy, Prof. J M Chandra Kishen: Rs. 3.17 lakhs: 6 Weeks.
64. **Proof checking of structural designs of road over bridge on NH 207 at chainage:** M/S. Transstory (India) Limited, Devanahalli: Prof. J M Chandra Kishen, Prof. Ananth Ramaswamy: Rs. 3.34 lakhs: 2 Weeks.
65. **Design and drawing pertain into stabilization of hill slope:** M/S. Vishwanath Projects Limited, Hyderabad: Prof. G L Sivakumar Babu: Rs. 1.04 lakhs: 1 Week.
66. **Co-processing of solid wastes generated in smelting:** M/S. Chloride Alloys, Kolar Dist: Prof. P V Sivapullaiah: Rs. 5.41 lakhs: 4 Months.
67. **Revision of slope stability analysis of slope S10-S40, Swedge and Flac 2D software:** M/S. Chenab Bridge Project Undertaking, Mumbai: Prof. G Madhavi Latha: Rs. 5.00 lakhs: 2 Months.
68. **Surge analysis and recommendations for the 600nb treated water system HZL, Udaipur project:** M/S. Raunag International Limited, Faridabad: Mr. P Raghuveer Rao: Rs. 1.01 lakh: 1 Week.
69. **Proof consultancy for Nuclear Power Corporation of India, Gorakhpur project:** M/S. DBM Geotechnics & Constructions Pvt Ltd, Mumbai: Prof. G L Sivakumar Babu: Rs. 3.42 lakhs: 4 Months.
70. **Analysis and design of surge protection for Attur water supply scheme, Salem:** M/S. Larsen & Toubro Limited, Salem: Mr. P Raghuveer Rao: Rs. 2.38 lakhs: 4 Weeks.
71. **Surge analysis for water transmission pipeline:** M/S. Doshion Pvt Ltd, Ahmedabad: Mr. P Raghuveer Rao: Rs. 1.12 lakhs: 1 Week.
72. **Revised slope stability analysis for slopes between 550 – 580:** M/S. Chenab Bridge Project Undertaking, Jammu: Prof. G Madhavi Latha: Rs. 5.00 lakhs: 2 Months.
73. **Design and analysis of embankment and slope section and airfield pavement design at the airport site:** M/S. JINDAL STEEL LIMITED, BALLARI: Prof. G L Sivakumar Babu: Rs. 2.92 lakhs: 6 Months.
74. **Design of partition dykes inside as pond for removal of pons ash at Damajodi:** M/S. Nalco Ltd, Odisha: Prof. T G Sitharam: Rs. 4.37 Lakhs: 1 Month.
75. **Review and certification of designs and drawings:** M/S. Nitesh Estates Ltd, Bangalore: Dr. K S Nanjunda Rao: Rs. 0.07: Lakhs: 1 Week.
76. **Towards clarifications on certain technical points raised on the evaluation of the tender:** M/S. Raichur Power Corporation Limited, Bangalore: Prof. M S Mohan Kumar: Rs. 0.75 Lakhs: 1 Week.
77. **Interaction with RBEI team on smart card based ticketing system:** M/S. Robert Bosch Engineering & Business Solutions Ltd, Bangalore: Prof. T G Sitharam: Rs. 6.07 Lakhs: 3 Months.
78. **Flac analysis of precast RCC arch system for bridge work bridge:** M/S. CIDCO, Navi Mumbai: Prof. T G Sitharam, Prof. G Madhavi Latha: Rs. 7.20 Lakhs: 2 Months.
79. **Shear wave velocity measurement using MASW system SWR project site:** M/S. Patil Engineers & Contractors, Hubli: Dr. P Anbazhagan, Prof. T G Sitharam: Rs. 1.00 Lakhs: 1 Week.
80. **Transient analysis for CW system of one unit of UTE MAU3 power plant:** M/S. Siemens Limited, Gurgaon: Mr. P Raghuveer Rao: Rs. 3.60 Lakhs: 6 Weeks.
81. **Erection stage analysis of slope S10 to S40 and S50 to S80:** M/S. Chenab Bridge Project Undertaking, Jammu: Prof. G Madhavi Latha, Prof. T G Sitharam: Rs. 9.50 Lakhs: 2 Months.







Highways, Bangalore: Prof. J M Chandra Kishen: Rs. 1.98 lakhs: 2 Weeks.

107. **Project appraisal report for continuous pressurized water supply to Hassan city:** Karnataka Urban Water Supply And Drainage Board, Hassan: Prof. M S Mohan Kumar: Rs. 4.90 Lakhs: 2 Months.
108. **GPR study on the selected existing roads:** M/S. Alchemist Rouchnology Limited, New Delhi: Dr. P Anbazhagan: Rs. 2.25 Lakhs: 2 Months.
109. **Surge analysis for ASTI stage 1 & 2 lift irrigation schemes:** Ujjani Canal Division, Solapur: Mr. P Raghuveer Rao: Rs. 3.00 Lakhs: 4 Weeks.

#### Management Studies

# Projects: 3 Value: ₹ 8.09 lakhs

110. **Consultancy service for stability analysis of Devarabelakere dam for KNNL:** Karnataka Neeravari Nigam Limited, Malebennure: Prof. T G Sitharam: Rs. 4.95 Lakhs: 2 Months.
111. **Surge analysis for rising main:** M/S. Doshin Pvt Ltd, Ahmedabad: Mr. P Raghuveer Rao: Rs. 1.12 Lakhs: 1 Week.
112. **Technical advice:** M/S. United India Insurance Co Ltd, Bangalore: Prof. J M Chandra Kishen: Rs. 0.28 Lakhs: 1 Week.
113. **Surge analysis:** M/S. Shridhan International Pvt Ltd, Bangalore: Mr. P Raghuveer Rao: Rs. 1.01 Lakhs: 1 Week.
114. **Transient analysis for CW system of NTPC Vindhyachal STPP stage V:** M/S. Jyoti Limited, Vododara: Mr. P Raghuveer Rao: Rs. 4.40 Lakhs: 8 Weeks.
115. **Proof checking of sub-structure of foundation of railway bridges of HosadurgaChikjajur:** M/S. South Western Railway, Bangalore: Prof. G L SivakumarBabu: Rs. 6.23 Lakhs: 1 Month.
116. **Review and proof checking of PEB structure design and drawings:** M/S. Kirby Building Systems India (Uttaranchal) Pvt Ltd, Uttarakhand: Prof. J M Chandra Kishen: Rs. 3.71 Lakhs: 2 Weeks.
117. **Review and proof checking of PEB structure:** M/S Kirby Building Systems India (Uttaranchal) Pvt Ltd, Uttarakhand: Prof. J M Chandra Kishen: Rs. 1.20 Lakhs: 2 Weeks.
118. **Surge analysis for the make up water pipeline package for Kudgi STPP Stage 1 (3X800 MW):** M/S Graphite India

Limited, Nashik: Prof. M S Mohan Kumar, Mr. P Raghuveer Rao: Rs. 3.00 Lakhs: 6 Weeks.

119. **Proof checking of structural designs and drawing of rob at KM60/600-700 on Ramdurga Badami Road:** Karnataka State Highways Improvement Project, Bangalore: Prof. J M Chandra Kishen: Rs. 1.98 Lakhs: 2 Weeks.
120. **Proof checking of structural design and drawing of ROB at KM 316/200-300 on Devanagere - Channagiri Road:** Karnataka State Highways Improvement Project, Bangalore: Prof. J M Chandra Kishen: Rs. 1.96 Lakhs: 2 Weeks.
121. **Analysis and design of surge protection for three reaches of Chambal Bhilware WSP Rajasthan:** M/s. NCC Limited, Hyderabad: Mr. P Raghuveer Rao: Rs. 6.70 Lakhs: 8 Weeks.
122. **Suitability of granulated blast furnace slag as fine aggregate in structural concrete and mortal APP:** M/S. Sati Construction Products, Bangalore: Prof. B V Venkatarama Reddy: Rs. 5.52 Lakhs: 8 Months.

#### Management Studies

# Projects: 2 Value: 9.46 lakhs

123. **Electricity planning in Karnataka:** M/S. Civic, Bangalore: Prof. AnjulaGurtoo: Rs. 2.40 Lakhs: 6 Months.
124. **Evaluation of three research schemes under CPRI for 11 five year plan:** Central Power Research Institute, Bangalore: Dr. M Mathirajan, Prof. M H BalaSubrahmanya: Rs. 7.06 Lakhs: 11 Weeks.

#### Sustainable Technologies

# Projects: 3 Value: 44.68 lakhs

125. **Feasibility study to linking agriculture to nutrition mechanisms to improve access to nutritious:** The Karnataka Com Prehensive Nutrition Mission, Bangalore: Prof. N H Ravindranath, Dr. H N Chanakya, Mr. H I Somashekar: Rs. 6.18 Lakhs: 6 Months.
126. **Verifying thermal performance analysis of reidential buildings:** M/S. Larsen And Toubro Limited, Chennai: Prof. Monto Mani: Rs. 1.27 Lakhs: 1 Month.





127. **Climate resilient strategy for Karnataka:** M/S. C-Step, Bangalore: Prof. G Bala, Prof. N H Ravindranath: Rs. 37.23 Lakhs: 6 Months

**Supercomputer Education and Research Centre**

**# Projects: 4**

**Value: 20.20 lakhs**

128. **Advice on implementation of integrated MIS :** M/S. Karnataka Urban Water Supply and Drainage Board, Bangalore: Dr. M R Muralidharan: Rs. 3.66 lakhs: 6 Months.

129. **Cheque image analysis:** M/S. Canvasm Technologies Limited, Bangalore: Dr. R Venkatesh Babu: Rs. 7.67 lakhs: 6 months.

130. **Advice on development of oncology PACs:** Meddiff Technologies, Bangalore: Dr. Phaneendra K Yalavarthy: Rs. 2.07 lakhs: 6 weeks.

131. **Intuitive image video capture:** M/S. L G Soft India Pvt Ltd., Bangalore: Dr. R. Venkatesh Babu: Rs. 6.80 lakhs: 10 Months.





127. **Climate resilient strategy for Karnataka:** M/S. C-Step, Bangalore: Prof. G Bala, Prof. N H Ravindranath: Rs. 37.23 Lakhs: 6 Months

**Supercomputer Education and Research Centre**

**# Projects: 4**

**Value: 20.20 lakhs**

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### 7.3 Intellectual Property Cell

Chairman: Jayant M Modak

In its drive towards achieving the objective of IISc's IP Policy, the IP Cell has entered into agreements with industries to commercialise the IP of the Institute. To list a few, a license agreement has been signed with Mesha Tech LLC. Mesha is a US based company and is involved in developing energy solutions based on the Hybrid Ultra Capacitor (HUC) technology for energy storage and automotive applications. Further, the IP Cell is also in talks with Dow Chemicals Ltd with respect to some Institute inventions. In addition to the above, agreements with patent commercialization companies, viz., Think Village, Skyquest and Synergia continue to be in force. In addition, the IP Cell together with IISc alumni with SID is working towards identifying various avenues in commercializing the Institute's patented technologies.

The Institute faculty are becoming more competent in the field of IP protection. One measure of this is the significant increase in disclosure rates over time by the faculty. The increased disclosures are helping the IP Cell in building a robust portfolio which over a period of time will help IISc in successfully collaborating with Industries to commercialize the IP of the Institute. Realising that the number of inventions and technologies of the Institute, as well as their potential value, is ever increasing, the IP Cell has relocated to more spacious quarters than the present one in order to be able to work more closely with the Entrepreneurship Cell and to accommodate more personnel who can help handle the technology licensing, market inventions to industry, and file for patents.

In addition to the activities above, the IP cell continues to review various research agreements such as NDAs, MTAs and license agreements. Based on the requirements, the IP cell engages itself in drafting, amending and/or negotiating the agreements with outside organisations to protect the interests of the Institute.

**Statistics:** IP filing, capital and operational expenditures, and returns on commercialization over the years and, more particularly in 2013, are illustrated below:-

Number of patent Applications filed in the year 2013: The Division-wise breakup of the number of patent applications filed (Indian, Foreign & PCT applications) is as follows:

Mechanical Sciences: 4

Chemical Sciences: 12

Biological Sciences: 2

Electrical Sciences: 8

Physical & Mathematical Sciences: 4

Number of Indian Patents filled: 23, Foreign - 7  
Number of Indian Patents Granted: 3, Foreign - 12

Expenses incurred and Revenue generated for the year 2013:

Expenses incurred: Rs.68,43,408/-

Revenue generated: Rs.10,28,162/-

Basic portfolio index (1995-2013)

❖ Total Patents filed: 425

|                           |            |
|---------------------------|------------|
| Granted Patents in Force  | 58         |
| Patents Lapsed            | 53         |
| Patents under Prosecution | 315        |
| <b>Total</b>              | <b>425</b> |

**Total Number of Patents filed:  
Year wise break-up (1995-2013)**

| Year         | Indian     | Foreign    | Total Patent |
|--------------|------------|------------|--------------|
| 1995         | 1          |            | 1            |
| 1996         | 1          |            | 1            |
| 1997         | 1          |            | 1            |
| 1998         | 5          |            | 5            |
| 1999         | 6          | 1          | 7            |
| 2000         | 3          | 4          | 7            |
| 2001         | 8          | 3          | 11           |
| 2002         | 15         | 4          | 19           |
| 2003         | 14         | 8          | 22           |
| 2004         | 6          | 6          | 12           |
| 2005         | 20         | 11         | 31           |
| 2006         | 9          | 11         | 20           |
| 2007         | 16         | 12         | 28           |
| 2008         | 26         | 18         | 44           |
| 2009         | 28         | 38         | 66           |
| 2010         | 29         | 40         | 69           |
| 2011         | 11         | 16         | 27           |
| 2012         | 19         | 5          | 24           |
| 2013         | 2          | 7          | 30           |
| <b>Total</b> | <b>241</b> | <b>184</b> | <b>425</b>   |



## 7.4 Society for Innovation and Development

**Chief Executive:** Jayant M Modak

The mission of SID is to enable India's innovations in science and technology by creating a purposeful and effective channel to help and assist industries and business establishments to compete and prosper in the face of global competition, turbulent market conditions and fast moving technologies. SID strives to bring the leading intellectuals of IISc and the fruits of their research and development efforts closer to industries and business.

It has made long strides in achieving its mission of being a purposeful channel for transferring technologies developed by IISc faculty, connecting them to industries and networking with other institutions to promote innovations in Science and Technology.

**The following summarizes the activities and achievements during 2013-14:**

|                       |   |
|-----------------------|---|
| ➤ Projects Sanctioned | 5 |
| ➤ MOUs signed         | 2 |

**Projects Sanctioned:** During the period under review, SID got 5 projects sanctioned. These were in different departments of the Institute and involved the participation of a number of faculty members.

**Industry R&D Centres in SID/IISc campus:** The following companies continue to operate their R&D Centres on Campus: Tata Motors (Automotive), Pratt & Whitney (Aerospace), i2n Technologies Private Limited (Nanotechnology), Robert Bosch Centre for Cyber Physical Systems and OSDD CSIR Research Centre.

**Other Centres in SID/IISc campus:** Kishore Vaigyanik Prothsaan Yojana, Centre for Infrastructure, Sustainable Transportation and Urban Planning, Spectroscopy Analytical Test Facility

**Companies/Industries with which Agreements/ MOUs have been signed during 2013-14:** The following firms have entered into agreements, and project proposals have been submitted. In some cases projects have been funded/ and in others they are in process.

- Unilever

### Interact Meetings

SID has regularly been receiving a number of enquiries on the modalities to be followed in the sponsoring of projects, and for the establishment of R&D Centers. SID continues to organize Interact sessions between the scientists/technologists from various industries and the faculty of IISc to showcase the capabilities of the Institute that would enable in the growth of applied research. The following participated in the interact sessions:

- CocaCola
- Loreal
- BEML
- DSM
- SAFRAN
- NTPC

### Incubation Centre:

The following incubatees continue to operate under the Incubation Centre provided by SID.

| Company   | Incubatees                                | Technology Area  |
|---|---|--|
| Instrumentation Scientific Technologies Pvt. Ltd. | Mr. Sumeet Yamdagni<br>Alumnus of IISc    | Structural Health Monitoring using Fiber Bragg Grating to cater to the needs of the aerospace, civil and risk management sectors |
| Gamma Porite Electro Tech Pvt. Ltd.               | Mr. Adhiraj Deshpande,<br>Alumnus of IISc | Energy Efficient Lighting products   |

SID has received new proposals on Incubation facilitation and these are in process.

**Entrepreneurship Cell:** The Entrepreneurship Cell continues to be actively involved in the examination of new proposals for incubation, mentoring the present incubatee and creating awareness among the student community of IISc.



## 7.5 Advanced Bioresidue Energy Technologies Society (ABETS)

Chief Executive: Jayant M Modak

**Research Highlights:** Further, the research activities related to producer gas engine and biomass gasification has resulted in the development of technology packages. Hydrogen generation from biomass gasification and liquid fuel generation using FT synthesis is another important area of research.

**Collaborative Research with Cummins India Limited:** The 500 kW lean burn engine designed for natural gas has been adapted for producer gas and is being field tested for peak power.

**Precipitated Silica:** The installation of the 5 Tons per day silica plant is nearly complete and it will begin operation during the month of March 2014. This would be first of its kind in the world, where a commercial scale plant will convert rice husk ash to precipitated silica. Over the last year, based on pilot scale research activity, the properties of silica such as surface area, purity, particle size and related aspects have been matched with the requirement of the tyre industry, thus ensuring a marketable product.

**National Focal Point for Biomass Resource Mapping:** A Biomass web atlas has been developed and has been operational since 2008. A Nationwide geographical biomass assessment was done, initially, for agricultural residues for the year 1998-99. Later it was updated by adding the biomass assessment for the years beyond 1999. Low resolution land use RSD (Remote Sensing Data) was taken from ISRO-RRSC for the purpose of bringing down the costs. The biomasses are of different types and have different characteristics in terms of energy generation. With this background, certain a-priori logics were used to classify the agricultural land use areas into specific crops at the district level according to district level crop statistics published by MoA.

### Current Projects

- The Following three R & D projects have been sanctioned from MNRE and are ongoing.
  - Hydrogen and Liquid fuel from biomass gasification
  - Advanced RDF Gasification Systems
  - Biomass Resource Map of India

**Progress on Stoves:** An EIGAS stove integrated to a boiler with aluminum clad insulation has been installed in the South indies first floor kitchen. The stove is operational in the kitchen for generating steam. The Biomass consumption is 5.4 tons/month replacing 1.7 tons of LPG per ton. (Biomass : Rs. 7000/ton, Rs. 0.37 lakhs/month, LPG: Rs. 96,000/- per ton, 1.71 lakhs/month) The daily operational duration is about 14 hours. The system is capable of heating about 160 l of ambient temperature water to boiling point in 20 minutes. The system is used for cooking South Indian breakfasts and lunches/dinners. Large scale activity is being planned.

On the commercial side with a pelletised stove, 3000 commercial establishments are using the stove consuming around 100 tons of Pellets every day and replacing around 40 tons of LPG per day. Thus amounts to a daily saving of around Rs. 15 Lakhs per day (400.00 million savings annually).

**On-going Demonstration Project:** Based on gasification technology, major projects are being implemented. The following are some of the highlights of the projects.

- Project : 1.5 MW in Gadag, grid connected operational
- Project : Cummins Co-generation group – 1.2 MW as an IPP in Tamilnadu – operational
- Project : 2.3 MW project in the heart of Tirupur for power generation and air-conditioning of a shopping mall – Installation complete
- 6 MW of Independent Power Production is being implemented in Tamilnadu – commissioning in progress.

**Technology Transfers:** An MoU has been signed with M/s Usher Eco Power Limited, who is the license holder for precipitated silica from rice husk ash technology. They sought a 5-year time exclusivity and this has been granted.

### Patents Filed

- A Vietnamese Patent has been granted for the Application No. 1-2005-01301 filed on 18/02/2004 Entitled: "A novel process and apparatus for the manufacture of precipitated silica from rice husk ash" Patent No. 11795



## 8. Central Facilities

### 8.1 Infrastructure – Buildings

**W**orks completed during the year (value higher than ₹. 10.00 lakh each)

| Sl. No.                          | Description of Works  | Cost (₹ in lakhs) | Area in Sq. Mtrs. |
|----------------------------------|---|-------------------|-------------------|
| <b>New</b>                       |   |                   |                   |
| 1.                               | Construction of 2.0 lakhs litre capacity overhead tank and 6.0 lakh litre capacity UG Sump tank in the Campus                           | 75.00             |                   |
| 2.                               | Construction of additional building in Mathematics Department   | 127.79            | 904.00            |
| <b>Additions and Alterations</b> |   |                   |                   |
| 3.                               | Providing paved parking for car and bicycles at Aerospace Engineering Department  | 23.90             |                   |
| 4.                               | Renovation of works (Civil) in old MRDG Building  | 24.77             |                   |
| 5.                               | Renovation of Instrumentation Department Annexe Building erstwhile genetic Engineering (Civil & Electrical)                             | 40.06             |                   |
| 6.                               | Refurbishment of wards, corridor and internal painting to Health Centre Building  | 22.58             |                   |
| 7.                               | Renovation of LT Substation and Transformer yards   | 14.33             |                   |
| 8.                               | Additions and Alterations to CIDR Lab at CAF Building   | 18.86             |                   |
| 9.                               | Renovation of Electrical Works at Old MRDG Building   | 21.68             |                   |
| 10.                              | Renovation and Electrification works at Ground, First and Second Floor of ICER Building including cable for compressor at IISc Building | 19.98             |                   |

### Work-in-Progress during the year

| Sl. No.                          | Description of Works   | Cost (₹ in lakhs) | Area in Sq. Mtrs. |
|----------------------------------|--|-------------------|-------------------|
| <b>New</b>                       |  |                   |                   |
| 1.                               | Construction of new second floor for CSA & Electrical Engineering  | 384.41            | 2751.00           |
| 2.                               | Construction of laboratories, classrooms, conference hall and office space in Material Engineering Department  | 465.60            | 2265.00           |
| 3.                               | Construction of shopping complex and tea Kiosk   | 301.52            | 2067.00           |
| 4.                               | Asphalting of peripheral road (D Gate to NIAS, NIAS to junction near centenary visitors hostel) new Aerodynamics Building and Internal roads to campus | 210.67            |                   |
| 5.                               | Construction of Dining facility and parking at main guest house  | 43.26             | 300.90            |
| 6.                               | Covering the open spaces on the southern side of Prakruthi Canteen   | 30.36             |                   |
| 7.                               | Construction of New Block for Electronics and Communication Engineering Department   | 643.93            | 3206.00           |
| 8.                               | Construction of additional rooms and dismantling of existing class rooms at Kendriya Vidyalaya   | 260.56            | 1698.00           |
| 9.                               | Construction of new Hydraulics building for Civil Engineering Department   | 791.09            | 4875.00           |
| 10.                              | Construction of additional second floor to Department of Electronic System Engineering (DESE) Building   | 258.17            | 1705.00           |
| 11.                              | Construction of Mezzanine rooms in Hypersonic Laboratory Aerospace Engineering Department  | 33.63             |                   |
| <b>Additions and Alterations</b> |  |                   |                   |
| 12.                              | Replacing wooden windows with aluminium windows and grills in old E type quarters at New Housing Colony  | 36.23             |                   |
| 13.                              | Acoustic treatment and connected Civil and Electrical works at Raja Ramanna Auditorium in Gymkhana Campus  | 66.24             |                   |
| 14.                              | Renovation of ground floor rooms and laboratories at ICER Department   | 31.63             |                   |
| 15.                              | Establishment of 0.5 MLD domestic STP  | 294.00            |                   |
| 16.                              | Renovation and improvement to 'E' Block Hostel   | 162.61            |                   |
| 17.                              | Renovation and additions to old Aerospace Department building to accommodate Administrative Offices  | 267.56            | 653.00            |
| 18.                              | Renovation to ground floor and first floor of southern wing of old MRDG Building   | 19.23             |                   |
| 19.                              | Providing electrical works with fixtures at SSCU annexe (old MRDG Building)  | 21.58             |                   |
| 20.                              | Providing main panel board at SSCU   | 10.69             |                   |

## 8.2 Activities

### 8.2.1 Official Language Unit

**Hindi Teaching Scheme:** An In-Service Hindi Teaching Programme is offered to the staff to train them in the Official Language. The Institute takes the responsibility of providing class-rooms and text books. Classes are organised during office hours. The Institute has also been receiving help from the Office of the Hindi Teaching Scheme, Department of Official Language, Ministry of Home Affairs, Government of India in maintaining the activities of the Institute by nominating teachers to train the staff. Several candidates have been trained in Hindi typing and are able to use Hindi software on the computer.

With a view to enable the staff to understand/correspond in Hindi, many incentives have been provided.

**Hindi Day:** Hindi Day was celebrated on September 16, 2013. Smt. Janki Nair, Joint Director, Central Translation Bureau, Bangalore was the Guest of Honour. Smt. Janki Nair gave away cash prizes to the winners of various competitions and also distributed cash prizes & certificates to the staff members who did well in Hindi examinations. Competitions like Handwriting, Dictation, Solo singing, Reading etc., in Hindi were organized. The Staff of the Institute took part in these competitions with great enthusiasm. A total prize amount worth Rs. 7200/- was given to the winners.

**Hindi Workshop:** The Institute regularly organizes Hindi Workshops on various aspects of the use of Hindi in Central Government offices and conversation sessions for the benefit of the Institute staff. Staff from different sections/units of the Institute take part in these workshops and are utilizing the same in their offices.

Dr. Mahesh, Hindi Officer, DRDO, Bangalore conducted a workshop on "Hindi on Computer" on 7-1-2014 to 9 March, 2014.

Mr. Damodaran, Deputy Director, Hindi Teaching Scheme, Bangalore conducted a workshop on "Hindi Grammar" on 14 August, 2013.

**Darshini Magazine:** Published Quarterly Magazine October-December, 2013 and January-March 2014 issues.

#### Hindi Lecture Series

- Mr. Dr. Abha Mishra, Assistant Professor in Instrumentation & Applied Physics Department, IISc delivered a technical Lecture on "Carbon Structure" on 21 March, 2014

**Official Language Implementation:** To implement the Official Language Policy of the Government, the Institute has made bilingual name plates. The translation of some technical and popular science books is under progress. The Institute has decided to put up uniform trilingual name boards at the main gate entrance. The Institute bilingual webpage is ready for uploading.

#### TOLIC Competitions

Many participants from different Central Government offices participated in "ANTAKSHARI" TOLIC competitions held on 24 October 2013, organized under the Town Official Language Implementation Committee.

Many participants from different Central Government offices participated in the "HINDI SYPOSIUM". The Official Language Unit organized TOLIC competitions on 5 June 2013, under the Town Official Language Implementation Committee. The Institute staff also participated in different competitions organized by TOLIC and won two prizes.

#### Translation:

- Translation of Institute Annual Report into Hindi
- Translation of Annual Accounts into Hindi
- Translation of other administrative manuals, forms and day-to-day correspondence.
- Translation of Institute Profile into Hindi
- Translation of "Sir J.C. Bose" book into Hindi

### 8.2.2 SC/ST Cell

The Governing Council of the Institute has decided to follow Government of India directives/orders regarding reservations, concessions, relaxation, etc., in favour of Scheduled Castes and Scheduled Tribes.

The SC/ST Cell monitors "Registers of Roster" pertaining to direct recruitments and promotions maintained for both teaching and non-teaching staff. The Cell strictly ensures the Institute's adherence to Government of India directives/orders regarding reservations, concessions, relaxation etc., for Scheduled Castes and Scheduled Tribes.

The Cell furnishes statistical information regarding the representation of SCs & STs in the service of the Institute to the Ministry of Human Resource Development, the University Grants Commission and the National Commission for Scheduled Castes and Scheduled Tribes as and when called for.





The Cell also looks after the implementation of welfare measures such as the reimbursement of tuition and other fees, etc. for SC/ST staff wards.

### 8.2.3 Counselling and Support Centre

The Centre for Counselling and Support (CCS) provides professional support to employees in various kinds of distress, especially those related to debts, alcoholism, absenteeism, family, health and personal matters. The Centre extends educational support to the children of the employees of the Institute through Guidance programmes. The Centre also runs training programmes for family members of the staff who are assessed to be in need of them. A small library for school-going children is also maintained.

Also, the Centre raises awareness amongst the Institute community about social problems through (i) arranging lectures, film shows, (ii) disseminating information through pamphlets, posters

During the year the Centre conducted the following programmes:

- ◆ Yoga, Pranayama, Mudra & Meditation and Clapping and Laughter Therapy classes for Faculty/Students/ Employees and their dependents.
- ◆ Drawing and painting classes for employees and their dependents.
- ◆ Organized a Lecture on "Constitution of India and Economic conditions of SC/ST" by Mr. Hariram, Lecturer, NMKRV College, Bangalore on 30 April 2012.
- ◆ Launched an online chat facility for Counselling on 30 October 2012 followed by a special talk "Handling stress for better work-life balance" by Dr. Sudha Bhogle in collaboration with Student support Network, Student Council, IISc.
- ◆ Organized interaction with Students (Student support network committee, Students Council) for Counselling.

### 8.3 Women's Cell

This cell was established in 2004. The cell takes care of the welfare of women employees and students on the campus. Prof. Nalini Dwarakanath has been engaged as Counsellor at the cell to counsel women employees/ students in the campus. The cell, in collaboration with the Centre for Counselling and Support, conducts Yoga, Pranayama, Mudra, Meditation, Clapping and Laughing Therapy classes every day. The cell meets periodically during the year and addresses complaints received from women.

### 8.4 Public Information Office

Right to Information Act, 2005: The Institute adopted the Right to Information Act, 2005 in the year 2006. Mr. M.R. Chandrasekar, Senior Security Officer has taken charge as Public Information Officer (PIO) from Mr. V. Nagaraja. The Institute has disseminated certain information voluntarily through its website, which is accessible to the public. So far, the Public have made 175 requests to the Institute seeking information under RTI, 2005 and the information available with the Institute has been promptly furnished.

### 8.5 Alumni Association

A brief report of the activities organised by IIScAA are as follows:

The IISc Alumni Association (IIScAA) has about 9065 members, During 2013-14, a total of 112 members were enrolled.

IISc Alumni Association Science Forum is intended to promote the quality of the dialogue on the new roles and challenges of global society through a Popular Lecture Series. During the year, it organized 7 popular lectures on different topics. In addition, it arranged several Alumni Network Meets. It also periodically brought out IIScAA Newsletters.

The IISc Alumni Association, in association with the Tata Memorial Club, organized an Aadhaar Card Registration Facility exclusively for alumni members and their Spouses

The 38<sup>th</sup> Annual General Body Meeting was organized on August 24, 2013. Election was held for the IISc Alumni Association for the year 2013-15 and was held for the Executive Committee, but the Elections were not held as the number of nominations received equaled the number of Posts. The Distinguished Alumnus Awards 2013 were also presented by the Director on that day.

The IIScAA organized the felicitation function of **Prof. C.N.R. Rao**, Honorary President, Linus Pauling Research Professor, National Research Professor, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, on being conferred the prestigious "**BHARAT RATNA**" by the Government of India. It was held on January 10, 2014 at the Faculty Hall, IISc. Prof. Arcot Ramachandran, Former Secretary to the Department of Science & Technology and Former Director, IIT-Madras, presided over the function. Prof. N. Balakrishnan, Prof. G. Padmanaban and Dr. V. K. Aatre spoke on the occasion.





The 4<sup>th</sup> Sports Meet among IISc alumni was held on 19<sup>th</sup> January 2014 (Sunday) at the IISc Gymkhana ground. A total of 70 members participated in the event.

The IISc Alumni Association honoured senior retired professor of IISc on January 26, 2014

The IISc Alumni Association organized a talk by Dr. Sharat Singh, Head of Diagnostics, Nestle Health Sciences and Chief Scientific Officer, Prometheus Laboratories, San Diego, California, USA, on the topic – “Personalized Medicine” on February 12, 2014 at the Centre for Nano Science and Engineering Auditorium, IISc.

## 8.6 Professional Societies

### The Professional Societies at IISc are:

- ◆ Advanced computing and Communication Society (ACCS)
- ◆ American Society of Civil Engineers, [IS] Southern Region, Bangalore
- ◆ Asian Nature Conservation Foundation (ANCF)
- ◆ Chemical Research Society of India
- ◆ Electrochemical Society of India
- ◆ I E E E – Council on Nanotechnology
- ◆ IEEE Signal Processing Society, Bangalore chapter
- ◆ Indian Crystallographic Association
- ◆ Indian Institute of Metals, Bangalore Chapter
- ◆ Instrument Society of India
- ◆ Karnataka Geotechnical Centre, Bangalore Chapter
- ◆ Materials Research Society of India
- ◆ National Magnetic Resonance Society, India
- ◆ National Organic Symposium Trust
- ◆ Operation Research Society India
- ◆ Society of Biological Chemists (India)



## 9. Campus Facilities

### 9.1 Health Centre

The Health Centre extends primary health care to the staff, their family members, pensioners and their spouses, family pensioners and students. The Centre offers round-the-clock out-patient and in-patient treatment. A Clinical Laboratory, ECG, Digital X-ray and Ultrasound facilities are available. Specialist care in General Medicine, Gynaecology, ENT, Dermatology, Dentistry, Ophthalmology, Psychiatry and Physiotherapy are also available. It has a Pharmacy which stores most medicines and an operation theatre to cater to minor surgeries.

For cases requiring hospitalization for major illness, patients are referred to outside recognized hospitals for admission and treatment. All the permanent employees and their family members, and retired employees and their spouses and also family pensioners are covered by the Group Mediclaim Insurance Policy under the Contributory Health Service Scheme (CHSS).

The Health Centre has experienced doctors and area doctors to cater to the needs of employees residing in the campus and outside.

Ayurvedic Health care is provided in an alternative system of medicine by recognized Ayurvedic Practitioners. Emergency care is given at the Health Center round-the-clock and an ambulance service is available.

### 9.2 Recreation

**9.2.1 Gymkhana:** The spacious and well designed Gymkhana is the nodal centre for sports and cultural activities of the students and faculty. It offers facilities for many outdoor and indoor games and has a well equipped gymnasium, a mini gymnasium for ladies and a swimming pool. In addition, the Gymkhana houses the Nature club, Dance club, Dramatic club, Literary, Fine Arts and Photographic club and a well-equipped modern music room. The Ranade Library in Gymkhana offers light reading material in English and in many Indian languages. Other features include periodic coaching classes in games and athletics such as Basket Ball, Tennis, Swimming, Kung Fu, Archery, Athletics, Aerobics and Dance. The Football/ Hockey and Tennis grounds are facilitated with floodlight. The Raja Ramanna Student's Activity Centre (SAC) is open for cultural activities.

The Gymkhana conducted a number of sports and games competitions during the year in connection with Founder's Day, Independence Day, Republic Day and Gandhi Jayanthi. The indoor and outdoor game clubs held annual tournaments throughout the year. The Institute's Cricket team, Football team, Hockey team, Tennis Team, Billiards team, Lawn Tennis team and Volleyball team participated in Club Tournaments, League matches and Inter Collegiate Tournaments. The Gymkhana has also conducted Inter Departmental / Open matches for the students, faculty, staff, spouses and their children.

**9.2.2 Faculty Club:** The Faculty Club is a place for recreational, social and cultural activities.

Some of the salient activities of the club are: Indoor Games (Billiards/Snooker, Carrom, Table Tennis and Chess); Outdoor Games (Tennis); Fine Arts; Library & Reading Room (subscribes to dailies, weeklies and popular magazines); T V Lounge; Ladies Section; Snack Parlour and Pastry Shop and a Mini Gym. Classical music concerts are organized regularly on the campus.

During the year Hatric Sports Magnetic Elliptical Cycle, Hatric Sports steel dumbbells, two computers with UPS, a Reclining Sofa and new chairs were added.

**9.2.3 Tata Memorial Club:** This Club provides the space and facilities for various games and cultural activities for the supporting staff of the Institute.

In addition to organizing outdoor and indoor games, its activities cover swimming coaching, computer training, Abacus class, creative camps, dance training, musical instrument training. Yoga / Meditation classes, and Sloka classes for members, students & their dependents. Tution classes are conducted with, the support of student volunteers for needy dependents children. The club also can borrow Engineering and Medicine text books for needy children of the Institute community. The mini multi gym facility is open to the Institute community. The club also maintains a Library. A Regular Blood Donation camp is organized on Independence and Republic day in co-ordination with the Students Council / Lions club (Aishwarya).

The Tata Memorial science quiz was organized on National Science Day. The club organised Badminton / Carrom / Table Tennis tournaments for students, faculty and staff. The club also organised the Karnataka Rajayotsava in co-ordination with the Kannada Sangha.

The club made arrangements for AADHAR registration for the Institute community.



## 9.3 Auditoria

**9.3.1 National Science Seminar Complex:** The magnificent National Science Seminar Complex situated in the IISc Campus is the first of its kind in India. The complex is open for seminars, symposia and conferences organized by recognized scientific societies, educational institutions and professional bodies. The total built up area measures around 5750 sq. metres.

This fully air conditioned complex houses the JN Tata Auditorium with a seating capacity of 750 and 3 mini auditoria to seat 120, 90 and 60 people respectively. Interactive concourses at the basement and ground level with excellent light and sound facilities are part of the seminar complex. The business centre at the complex has facilities for photo copying, FAX, STD/ISD phone booths and secretarial assistance.

**9.3.2 Prof. Satish Dhawan Auditorium:** Located on the first floor of the Centre for Scientific and Industrial Consultancy, this medium sized auditorium has a seating capacity of 265. It has fixed seats and a dais suitable for conferences and chamber music. It is fully air-conditioned and is adequately equipped with sound, lighting and projection equipment.

**9.3.3 Rustum Choksi Hall:** Located close to the entrance of the Institute, with a seating capacity of 120, the interior of the hall and its surroundings provide the right environment for intellectual inquiry and cultural activities.

**9.3.4. Faculty and Reception Hall:** The Faculty Hall with a seating capacity of 275 is located in the east wing, on the first floor of the tower building. The Reception Hall is in the west wing. These are used for formal events.

## 9.4 Amenities

The following amenities located in different parts of the campus make day-to-day life smoother and more

comfortable. In fact, these facilities have made IISc a totally self contained campus.

- Travel Agencies (Domestic & International Travel)
- Photo copying and DTP Centres
- Stationery/Book Shops
- Pharmacy
- Laundries/Dry cleaners
- Tailoring Shops
- Restaurant
- Tea Parlour
- Juice Shop
- Provision and General Stores
- Vegetable Shop
- Bakery & Pastry Shop
- Hair Dressing Saloons
- Baby Care Centre
- Ladies Boutique
- STD Booth
- Cycle Shop
- Canteen Facility
- Cable Facility
- Nandini Milk Parlour
- Regal Star Electronics/Electrical Repair Shop

**Communications:** There is a Post Office (Science Institute, Bangalore – 560 012), Telecom Centre and STD booths. The Institute is connected by the Centrex Exchange from M/s BSNL with 1200 extensions. In addition, there are nearly 250 direct lines to different departments and centres.

Centralized electronic franking takes care of outward postage and is supported by a centralized FAX facility. The Transport section maintains a fleet of service vehicles through approved travel agencies.

**Banks:** The Canara Bank and the State Bank of India have fully computerized branches with many facilities including foreign exchange transactions and ATM machines.





# 10. New Initiatives and Second Campus

## 10.1 New Initiatives

### 10.1.1 Interdisciplinary Centre for Energy Research

The Interdisciplinary Centre for Energy Research (ICER) was set up in 2012. Research in energy is interdisciplinary by its nature, needing expertise in many different domains. Taking into consideration the strengths of the Institute in various field related to energy and the present need for the country in energy research, IISc has created this interdisciplinary centre. A wide range of research activities related to energy are already being carried out by individual faculty members, which are already serving as a base for energy research. Under ICER, research on various fields such as concentrating solar power (CSP), next generation solar photovoltaic (PV), high storage density battery, green buildings, sustainable technologies, combustion science and technology have been undertaken.

As part of the Centre's activities, collaborative projects between various departments at IISc have already been initiated. Major projects have been recently funded (or approved for funding) by DST, MNRE, Indo-US Science and Technology Forum, and Karnataka Government. An MoU has been signed between IISc and Homi Bhabha National Institute (HBNI) for carrying out joint research and educational activities in the field of energy. MoUs have also been signed with the Solar Energy Centre (SEC), Gurgaon, and the Bureau of Energy Efficiency (BEE), Ministry of Power, for collaborative work in energy. In addition to the energy research activities in the main IISc campus, ICER has also undertaken the development of major research solar fields in PV as well as CSP areas in the new IISc Challakere campus, along with the establishment of some solar power systems based on innovative technologies. Some notable projects under ICER which have already been initiated are the Solar Energy Research Institute for India and the United States (SERIUS) funded by IUSSTF, National Centre for Combustion Research and Development (NCCRD) funded by DST and Research Centre for Solar Power funded by the Government of Karnataka.

### 10.2 IISc Second Campus (Challakere, Chitradurga)

Consequent upon the acquisition of 1,500 acres of land near Challakere in Chitradurga district, and a topographical survey and a rapid survey of bio-diversity have been completed. The planning and development of the Challakere campus of the Institute has been progressing steadily.

A detailed Master Plan for land use and demarcation of the areas for academic and residential requirements has been prepared. The Plan also includes possible regions for developing vegetation and rain water harvesting.

The Following activities pertaining to infrastructure development have been initiated:

- The Main Gate and Security Complex which was awarded to CPWD has been completed.
- Uninterrupted Power supply to the campus has been completed and a substation has been erected on the northern boundary of the campus.
- The work related to two check dams for harvesting rain water has been awarded to CPWD, who in turn awarded the work to a Contractor. The complete design of the check dams has been scrutinized by experts.
- The site work pertaining to the establishment of Solar Power Generation and the Research Centre sponsored by the Government of Karnataka is about to begin.
- Planning of a Climate Research Centre funded by ISRO is in an advanced stage.

All these activities are expected to proceed at a rapid rate once the PIL case filed before the National Green Tribunal, Chennai, regarding allotment of land is cleared.

Talent Development Centre (TDC): Imparting training to High School Science teachers for up-gradation of their knowledge and teaching skills, which commenced during February 2011, continued during 2013-14, with financial support extended by the Government of Karnataka. During the year, PU College teachers were also trained. The programme was well received and more than 4500 personnel have undergone training since its inception.

# 11. Finance

The Ministry of Human Resource Development provides Non-Plan and Plan grant to the Institute for meeting Recurring & Developmental Initiative. The Institute also receives funds from other Government agencies like DST/ DBT/CSIR etc for Extra Mural Research. The UGC/DST also released grants for emerging areas & expansion of

Infrastructure under Centre for Advance Study / FIST Programmes.

The total receipts covering all major areas for the year 2013-14 was ₹ 79,402.37 lakhs and the payments for various activities of the Institute was ₹ 74,706.27 lakhs.

The details of Receipts and Payments are as follows:

₹ in lakhs

| Sl. No. | Particulars                                      | Receipts         | Payments         |
|---------|--|------------------|------------------|
| 1.      | Non-Plan Grant – Recurring                       | 23,718.10        | *23,715.76       |
| 2.      | Plan Grants                                      | 19,468.00        | 14,305.17        |
| 3.      | Developmental Projects                           | 3,828.76         | 6,458.31         |
| 4.      | Centre for Sponsored Schemes & Projects          | 24,578.50        | 22,773.84        |
| 5.      | Centre for Scientific and Industrial Consultancy | 861.92           | 774.00           |
| 6.      | Centre for Continuing Education                  | 315.97           | 385.64           |
| 7.      | Sponsored Scholarships (CSIR/AICTE/UGC)          | 2,020.37         | 1,682.80         |
| 8.      | Academic/Other Income                            | 939.55           | *939.55          |
| 9.      | Interest Earnings/Project Overheads              | 3,671.20         | 3,671.20         |
|         | <b>Total</b>                                     | <b>79,402.37</b> | <b>74,706.27</b> |

\* Salaries & Allowances 18,228.97

Working Expenses 6,426.34

**Total** **24,655.31**