

# ANNUAL REPORT

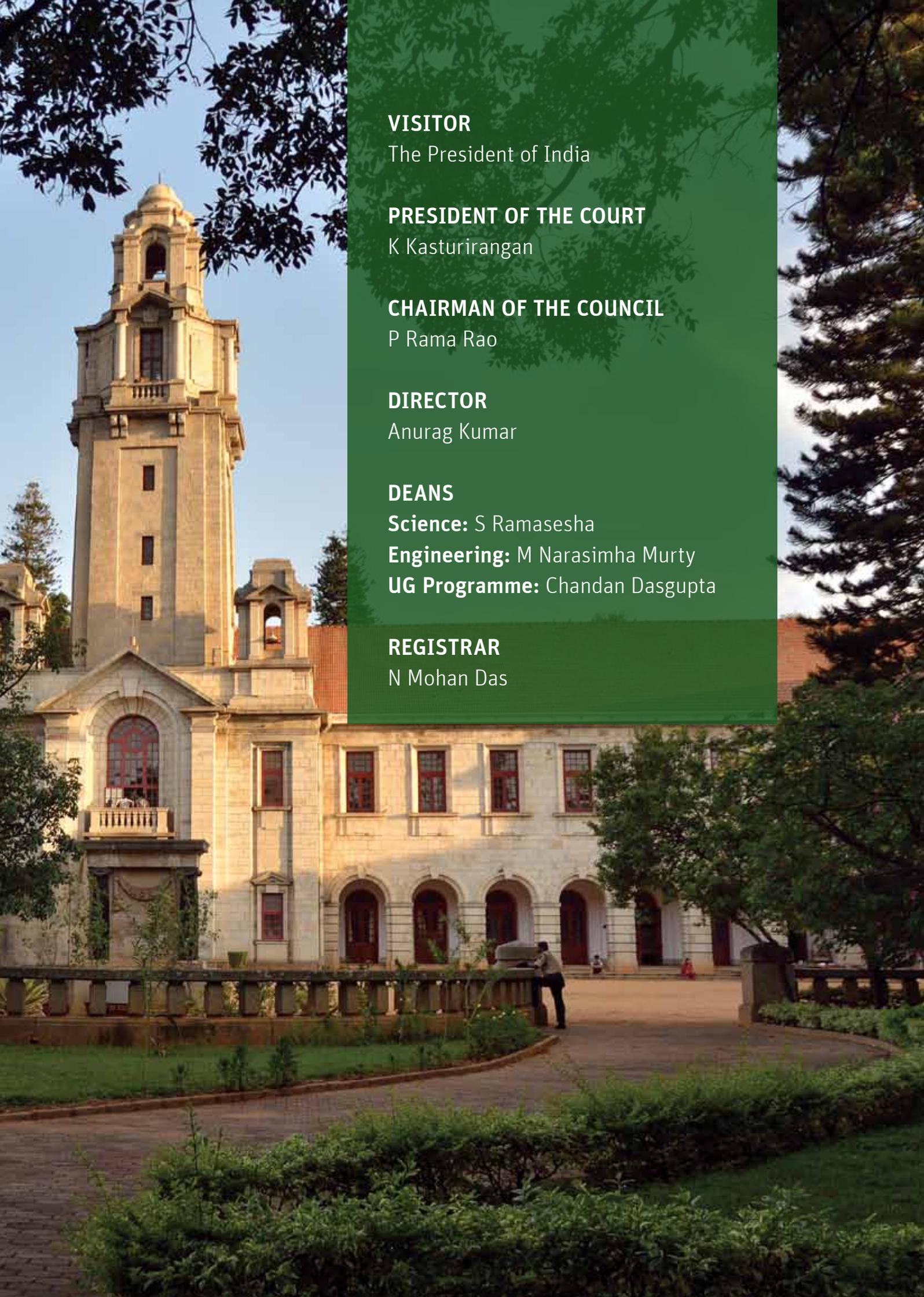
---

IISc 2014-15



INDIAN INSTITUTE OF SCIENCE





**VISITOR**

The President of India

**PRESIDENT OF THE COURT**

K Kasturirangan

**CHAIRMAN OF THE COUNCIL**

P Rama Rao

**DIRECTOR**

Anurag Kumar

**DEANS**

**Science:** S Ramasesha

**Engineering:** M Narasimha Murty

**UG Programme:** Chandan Dasgupta

**REGISTRAR**

N Mohan Das



# CONTENTS

---

<b>Foreword</b>	<b>1</b>	<b>7. Interactions and Outreach</b>	<b>136</b>
<b>IISc at a Glance</b>	<b>3</b>	7.1 Institute Lectures	136
<b>1. The Institute</b>	<b>7</b>	7.2 Conferences/Seminars/ Symposia/Workshops	136
1.1 Court	7	7.3 Departmental Seminars and Colloquia	143
1.2 Council	8	7.4 Visitors	143
1.3 Finance Committee	9	7.5 Faculty: Other Professional Services	143
1.4 Senate	10	7.6 Outreach	143
1.5 Faculties	10	7.7 Office of International Relations	144
<b>2. Visit by the Prime Minister</b>	<b>11</b>	<b>8. Sponsored Research and External Interactions</b>	<b>146</b>
<b>3. Staff</b>	<b>13</b>	8.1 Centre for Sponsored Schemes & Projects	146
<b>4. Awards/Distinctions</b>	<b>24</b>	8.2 Centre for Scientific and Industrial Consultancy	193
<b>5. Students</b>	<b>27</b>	8.3 Intellectual Property Cell	201
5.1 Admissions and On Roll	27	8.4 Advanced Bioresidue Energy Technologies Society (ABETS)	202
5.2 SC/ST Students	29	8.5 Society for Innovation and Development	203
5.3 Scholarships/Fellowships	30	<b>9. Central Facilities</b>	<b>206</b>
5.4 Students Assistance Programme	30	9.1 Infrastructure – Buildings	206
5.5 Students Council	30	9.2 Official Language Unit	207
5.6 Hostels	31	9.3 SC/ST Cell	208
5.7 Institute Medals	31	9.4 Counselling and Support Centre	209
5.8 Awards and Distinctions	33	9.5 Public Information Office	210
5.9 Placement	36	9.6 Alumni Association	210
<b>6. Research and Teaching</b>	<b>38</b>	9.7 Professional Societies	210
6.1 Division of Biological Sciences	38	<b>10. Campus Facilities</b>	<b>211</b>
6.2 Division of Chemical Sciences	49	10.1 Health Centre	211
6.3 Division of Electrical Sciences	58	10.2 Sports and Recreation	211
6.4 Division of Interdisciplinary Research	74	10.3 Auditoria	212
6.5 Division of Mechanical Sciences	83	10.4 Amenities	213
6.6 Division of Physical and Mathematical Sciences	102	<b>11. IISc Second Campus</b>	<b>214</b>
6.7 Research Publications	111	<b>12. Finance</b>	<b>215</b>
6.8 Programmes and Courses	112		
6.9 Degrees Awarded	113		
6.10 Research Conferments	114		
6.11 External Registration	127		
6.12 Undergraduate Program	128		
6.13 Centre for Continuing Education	130		
6.14 J R D Tata Memorial Library	131		





# FOREWORD

---

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 106 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 faculty continues to be very active in research and maintains a high annual publication output, which covers 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 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 sharing, translational research, and technology transfer.

The Institute has a highly qualified and internationally acclaimed faculty numbering about 500, and a student strength of almost 4000. The Institute has introduced many innovations in teaching and research. The traditional degree programs have been the ME, MTech, MDes, MMgt, MSc (Engg) and PhD degrees. In 1990, the Institute introduced the very popular Integrated PhD program (to which students are admitted after a three year BSc) in biological, physical, chemical,

and mathematical sciences. In 2011, the Institute introduced a four-year undergraduate program in which, apart from their course and laboratory work, the students are exposed to research in the laboratories of the Institute.

During the Centenary celebrations in 2009, the Institute acquired a second campus of 1,500 acres in the emerging Science City promoted by the State of Karnataka in Challakere, in the district of Chitradurga. 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. A state electricity board power line now reaches the campus. The main gate of the campus, and an associated security complex have been completed. This campus will be the location for large projects (such as in renewable energy and climate change), extension laboratories, and a skill development centre. A solar collector field for a solar thermal power generation project is nearing completion. A school level science teachers training program is already underway in IISc’s Talent Development Centre, and has been supported by the Government of Karnataka. More than 6,000 science teachers have been trained, and the centre has recently been designated as a Centre of Excellence under the Madan Mohan Malaviya National Program on Teachers and Teaching.

The Institute continues to receive major research support from national and international sources, public and private. The support for recurring expenses, and also for 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 various 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 many other organizations, in the

public and the 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.

Private sources have also supported basic and applied research at the Institute. The activities of the recently established Centre for Neuroscience (CNS) have received a major boost by ₹ 75 crore grant from the Tata Trust. Mr. and Mrs. Kris Gopalakrishnan have committed ₹ 225 crores to the establishment of a Centre for Brain Research, which will be housed on the IISc campus, and will conduct translational research on diseases of the aging human brain. The Infosys Foundation has endowed international visiting chairs in Physics and Mathematics. Recently a major memorandum of understanding has been signed with TCS for promoting a variety of interactions between IISc and India's largest software company.

The Institute strives to have strong international connections in the form of collaborative research programs, such as the INDO-US Energy Program – The Solar Energy Research Institutes for India and United States (SERIUS), the Indo-French Water Cell, and the Indo-French Centre for Applied Mathematics (IFCAM). The Office of International Relations (OIR) at the Institute has facilitated agreements with several universities and R&D institutions worldwide. A newly established Office of Development and Alumni Affairs (ODAA) will strengthen the engagement of alumni all over the world with the Institute, and will enable the Institute to tap various non-government sources for the support of infrastructure development and some new initiatives.

In the recent years, the Institute has created new avenues for the dissemination of knowledge to society. The IISc Press was established during the Institute's centenary year, and has published several monographs and lecture notes in a co-publishing agreement with international publishers. Efforts have been underway

to regularly release information to the public about significant scientific and technical progress at the Institute; this also aims to promote scientific temper in the society.

I am honoured to present the IISc Annual Report which reports the academic output and related achievements during the period 2014-15. The volume of high quality work reported goes to the credit of the intellectual activities of the faculty members and the students, to the support of the technical and administrative personnel, and to financial support from various funding agencies. Some notable landmarks for the year 2014-15 were: (1) A visit by the Honourable Prime Minister of India, Mr. Narendra Modi, during which he dedicated to the nation the Centre for Excellence in Nano Science and Engineering, unveiled the foundation stone of the Centre for Brain Research, presided over the signing of an MoU between an IISc promoted company and ONGC, and had technical interactions with a cross-section of the IISc faculty; (2) The graduation of students from the first batch of IISc's new undergraduate program; (3) The installation and commissioning of the fastest supercomputer in the country in IISc's Supercomputer Education and Research Centre.

As I complete my first year as Director of this unique institution, I recall the visionary leadership of the former Director Prof. P. Balaram, and the Associate Director Prof. N. Balakrishnan who were at helm of the Institute for almost a decade, and I place on record my personal gratitude to the Chairman and the Members of the Council of the Institute for their valuable guidance.



A handwritten signature in black ink that reads "Anurag Kumar". The signature is fluid and cursive, written in a professional style.

**ANURAG KUMAR**  
Director

September 2015

# DIVISIONAL STRUCTURE

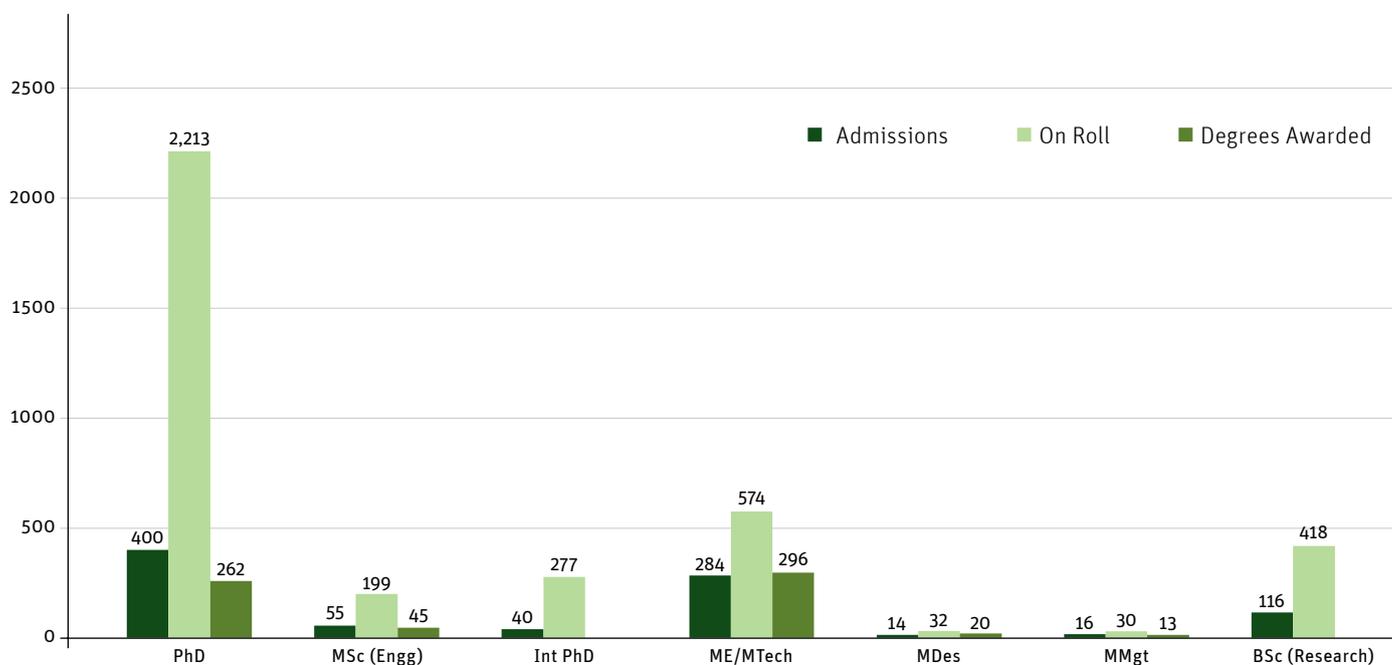
IISc at a Glance 2014-15

<b>Division of Biological Sciences</b>	<b>BC</b>	Biochemistry	Academic Faculty	74
	<b>MCB</b>	Microbiology and Cell Biology	Sci./Tech Officers	10
	<b>MRDG</b>	Molecular Reproduction, Development and Genetics	Degrees Awarded	49
	<b>MBU</b>	Molecular Biophysics Unit	Publications	351
	<b>CES</b>	Centre for Ecological Sciences		
	<b>CIDR</b>	Centre for Infectious Disease Research		
	<b>CNS</b>	Centre for Neuroscience		
	<b>CAF</b>	Central Animal Facility		
<b>Division of Chemical Sciences</b>	<b>IPC</b>	Inorganic and Physical Chemistry	Academic Faculty	53
	<b>OC</b>	Organic Chemistry	Sci./Tech Officers	11
	<b>SSCU</b>	Solid State and Structural Chemistry Unit	Degrees Awarded	44
	<b>MRC</b>	Materials Research Centre	Publications	344
	<b>NRC</b>	NMR Research Centre		
<b>Division of Electrical Sciences</b>	<b>CSA</b>	Computer Science and Automation	Academic Faculty	75
	<b>ECE</b>	Electrical Communication Engineering	Sci./Tech Officers	21
	<b>EE</b>	Electrical Engineering	Degrees Awarded	239
	<b>ESE</b>	Electronic Systems Engineering	Publications	389
<b>Division of Interdisciplinary Research</b>	<b>MS</b>	Management Studies	Academic Faculty	33
	<b>CCS</b>	Centre for Contemporary Studies	Sci./Tech Officers	11
	<b>CISTUP</b>	Centre for Infrastructure, Sustainable Transportation and Urban Planning	Degrees Awarded	36
			Publications	237
	<b>CeNSE</b>	Centre for Nano Science and Engineering		
	<b>ICER</b>	Interdisciplinary Centre for Energy Research		
	<b>RBCCPS</b>	Robert Bosch Centre for Cyber Physical Systems		
	<b>SERC</b>	Supercomputer Education and Research Centre		
<b>Division of Mechanical Sciences</b>	<b>AE</b>	Aerospace Engineering	Academic Faculty	120
	<b>CiE</b>	Civil Engineering	Sci./Tech Officers	31
	<b>CH</b>	Chemical Engineering	Degrees Awarded	219
	<b>MT</b>	Materials Engineering	Publications	880
	<b>ME</b>	Mechanical Engineering		
	<b>CAOS</b>	Centre for Atmospheric and Oceanic Sciences		
	<b>CEaS</b>	Centre for Earth Sciences		
	<b>CPDM</b>	Centre for Product Design and Manufacturing		
	<b>CST</b>	Centre for Sustainable Technologies		
	<b>DCCC</b>	Divecha Centre for Climate Change		
	<b>AFMM</b>	Advanced Facility for Microscopy and Microanalysis		
<b>Division of Physical and Mathematical Sciences</b>	<b>IAP</b>	Instrumentation and Applied Physics	Academic Faculty	70
	<b>MA</b>	Mathematics	Sci./Tech Officers	15
	<b>PHY</b>	Physics	Degrees Awarded	55
	<b>CCT</b>	Centre for Cryogenic Technology	Publications	313
	<b>CHEP</b>	Centre for High Energy Physics		

# STUDENTS

IISc at a Glance 2014-15

## STUDENTS – ADMISSIONS, ON ROLL AND DEGREES AWARDED 2014-15



### COURSES OFFERED (1,408)

Level	
100 (Undergraduate)	21
200 (Post Graduate)	1,093
300 (Research)	291

### CONTINUING EDUCATION (737)

Participants	
QIP	34
Short Term	20
Proficiency	683

### EXTERNAL REGISTRATION (190)

Sponsors	
Government/Undertakings	107
Industries	83

### HOSTELS (2,850)

Men	2,106
Women	744
Messes (4)	

### SCHOLARSHIPS/FELLOWSHIPS (2,696)

IISc	2,189
UGC/CSIR/Others	507

# STAFF

IISc at a Glance 2014-15

## STAFF (1,104)

	SC/ST	OBC	GN
<b>Teaching (513)</b>			
Academic	12	8	405
Scientific	25	5	58
Technical (53)	15	2	36
<b>Support (538)</b>			
Officers	10	2	8
Administrative	72	8	122
Technical	31	3	59
Maintenance	82	7	128
Other	3	-	3

## PUBLICATIONS (2,514)

Science	1,008
Engineering	1,269
Interdisciplinary	237

## INTERACTIONS

### On Campus

Distinguished Lectures	9
Conferences	169

### Visitors

National	410
Overseas	419
Delegations	41

### Staff

Visits	755
Conferences	601
Thesis Examiners	379

## AWARDS/DISTINCTIONS (82)

### Fellows

National Academies	13
International and Others	13

### Awards

**31**

### Medals/Prizes

**10**

### Others

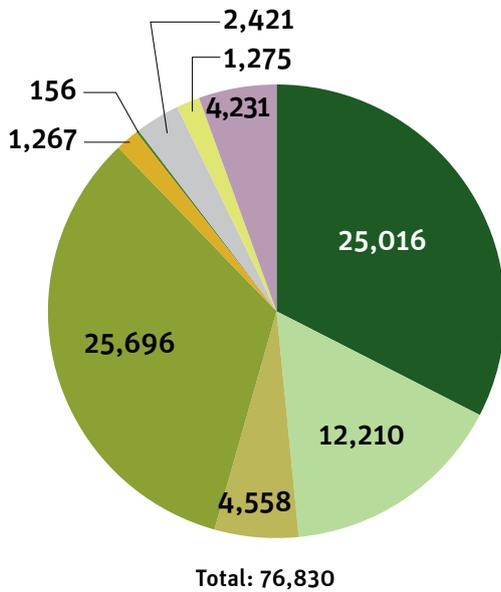
**10**

# FINANCE 2014-15

IISc at a Glance 2014-15

## RECEIPTS

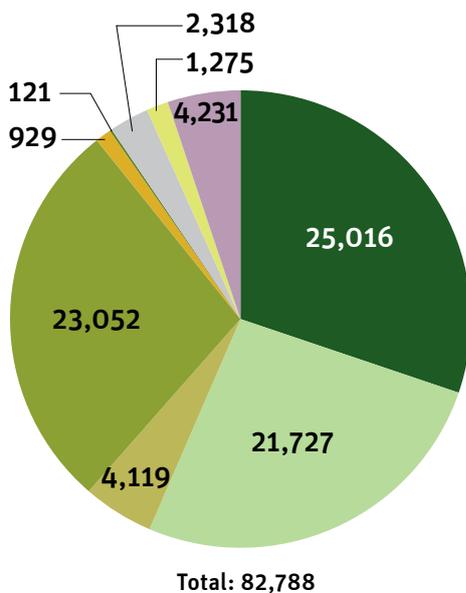
(₹ in lakhs)



- Non-Plan Grant – Recurring
- Plan Grants
- Developmental Projects
- Centre for Sponsored Schemes & Projects
- Centre for Scientific & Industrial Consultancy
- Centre for Continuing Education
- Sponsored Scholarships (CSIR/AICTE/UGC)
- Academic/Other Income
- Interest earnings/Project Overheads

## PAYMENTS

(₹ in lakhs)



# 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

(as on 31.03.2015)

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)

### **PRADEEP VASANT NAIK**

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

### **RAJINDER SINGH MAKER**

Director General  
The Employers Federation of India  
Mumbai (Rep. Employers Federation  
of India)

### **SOM MITTAL**

Former President  
NASSCOM, New Delhi  
(Nom. Visitor)

### **B G NANDAKUMAR**

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

### **AVINASH S PANT**

Chairman  
AICTE, New Delhi  
(Rep. AICTE)

### **SURESH CHANDRA MUKUL**

Former Air Marshal  
New Delhi (Nom. Visitor)

### **R K KRISHNA KUMAR**

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

### **P S AHUJA**

Director General  
CSIR, New Delhi (Rep. CSIR)

### **SATYANARAYAN MOHANTY**

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

### **SAROJ K PODDAR**

Chairman  
Gillette India Ltd.  
Kolkata (Rep. FICCI)

### **HAR SARUP CHAHAL**

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

### **APPARAO MALLAVARARUPU**

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

### **S N AGARWAL**

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

### **C K KOKATE**

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

**S N PURI**

Vice Chancellor  
Central Agricultural University  
Imphal (Rep. Indian Universities)

**V S RAMAMURTHY**

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

**ALL PROFESSORS OF  
THE INSTITUTE**

(Ex-officio)

**HARISH PADH**

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

**H R PARTHASARATHY**

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

**ALL MEMBERS OF  
THE COUNCIL**

(Ex-officio)

**RATAN N TATA**

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

**ANURAG KUMAR**

Director (Ex-officio)

**N MOHAN DAS**

Registrar  
(Ex-officio Secretary)

During the year, the Court met once on 28th March 2015.

---

**1.2 Council**

(as on 31.03.2015)

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)

**I S N PRASAD**

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

**MURLI MANOHAR JOSHI**

Member of Parliament  
(Lok Sabha)  
New Delhi  
(Rep. Parliament)

**SATYANARAYAN MOHANTY**

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

**A N SINGH**

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

**SURESH C ANGADI**

Member of Parliament  
(Lok Sabha)  
New Delhi (Rep. Parliament)

**S P GOYAL**

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

**J J IRANI**

Director  
Tata Sons Limited  
Mumbai (Nom. Tata Trusts)

**ASHOK S GANGULY**

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

**BHARAT LAL MEENA**

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

**S K JOSHI**

Former Director General  
CSIR, Gurgaon (Rep. UGC)

**S N AGARWAL**

Chairman  
Bhoruka Power Corporation Ltd.  
Bangalore (Nom. Court)



**V S RAMAMURTHY**

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

**AVINASH S PANT**

Chairman  
AICTE, New Delhi  
(Rep. AICTE)

**M NARASIMHA MURTY**

Dean  
Engineering Faculty  
(Ex-officio)

**S N PURI**

Vice Chancellor  
Central Agricultural University,  
Imphal (Rep. Indian Universities)

**P S AHUJA**

Director General  
CSIR, New Delhi  
(Rep. CSIR)

**S RAMASESHA**

Dean  
Science Faculty  
(Ex-officio)

**HARISH PADH**

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

**ANURAG KUMAR**

Director  
(Ex-officio)

**N MOHAN DAS**

Registrar  
(Ex-officio Secretary)

The Council met quarterly on 28th Jun 2014, 27th Sep 2014, 23rd Dec 2014 and 28th Mar 2015.

---

## 1.3 Finance Committee

(as on 31.03.2015)

The following are the members of the Finance Committee:

**P RAMA RAO**

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

**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)

**YOGENDRA TRIPATHI**

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

**BURZIS S TARAPOREVALA**

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

**ANURAG KUMAR**

Director  
(Ex-officio)

**S P GOYAL**

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

**V S RAMAMURTHY**

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

**N MOHAN DAS**

Registrar  
(Ex-officio Secretary)

The Finance Committee met quarterly on 27th Jun 2014, 26th Sep 2014, 19th Dec 2014 and 27th Mar 2015.

---

## 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 27th May 2014, 15th Sep 2014, 1st Dec 2014 and 10th Feb 2015.

**The Senate recommended the award of various degrees as follows:**

- PhD : 262
- MSc (Engg): 45
- ME/MTech : 296
- MDes : 20
- MMgt : 13
- Total : 636**

---

## 1.5 Faculties

---

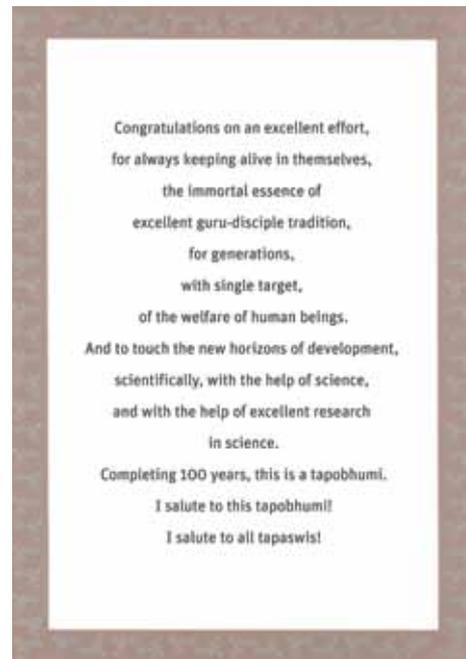
The faculties act as advisory bodies to the Senate and assist in the discharge of its duties. Each Faculty consists of the respective Dean as Chairman, all Professors, Associate Professors, Chief Research Scientists, Principal Research Scientists, Assistant Professors and Senior Scientific Officers as members and the Assistant Registrar as the Secretary.

- The Science Faculty met on 22nd Apr 2014 and 20th Oct 2014.
  - The Engineering Faculty met on 23rd Apr 2014 and 21st Oct 2014 during the year.
  - The Joint Meeting of the Faculties was held twice on 4th Sep 2014 and 9th Jan. 2015. The Director chaired these meetings.
-

# 2

## VISIT BY THE PRIME MINISTER

On 18 February 2015, Prime Minister Narendra Modi visited the Indian Institute of Science (IISc). During his visit, he unveiled the foundation stone of the new Centre for Brain Research (CBR) and rededicated the Centre for Nano Science and Engineering (CeNSE) to the nation. He also witnessed the signing of an MoU between the Oil and Natural Gas Corporation Limited (ONGC) and the Super Wave Technology Pvt. Ltd. (SWTPL), a company started by researchers from the Institute under the Faculty Entrepreneurship Programme (FEP) of IISc.



Prime Minister Narendra Modi's message for the Institute in the Visitors' Book during his visit and translation of the message from Gujarati to English



Prime Minister Narendra Modi interacting with students from IISc.



Foundation stone of the new Centre for Brain Research being unveiled by Prime Minister Narendra Modi



The Prime Minister at the Centre for Nano Science and Engineering



Prime Minister Narendra Modi witnesses the MoU signing between ONGC and a company started by researchers from IISc



# 3

## STAFF

(as on 31.03.2015)

### Administration

**Director: Anurag Kumar**

#### Deans

Science: S Ramasesha

Engineering: M Narasimha Murty

UG Programme: Chandan Dasgupta

#### REGISTRAR

N Mohan Das, PhD (Anna)

#### DEPUTY REGISTRAR

K Panneer Selvam

MA (Madras), LLB (Bangalore)

PhD (Gandhigram Rural)

#### ASSISTANT REGISTRARS

Aparna Kandi, BE (Gulbarga)

V Nagaraja, MA (Mysore)

Veeranna Kammar, MSc (Bangalore)

Joydeep Deb, MSc (Jadavpur)

B N Sreedhar, MBA (KSOU)

P Selva Kumar, MA (KSOU)

#### 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 (Karnatak)

#### FINANCIAL CONTROLLER

Indumati Srinivasan, MA (JNU)

MPhil (JNU), PGDPPM (IIM-B)

#### DEPUTY FINANCIAL CONTROLLERS

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 OFFICERS

R Nirmala, MBBS (Madras)

C Sathish Rao, MBBS (Mysore)

L Sharada, MBBS, DGO

(CMC, Vellore)

#### AUTHORIZED MEDICAL OFFICER

Dr. P Subhashini, MBBS (Bellary)

MS (Rajiv Gandhi)

#### Consultants

##### 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), MTech (Visvesvaraya)

### TECHNICAL OFFICERS

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

### Gymkhana

#### HON. PRESIDENT

R V Ravikrishna, PhD (Purdue)

### Hostels

#### CHAIRPERSON – COUNCIL OF WARDENS

Ashok M Raichur, PhD (Nevada)

#### 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)

### ADVISORS (STUDENTS AFFAIRS)

Nagasuma R Chandra, PhD (Bristol)  
Satish V Kailas, PhD (IISc)

### STUDENTS COUNSELLORS

Vishwesh Guttal, PhD (Ohio State)  
Ambedkar Dukkipati, PhD (IISc)  
Prabal K Maiti, PhD (IIT-K)  
Partha Pratim Mondal, PhD (IISc)  
Ravishankar Narayan, PhD (IISc)

### GUEST HOUSE

P Selva Kumar, MA (KSOU)

## Division of Biological Sciences

Chairperson: D Narasimha Rao

### Biochemistry

#### CHAIRPERSON

C Jayabaskaran

#### PROFESSORS

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 PROFESSORS

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

#### ASSISTANT PROFESSORS

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

#### SENIOR SCIENTIFIC OFFICER

P G Vatsala, PhD (IISc)

### Microbiology and Cell Biology

#### CHAIRPERSON

Umesh Varshney

#### PROFESSORS

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 PROFESSORS

P Ajit Kumar, PhD (IISc)

Dipshikha Chakravorthy, PhD (Pune)

#### ASSISTANT PROFESSORS

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 OFFICERS

Shantinath S Indi, PhD (Exeter, UK)  
William Rasican Surin, PhD (JNU)

#### TECHNICAL OFFICER

Ramappa K Talawar, MSc (Karnatak)

### Molecular Reproduction, Development and Genetics

#### CHAIRPERSON

P Kondaiah

## PROFESSORS

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 PROFESSORS

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

## ASSISTANT PROFESSORS

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

## Molecular Biophysics Unit

---

### CHAIRPERSON

Raghavan Varadarajan

### HON. PROFESSOR

A Surolia, PhD (Madras)

## PROFESSORS

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)  
Balasubramanian Gopal, PhD (IISc)

## ASSISTANT PROFESSORS

Jayanta Chatterjee, PhD (TU,  
Munich)

Rishikesh Narayanan, PhD (IISc)  
Mahavir Singh, PhD (TU, Munich)

## TECHNICAL OFFICER

S Raju, MSc (Annamalai)

## SCIENTIFIC ASSISTANTS

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

## Centre for Ecological Sciences

---

### CHAIRPERSON

Renee M Borges

## PROFESSORS

Raghavendra Gadagkar, PhD (IISc)  
Renee M Borges, PhD (Florida)  
Rohini Balakrishnan, PhD (TIFR)  
R Sukumar, PhD (IISc)

## ASSOCIATE PROFESSORS

N V Joshi, PhD (IISc)  
Kartik Shanker, PhD (IISc)  
Praveen Karanth, PhD (SUNY,  
Albany)

## ASSISTANT PROFESSORS

Kavitha Isvaran, PhD (Florida)  
Maria Thaker, PhD (Indiana)  
Sumanta Bagchi, PhD (Syracuse)  
Vishwesh Guttal, PhD (Ohio State)

## PRINCIPAL RESEARCH SCIENTIST

D M Bhat, PhD (Karnatak)

## SCIENTIFIC OFFICER

T V Ramachandra, PhD (IISc)

## TECHNICAL OFFICER

N N Janardhanan Pillai MSc (Kerala)

## Centre for Infectious Disease Research

---

### CHAIRPERSON

Dipankar Nandi

## Centre for Neuroscience

---

### CHAIRPERSON

Vijayalakshmi Ravindranath

## PROFESSOR

Vijayalakshmi Ravindranath, PhD  
(CFTRI-Mysore)

## ASSOCIATE PROFESSORS

Aditya Murthy, PhD (Pittsburgh)  
Narendrakumar Ramanan,  
PhD (NUS)  
Shyamala Mani, PhD (Syracuse)

## ASSISTANT PROFESSORS

Arun P Sripati, PhD (Johns Hopkins)  
J Balaji, PhD (TIFR)  
Deepak Kumaran Nair,  
PhD (Otto Von Guericke)  
Supratim Ray, PhD (Johns Hopkins)  
Sridharan Devarajan, PhD (Stanford)

## Central Animal Facility

---

### CHAIRPERSON

Kumaravel Somasundaram

## CHIEF RESEARCH SCIENTIST

S G Ramachandra, MVSc (Bangalore)

## SENIOR SCIENTIFIC OFFICER

Ravindranath H Aladakatti,  
PhD (Karnatak)

## TECHNICAL OFFICER

V Ramesh, MSc (Bangalore)

## Division of Chemical Sciences

Chairperson: S Ramakrishnan

### Inorganic and Physical Chemistry

#### CHAIRPERSON

P K Das

#### PROFESSORS

E Arunan, PhD (Kansas)  
Balaji Rao Jagirdar, PhD (Kansas)  
Binny J Cherayil, PhD (Chicago)  
A R Chakravarty, PhD (Calcutta)  
P K Das, PhD (Columbia)  
E D Jemmis, PhD (Princeton)  
G Mugesh, PhD (IIT-B)  
N Munichandraiah, PhD (IISc)  
S Ramakrishnan, PhD (U Mass)  
S Sampath, PhD (IIT-M)  
A G Samuelson, PhD (Cornell)  
K L Sebastian, PhD (IISc)  
Siva Umopathy, PhD (Otago)  
S Vasudevan, PhD (IIT-K)

#### ASSOCIATE PROFESSOR

Partha Sarathi Mukherjee, PhD  
(IACS-Kolkata)

#### ASSISTANT PROFESSORS

Atanu Bhattacharya, PhD (Colorado)  
Sai G Ramesh, PhD (Wisconsin)  
P Thilagar, PhD (IIT-K)  
Upendra Harbola, PhD (JNU)

#### CHIEF RESEARCH SCIENTIST

M Nethaji, PhD (Madras)

#### SENIOR SCIENTIFIC OFFICER

S Sandya, PhD (Kerala)

#### SCIENTIFIC OFFICER

Sanjay Prasad, MTech (Anna)

### Organic Chemistry

#### CHAIRPERSON

Santanu Bhattacharya

#### HON. PROFESSOR

S Chandrasekaran, PhD (Madras)

#### PROFESSORS

S Chandrasekhar, PhD (London)  
N Jayaraman, PhD (IIT-K)  
Kavirayani R Prasad, PhD (NCL)  
Santanu Bhattacharya,  
PhD (Rutgers)  
Tushar Kanti Chakraborty,  
PhD (IIT-K)  
Uday Maitra, PhD (Columbia)

#### ASSOCIATE PROFESSORS

Erode N Prabhakaran, PhD (IIT-K)  
K R Prabhu, PhD (IISc)

#### ASSISTANT PROFESSORS

Mrinmoy De, PhD (U Mass)  
Santanu Mukherjee, PhD (Koln)

### Solid State and Structural Chemistry Unit

#### CHAIRPERSON

D D Sarma

#### HON. PROFESSOR

A K Shukla, PhD (IIT-K)

#### PROFESSORS

Biman Bagchi, PhD (Brown)  
Gautam R Desiraju, PhD (Illinois)  
T N Guru Row, PhD (IISc)  
S Natarajan, PhD (IIT-M)  
S Ramasesha, PhD (IIT-K)  
D D Sarma, PhD (IISc)  
S Yashonath, PhD (IISc)

#### ASSOCIATE PROFESSORS

Aninda J Bhattacharyya,  
PhD (Jadavpur)  
Satish Amrutrao Patil, PhD  
(Bergische, Wuppertal)

#### ASSISTANT PROFESSORS

Anshu Pandey, PhD (Chicago)  
Govardhan P Reddy,  
PhD (Wisconsin)

#### PRINCIPAL RESEARCH SCIENTISTS

A Govindaraj, PhD (Mysore)  
V Jayaram, PhD (IISc)  
C Shivakumara, PhD (IISc)

#### SENIOR SCIENTIFIC OFFICERS

K R Kannan, MSc (Engg) (IISc)  
N Y Vasanthacharya, PhD (IISc)

#### SCIENTIFIC OFFICER

Satish Kumar R, MTech (Anna)

#### SCIENTIFIC ASSISTANT

H M Venkatesh BSc, LLB (Bangalore)

### Materials Research Centre

#### CHAIRPERSON

Arun M Umarji

#### PROFESSORS

Arun M Umarji, PhD (IIT-M)  
Bikramjit Basu, PhD (Katholieke)  
S B Krupanidhi, PhD (Delhi)  
Ravishankar Narayan, PhD (IISc)  
K B R Varma, PhD (Madras)

#### ASSOCIATE PROFESSOR

Karuna Kar Nanda, PhD (IOP, BBSR)

#### ASSISTANT PROFESSORS

Abhishek Kumar Singh,  
PhD (Tohoku)  
Balaram Sahoo, PhD  
(Duisburg Essen)  
Prabeer Barpanda, PhD (Rutgers)

#### TECHNICAL OFFICER

T Narasimha Murthy MSc (Karnatak)

## **NMR Research Centre**

### **CHAIRPERSON**

S Vasudevan

### **PROFESSORS**

K V Ramanathan, PhD (IISc)

N Suryaprakash, PhD (Bangalore)

### **ASSOCIATE PROFESSOR**

P C Mathias, PhD (IISc)

Hanudatta S Atreya, PhD (TIFR)

### **CHIEF RESEARCH SCIENTIST**

S Ragothama, PhD (IISc)

### **SCIENTIFIC ASSISTANT**

P T Wilson MSc (Madurai Kamaraj)

## **Division of Electrical Sciences**

**Chairperson: Y Narahari**

### **Computer Science and Automation**

#### **CHAIRPERSON**

Jayant R Haritsa

#### **PROFESSORS**

Chiranjib Bhattacharyya, PhD (IISc)

K Gopinath, PhD (Stanford)

Y Narahari, PhD (IISc)

M Narasimha Murty, PhD (IISc)

Shalabh Bhatnagar, PhD (IISc)

Y N Srikant, PhD (IISc)

#### **ASSOCIATE PROFESSORS**

Deepak D'Souza, PhD (CMI, Chennai)

R C Hansdah, PhD (IISc)

Satish Govindarajan, PhD (Duke)

S K Shevade, PhD (IISc)

L Sunil Chandran, PhD (IISc)

Vijay Natarajan, PhD (Duke)

#### **ASSISTANT PROFESSORS**

Aditya Kanade, PhD (IIT-B)

Ambedkar Dukkupati, PhD (IISc)

Arnab Bhattacharyya, PhD (MIT)

Chandan Saha, PhD (IIT-K)

K V Raghavan, PhD (Wisconsin)

Murali Krishna Ramanathan, PhD (Purdue)

Sanjit Chatterjee, PhD (ISI Kolkata)

Shivani Agarwal, PhD (Illionois)

B Uday Kumar Reddy, PhD (Ohio)

Bhavana Kanukurthi, PhD (Boston)

Arpita Patra, PhD (IIT-M)

#### **PRINCIPAL RESEARCH SCIENTIST**

V Susheela Devi, PhD (IISc)

#### **TECHNICAL OFFICER**

N Jagadish B E (Mysore)

#### **SCIENTIFIC ASSISTANT**

B K Pushparaj DTE (Bangalore)

### **Electrical**

#### **Communication Engineering**

##### **CHAIRPERSON**

K V S Hari

##### **PROFESSORS**

Anurag Kumar, PhD (Cornell)

A Chockalingam, PhD (IISc)

K V S Hari, PhD (UCSD)

T V Sreenivas, PhD (TIFR/Bombay)

B Sundarajan, PhD (IIT-K)

P Venkataram, PhD (Sheffield)

P Vijay Kumar, PhD (USC)

Vinod Sharma, PhD (CMU)

##### **ASSOCIATE PROFESSORS**

Bharadwaj Amrutur, PhD (Stanford)

Chandra R Murthy, PhD (UCSD)

Navin Kashyap, PhD (Michigan)

Neelesh B Mehta, PhD (CalTech)

Rajesh Sundaresan, PhD (Princeton)

T Srinivas, PhD (IISc)

Utpal Mukerjee, DSc (MIT)

K J Vinoy, PhD (Pennsylvania)

#### **ASSISTANT PROFESSORS**

Aditya Gopalan, PhD (UT-Austin)

Dipanjan Gope, PhD (Washington)

Gaurab Banerjee, PhD (Washington)

Himanshu Tyagi, PhD (Maryland)

Parimal Parag, PhD (Texas)

Kausik Majumdar, PhD (IISc)

#### **PRINCIPAL RESEARCH SCIENTISTS**

T Badrinarayana, PhD (IISc)

Malathi Hedge, PhD (IIT-K)

E S Shivaleela, PhD (IISc)

#### **SENIOR SCIENTIFIC OFFICERS**

Anandi Giridharan MSc (Engg) (IISc)

S V Gopalaiah MSc (Engg) (IISc)

M K Ravishankar MSc (Engg) (IISc)

#### **TECHNICAL OFFICER**

K Elizabeth Rani BTech (JNTU)

### **Electrical Engineering**

#### **CHAIRPERSON**

A G Ramakrishnan

#### **PROFESSORS**

P S Nagendra Rao, PhD (IIT-D)

K Rajgopal, PhD (IISc)

B S Rajanikanth, PhD (IISc)

K R Ramakrishnan, PhD (IISc)

A G Ramakrishnan, PhD (IIT-M)  
L Satish, PhD (IISc)  
P Subbayya Sastry, PhD (IISc)  
D Thukaram, PhD (IISc)  
Uday Kumar, PhD (IISc)

### ASSOCIATE PROFESSORS

Chandra Sekhar Seelamantula,  
PhD (IISc)  
Indraneel Sen, PhD (IISc)  
G Narayanan, PhD (IISc)  
Vinod John, PhD (Wisconsin)

### ASSISTANT PROFESSORS

Kunal Narayan Chaudhury, PhD  
(EPFL)  
M Joy Thomas, PhD (IISc)  
Muthuvel Arigovindan, PhD (EPFL)  
Soma Biswas, PhD (Maryland)  
Venu Madhav Govindu, PhD  
(Maryland)  
Prasanta Kumar Ghosh, PhD (USC)  
Gurunath Gurrata, PhD (IISc)

### PRINCIPAL RESEARCH SCIENTISTS

U Jayachandra Shenoy, PhD (IISc)

G N Ratna, PhD (IISc)  
Subba Reddy Basappa, PhD (IISc)

### SCIENTIFIC OFFICERS

M K Champaka, MSc (Engg) (IISc)  
P V Suryanarayana, MSc (Engg)  
(IISc)

### TECHNICAL OFFICER

K Bhaskar, MCA (Bangalore)

### Electronic Systems Engineering

#### CHAIRPERSON

Joy Kuri

#### PROFESSORS

K Gopakumar, PhD (IISc)  
H S Jamadagni, PhD (IISc)  
Joy Kuri, PhD (IISc)

#### ASSOCIATE PROFESSORS

N S Dinesh, PhD (IISc)  
M K Gunasekharan, PhD (IISc)  
Santanu Mahapatra, PhD (EPFL)  
L Umanand, PhD (IISc)

### ASSISTANT PROFESSORS

Mayank Shrivastava, PhD (IIT-B)  
Chandramani Kishore Singh,  
PhD (IISc)  
Shayan Garani Srinivasa, PhD  
(Georgia)

### PRINCIPAL RESEARCH SCIENTISTS

N V Chalapathi Rao, PGDM (IIM-B)  
D R Hareesh, MSc (Engg) (IISc)  
G V Mahesh, MSc (Engg) (IISc)  
K Varghese, MTech (IISc)

### SENIOR SCIENTIFIC OFFICERS

T V Prabhakar, PhD (TU-Delft)

### SCIENTIFIC ASSISTANTS

V Naga Krishna, ME (Bharathiar)  
P Ramachandran, MSc (Engg) (IISc)  
C R Sachidananda, Dip. Electr.  
(Bangalore)  
A P Saravanan, BSc (Bangalore)  
G Sudarshan, BE (Bangalore)  
K B Vasantha, DEE (CBTE, GOTN)

## Division of Interdisciplinary Research

Chairperson: Govindan Rangarajan

### Management Studies

#### CHAIRPERSON

M H Bala Subrahmanya

#### PROFESSORS

K B Akhilesh, PhD (IISc)  
M H Bala Subrahmanya, PhD  
(Bangalore)  
Mary Mathew, PhD (IISc)  
C Mukhopadhyay, PhD (Missouri)  
R Srinivasan, FIIM (Bangalore)

#### ASSOCIATE PROFESSORS

Parthasarathy Ramachandran, PhD  
(Oklahoma)

Anjula Gurtoo, PhD (Ahmedabad)

#### CHIEF RESEARCH SCIENTIST

M Mathirajan, PhD (IISc)

#### PRINCIPAL RESEARCH SCIENTISTS

P Balachandra, PhD (IISc)  
Parameshwar P Iyer, PhD  
(California)  
Yadnyvalkya, MS (PF, USSR)

### Centre for Contemporary Studies

#### CHAIRPERSON

Raghavendra Gadagkar

### Centre for Infrastructure, Sustainable Transportation and Urban Planning

#### CHAIRPERSON

J M Chandra Kishen

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

#### CHAIRPERSON

Rudra Pratap

#### PROFESSORS

Navakanta Bhat, PhD (Stanford)  
Rudra Pratap, PhD (Cornell)

Staff

### ASSOCIATE PROFESSORS

Manoj Varma, PhD (Purdue)  
Srinivasan Raghavan, PhD  
(Penn State)

### ASSISTANT PROFESSORS

Akshay Naik, PhD (Maryland)  
Ambarish Ghosh, PhD (Brown)  
Digbijoy N Nath, PhD (Ohio State)  
Prosenjit Sen, PhD (California)  
Shankar Kumar Selvaraja, PhD  
(Ghent)  
Sushobhan Avasthi, PhD (Princeton)  
Supradeepa V R, PhD (Purdue)

### Interdisciplinary Centre for Energy Research

#### CHAIRPERSON

K Chattopadhyay

### Robert Bosch Centre for Cyber Physical Systems

#### CHAIRPERSON

S Asokan

### Supercomputer Education and Research Centre

#### CHAIRPERSON

R Govindarajan

#### PROFESSORS

R Govindarajan, PhD (IISc)  
Jayant R Haritsa, PhD (Wisconsin)  
T Mathew Jacob, PhD (Wisconsin)  
S K Nandy, PhD (IISc)

#### ASSOCIATE PROFESSORS

Atanu Kumar Mohanty, PhD  
(Polytech, NY)  
Debnath Pal, PhD (Jadavpur)  
Phaneendra Kumar Yalavarthy, PhD  
(Hanover, USA)  
Sathish S Vadhiyar, PhD (Tennessee)  
K Sekar, PhD (Madras)  
Soumyendu Raha, PhD (Minnesota)

#### ASSISTANT PROFESSORS

Murugesan Venkatapathi, PhD  
(Purdue)  
Partha Pratim Talukdar, PhD (Penn.)

Sashikumaar Ganesan, PhD  
(Lottovon Guericke)  
R Venkatesh Babu, PhD (IISc)  
Yogesh L Simmhan, PhD (Indiana)

#### CHIEF RESEARCH SCIENTIST

H Krishnamurthy, ME (IISc)

#### PRINCIPAL RESEARCH SCIENTISTS

Filbert Minj, MTech (JNU)  
J Lakshmi, MTech (Andhra)  
M R Muralidharan, MTech (Mysore)

#### SCIENTIFIC OFFICER

Yogendra Kumar Negi, MTech (Delhi)

#### TECHNICAL OFFICERS

K P Raghuraman, MSc  
(Bharatidasan)  
S S M Saquaf, BE (Bangalore)

#### SCIENTIFIC ASSISTANTS

T A Chandrappa, MSc (Bangalore)  
K H Gowranga, MSc (Engg) (IISc)  
Nalini Sreeshylan, MSc (Bangalore)

## Division of Mechanical Sciences

Chairperson: K Chattopadhyay

### Aerospace Engineering

#### CHAIRPERSON

Debasish Ghose

#### PROFESSORS

N Balakrishnan, PhD (IISc)  
Debasish Ghose, PhD (IISc)  
S Gopalakrishnan, PhD (Purdue)  
Gopalan Jagadeesh, PhD (IISc)  
Joseph Mathew, PhD (Cambridge)  
K N Lakshmisha, PhD (IISc)  
V Mani, PhD (IISc)  
Ranjan Ganguli, PhD (Maryland)  
K P J Reddy, PhD (BIT, Ranchi)  
M Seetharama Bhat, PhD (IISc)

#### ASSOCIATE PROFESSORS

N Balakrishnan, PhD (IISc)  
Debiprosad Roy Mahapatra, PhD  
(IISc)  
Karthik Venkatraman, PhD (IIT-M)  
Radhakant Phadi, PhD (Missouri)  
S V Raghurama Rao, PhD (IISc)  
O N Ramesh, PhD (IISc)  
T S Seshadri, PhD (Georgia)  
D Sivakumar, PhD (IISc)

#### ASSISTANT PROFESSORS

Arnab Samanta, PhD (Illinois)  
Ashwini Ratnoo, PhD (IISc)  
Dinesh Kumar Harursampath, PhD  
(Georgia)

Santosh Hemchandra, PhD (Georgia)  
Suhasini Gururaja, PhD  
(Washington)  
Swetaprovo Chaudhuri, PhD  
(Connecticut)

#### CHIEF RESEARCH SCIENTISTS

M Ramachandra Bhat, PhD (IISc)  
P S Kulkarni, PhD (IISc)  
S N Omkar, PhD (IISc)  
N K S Rajan, PhD (IISc)

#### PRINCIPAL RESEARCH SCIENTISTS

Charlie Oommen, PhD (IISc)  
S G Kandagal, MTech (Mangalore)

G Narayana Naik, MTech (IIT-M)  
S Saravanan, MTech (IIT-K)  
V Surendranath, MSc (Engg) (IISc)  
B Vasudevan, MAsc (Toronto)

#### SCIENTIFIC ASSISTANT

K Nagashetty, MSc (Engg)  
(Bangalore)

#### IISc-DRDL Joint Advanced Technology Programme (JATP)

#### CONVENER

Ranjan Ganguli

#### IISc – ISRO Space Technology Cell

#### CONVENER

Joseph Mathew

#### Civil Engineering

#### CHAIRPERSON

M Sudhakar Rao

#### PROFESSORS

Ananth Ramaswamy, PhD  
(Louisiana)  
J M Chandra Kishen, PhD (Colorado)  
Debasish Roy, PhD (IISc)  
Jayant Kumar, PhD (IISc)  
C S Manohar, PhD (IISc)  
M S Mohan Kumar, PhD (IISc)  
P P Mujumdar, PhD (IISc)  
D Nagesh Kumar, PhD (IISc)  
Sitharam G Thallak, PhD (Waterloo)  
G L Siva Kumar Babu, PhD (IISc)  
P V Sivapullaiah, PhD (IISc)  
M Sudhakar Rao, PhD (Poona)  
B V Venkata Rama Reddy, PhD (IISc)

#### ASSOCIATE PROFESSORS

Gali Madhavi Latha, PhD (IIT-M)  
M Sekhar, PhD (IISc)  
V V Srinivas, PhD (IIT-M)

#### ASSISTANT PROFESSORS

P Anbazhagan, PhD (IISc)  
Ashish Verma, PhD (IIT-B)

Debraj Ghosh, PhD (Johns Hopkins)  
Narayan K Sundaram, PhD (Purdue)  
Tejas Gorur Murthy, PhD (Purdue)

#### PRINCIPAL RESEARCH SCIENTIST

K S Nanjunda Rao, PhD (IISc)

#### SENIOR SCIENTIFIC OFFICERS

R Vidya Sagar, ME (Bharatiyar)  
P Raghuvver Rao, MSc (Engg)  
(Bangalore)  
S Venkatesha, BE (Bangalore)

#### SCIENTIFIC ASSISTANT

S Shantha Kumar B E (Bangalore)

#### Chemical Engineering

#### CHAIRPERSON

Ganapathy Ayappa

#### PROFESSORS

Ganapathy Ayappa, PhD (Minnesota)  
M Giridhar, PhD (Texas A&M)  
Jayant M Modak, PhD (Purdue)  
K Kesava Rao, PhD (Houston)  
V Kumaran, PhD (Cornell)  
Prabhu R Nott, PhD (Princeton)  
Sanjeev Kumar Gupta, PhD (IISc)

#### ASSOCIATE PROFESSORS

Narendra M Dixit, PhD (Illinois)  
Sudeep Punnathanam, PhD (Purdue)

#### ASSISTANT PROFESSORS

Rahul Roy, PhD (Illinois)  
S Venugopal, PhD (Purdue)

#### CHIEF RESEARCH SCIENTIST

J R Mudakavi, PhD (IIT-M)

#### SENIOR SCIENTIFIC OFFICER

P T Raghuram, MSc (Engg) (IISc)

#### Materials Engineering

#### CHAIRPERSON

Vikram Jayaram

#### PROFESSORS

T A Abinandan, PhD (CMU)  
Ashok M Raichur, PhD (Nevada)  
Atul H Chokshi, PhD (USC)  
K Chattopadhyay, PhD (BHU)  
Dipankar Banerjee, PhD (IISc)  
Govind S Gupta, PhD (Wollongong)  
U Ramamurthy, PhD (Brown)  
Subodh Kumar, PhD (London)  
S Subramanian, PhD (Mysore)  
M K Surappa, PhD (IISc)  
Vikram Jayaram, PhD (Stanford)

#### ASSOCIATE PROFESSORS

Aloke Paul, PhD (Eindhoven)  
Karthikeyan Subramanian, PhD  
(Ohio)  
Praveen C Ramamurthy, PhD  
(Clemson)  
Satyam Suwas, PhD (IIT-K)  
Rajeev Ranjan, PhD (BHU)

#### ASSISTANT PROFESSORS

Abhik N Choudhury, PhD  
(Karlsruhe Inst. of Technology)  
Chandan Srivastava, PhD (Alabama)  
Kaushik Chatterjee, PhD (Penn State)  
Praveen Kumar, PhD (Southern  
California)  
Suryasarathi Bose, PhD (IIT-B)  
Vijay Anand Sethuraman, PhD  
(South California)

#### PRINCIPAL RESEARCH SCIENTISTS

G S Avadhani, PhD (IISc)  
B V Narayana, PhD (SVU)  
R Ravi, PhD (IISc)

#### SENIOR SCIENTIFIC OFFICER

R J Deshpande, MSc (Engg) (IISc)

#### SCIENTIFIC OFFICER

P Padaikathan, MSc (Engg)  
(Bangalore)

#### TECHNICAL OFFICER

V Babu, AMIIM (Calcutta)

## **Mechanical Engineering**

---

### **CHAIRPERSON**

Pradip Dutta

### **HON. PROFESSOR**

M L Munjal, PhD (IISc)

### **PROFESSORS**

G K Ananthasuresh, PhD (Michigan)  
Ashitava Ghosal, PhD (Stanford)  
Chandrasekhar S Jog, PhD (Urbana)  
Jayawant H Arakeri, PhD (Cal Tech)  
R Narasimhan, PhD (Cal Tech)  
Pradip Dutta, PhD (Columbia)  
R V Ravikrishna, PhD (Purdue)  
Satish V Kailas, PhD (IISc)  
K R Yogendra Simha, PhD (Maryland)

### **ASSOCIATE PROFESSORS**

M S Bobji, PhD (IISc)  
Raghuraman N Goverdhan, PhD (Cornell)  
Saptarshi Basu, PhD (Connecticut)  
Venkata R Sonti, PhD (Purdue)

### **ASSISTANT PROFESSORS**

Gaurav Tomar, PhD (IIT-K)  
Namrata Gundiah, PhD (California)  
Pramod Kumar, PhD (IISc)  
Ratnesh K Shukla, PhD (California)  
Vinod Srinivasan, PhD (Minnesota)

### **CHIEF RESEARCH SCIENTIST**

G S V L Narasimham, PhD (IISc)

### **SENIOR SCIENTIFIC OFFICERS**

C Dharuman, MSc (Engg) (IISc)  
M Himabindu, PhD (Anna)

### **SCIENTIFIC OFFICERS**

M K Venkataraman, MSc (Engg) (IISc)  
R Thirumaleswara Naik, PhD (IIT-D)

## **Centre for Atmospheric and Oceanic Sciences**

---

### **CHAIRPERSON**

Ravi S Nanjundiah

### **HON. PROFESSOR**

J Srinivasan, PhD (Stanford)

### **PROFESSORS**

G S Bhat, PhD (IISc)  
Debasis Sengupta, PhD (Bombay)  
Govindasamy Bala, PhD (Mc Gill)  
Ravi S Nanjundiah, PhD (IISc)  
S K Satheesh, PhD (Kerala)  
P N Vinayachandran, PhD (IISc)

### **ASSOCIATE PROFESSORS**

Arindam Chakraborty, PhD (IISc)  
V Venugopal, PhD (Minnesota)

### **ASSISTANT PROFESSOR**

Jai Suhas Sukhatme, PhD (Chicago)

## **Centre for Earth Sciences**

---

### **CHAIRPERSON**

D Nagesh Kumar

### **ASSOCIATE PROFESSORS**

Binod Sreenivasan, PhD (Cambridge)  
Kusala Rajendran, PhD (South Carolina)  
Prosenjit Ghosh, PhD (DAV, Indore)

### **ASSISTANT PROFESSORS**

Attreyee Ghosh, PhD (Stony Brook)  
Ramananda Chakrabarti, PhD (Rochester)  
Sajeev Krishnan, PhD (Okayama)

## **Centre for Product Design and Manufacturing**

---

### **CHAIRPERSON**

B Gurumoorthy

### **ASSOCIATE CHAIRPERSON**

J E Diwakar

### **PROFESSORS**

Amareesh Chakrabarti, PhD (Cambridge)  
Anindya Deb, PhD (New York)  
B Gurumoorthy, PhD (CMU)

### **ASSOCIATE PROFESSOR**

Dibakar Sen, PhD (IISc)

### **ASSISTANT PROFESSOR**

Rina Maiti, PhD (IIT-B)

### **CHIEF RESEARCH SCIENTIST**

J E Diwakar, PhD (IISc)

### **SENIOR SCIENTIFIC OFFICER**

N D Shivakumar, ME (Bangalore)

## **Centre for Sustainable Technologies**

---

### **CHAIRPERSON**

B V Venkata Rama Reddy

### **PROFESSOR**

N H Ravindranath, PhD (IIT-B)

### **ASSOCIATE PROFESSORS**

S Dasappa, PhD (IISc)  
Monto Mani, PhD (IIT-M)

### **ASSISTANT PROFESSOR**

D Sannadurgappa, PhD (Karnataka)

### **CHIEF RESEARCH SCIENTIST**

H N Chanakya, PhD (UAS)

### **TECHNICAL OFFICER**

H I Somashekhar, MSc (UAS)

### **SCIENTIFIC ASSISTANT**

D Venkatakrishnappa, MSc (Bangalore)

## **Divecha Centre for Climate Change**

---

### **CHAIRPERSON**

J Srinivasan

## Division of Physical and Mathematical Sciences

Chairperson: Rahul Pandit

### Instrumentation and Applied Physics

#### CHAIRPERSON

K Rajanna

#### PROFESSORS

S Asokan, PhD (IISc)  
G Mohan Rao, PhD (IISc)  
J Nagaraju, PhD (Nagarjuna)  
K Rajanna, PhD (IISc)  
R M Vasu, PhD (Aston)

#### ASSISTANT PROFESSORS

Abha Misra, PhD (IIT-B)  
G R Jayanth, PhD (Ohio State)  
Partha Pratim Mondal, PhD (IISc)  
Sai Siva Gorthi, PhD (EPFL)  
Sanjiv Sambandan, PhD (Waterloo)

#### CHIEF RESEARCH SCIENTIST

N C Shivaprakash, PhD (Mysore)

#### PRINCIPAL RESEARCH SCIENTISTS

M Chandran, PhD (IISc)  
K R Gunasekhar, PhD (IISc)  
T K Mondal, PhD (IISc)  
S Ramgopal, MSc (Engg) (IISc)

#### SENIOR SCIENTIFIC OFFICER

Vani V Chatterjee, PhD (IISc)

#### TECHNICAL OFFICER

Sharat Ahuja, MSc (Alagappa)

#### SCIENTIFIC ASSISTANTS

B N Somashekara, BSc (Bangalore)  
M N Vanitha, BE (Bangalore)  
H S Vijaya, MSc (Bangalore)

### Mathematics

#### CHAIRPERSON

Gadadhar Misra

#### PROFESSORS

Basudeb Datta, PhD (ISI)  
T Bhattacharyya, PhD (ISI)  
Dilip P Patil, PhD (Bombay)  
Gadadhar Misra, PhD (SUNY, Stony  
Brook)  
Govindan Rangarajan, PhD  
(Maryland)  
Mrinal Kanti Ghosh, PhD (IISc)  
A K Nandakumaran, PhD (IISc)  
Siddhartha Gadgil, PhD (California)  
Srikanth Krishnan Iyer, PhD  
(California)  
S Thangavelu, PhD (Princeton)

#### ASSOCIATE PROFESSORS

Gautam Bharali, PhD (Wisconsin)  
Harish Seshadri, PhD (SUNY)  
Kaushal Verma, PhD (Indiana)  
Manjunath Krishnapur, PhD  
(California)  
E K Narayanan, PhD (Calcutta)

#### ASSISTANT PROFESSORS

Arvind Ayyer, PhD (Rutgers)  
Abhishek Banerjee, PhD  
(John Hopkins)  
Pooja Singla, PhD (IMS-Chennai)  
Soumya Das, PhD  
(Homi Bhabha National Institute)  
Thirupathi Gudi, PhD (IIT-B)

### Physics

#### CHAIRPERSON

V Venkataraman

#### PROFESSORS

Arnab Rai Choudhuri, PhD (Chicago)  
Chanda J Jog, PhD (New York)  
Chandan Dasgupta, PhD  
(Pennsylvania)  
H R Krishnamurthy, PhD (Cornell)  
Reghu Menon, PhD (IISc)

Rahul Pandit, PhD (Illinois)  
S Ramakumar, PhD (IISc)  
A K Sood, PhD (IISc)  
Sriram Ramaswamy, PhD (Chicago)  
Vasant Natarajan, PhD (MIT/USA)  
V Venkataraman, PhD (Princeton)  
Vijay B Shenoy, PhD (Brown)

#### ASSOCIATE PROFESSORS

P S Anil Kumar, PhD (Pune)  
Arindam Ghosh, PhD (IISc)  
Banibrata Mukhopadhyay, PhD  
(Calcutta)  
Jayadeep Kumar Basu, PhD (Calcutta)  
K S R Koteswara Rao, PhD (IISc)  
Prabal K Maiti, PhD (IIT-K)  
Rajan K, PhD (IISc)  
K P Ramesh, PhD (Bangalore)

#### ASSISTANT PROFESSORS

Anindya Das, PhD (IISc)  
Aveek Bid, PhD (IISc)  
Manish Jain, PhD (Minnesota)  
Prateek Sharma, PhD (Princeton)  
Ramesh Chandra Mallik, PhD (IIT-M)  
Subroto Mukerjee, PhD (Princeton)  
Tarun Deep Saini, PhD (Pune)  
Tanmoy Das, PhD (North Eastern Univ)

#### CHIEF RESEARCH SCIENTISTS

P V Bhotla, PhD (IISc)  
Suja Elizabeth, PhD (IISc)

#### PRINCIPAL RESEARCH SCIENTISTS

R Ganesan, PhD (IISc)  
K Ramesh, PhD (IISc)  
D V Suvisesha Muthu, PhD (IIT-K)

#### SENIOR SCIENTIFIC OFFICER

M N Ramanuja, PhD (IISc)

#### TECHNICAL OFFICER

V C Srinivas, BE (Bangalore)

### SCIENTIFIC ASSISTANTS

M V Manjula, MSc (Annamalai)  
K N Sathya Murthy, MSc (Bangalore)

### Astronomy and Astrophysics Programme

#### CO-ORDINATOR

Arnab Rai Choudhuri

### Centre for Cryogenic Technology

#### CHAIRPERSON

V Venkataraman

### ASSOCIATE PROFESSOR

R Karunanithi, PhD (IISc)

### PRINCIPAL RESEARCH SCIENTISTS

D S Nadig, MTech (IIT-Kgp)  
Upendra Behera, MTech (IIT-Kgp)

### Centre for High Energy Physics

#### CHAIRPERSON

B Anathanarayan

#### PROFESSORS

B Anathanarayan, PhD (Delaware)  
Apoorva Patel, PhD (Cal Tech)  
Diptiman Sen, PhD (Princeton)

Rohini M Godbole, PhD  
(Stony Brook)

### ASSOCIATE PROFESSORS

Justin Raj David, PhD  
(TIFR, Mumbai)  
Sachindeo Vaidya, PhD (Syracuse)  
Sudhir Kumar Vempati, PhD  
(Gujarat)

### ASSISTANT PROFESSORS

Aninda Sinha, PhD (Cambridge)  
Chethan Krishnan, PhD (Texas)  
Biplob Bhattacharjee, PhD  
(Calcutta)

## Centres and Units under the Director

### Archives and Publications Cell

#### CHAIRPERSON

T A Abinandanan

#### TECHNICAL OFFICER

Manu Rajan, BE (BIT, Ranchi),  
AISC (CSIR)

### Centre for Campus Management and Development

#### OFFICER-IN-CHARGE

B R Srinivasa Murthy

### Centre for Continuing Education

#### CHAIRPERSON

P Venkataram

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

#### CHAIRPERSON

J M Chandra Kishen

### ASSOCIATE CHAIRPERSON

N C Shivaprakash

### Centre for Sponsored Schemes and Projects

#### ADVISOR

R Mohan Das

### Intellectual Property Cell

#### CHAIRPERSON

Jayant M Modek

### J R D Tata Memorial Library

#### LIBRARIAN-IN-CHARGE

N C Shivaprakash

#### DEPUTY LIBRARIAN

Puttabasavaiah, BA, MLibSc  
(Mysore)

#### ASSISTANT LIBRARIAN GR.I

K Nirmala Devi, BSc (Bangalore),  
MLibSc (Annamalai)

### SCIENTIFIC OFFICER

Pitty Nagarjuna, ME (Sathyabhama)

### TECHNICAL OFFICERS

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 ASSISTANTS

Francis Jayakanth, PhD (Bangalore)  
V N Nagendra, MA (Bangalore)

### Office of International Relations

#### CHAIRPERSON

Usha Vijayaraghavan

### Undergraduate Programme

#### SENIOR SCIENTIFIC OFFICER

P G Vatsala, PhD (IISc)

#### SCIENTIFIC ASSISTANT

K Thulasi, BLibSc (MKU)

# 4

# AWARDS/ DISTINCTIONS

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

## Padmashri

---

Prof. E D Jemmis, IPC

## Shanti Swarup Bhatnagar Prize 2014

---

Prof. Kaushal Verma, MA  
Prof. Kavirayani R Prasad, OC

## Royal Society of Chemistry Fellowships

---

Prof. B R Jagirdar, IPC  
Prof. E Arunan, IPC  
Prof. S Ramakrishnan, IPC  
Prof. S Sampath, IPC

## Academy Fellowships

---

### INDIAN NATIONAL SCIENCE ACADEMY (INSA)

Prof. Pradip Dutta, ME  
Prof. Paturu Kondaiah, MRDG  
Prof. Srinivasan Sampath, IPC

### INDIAN ACADEMY OF SCIENCES (IASC)

Prof. A Chockalingam, ECE  
Prof. Arindam Ghosh, PH  
Prof. K R Prasad, OC  
Prof. N Ravishankar, MRC  
Prof. Kaushal Varma, MA  
Prof. P P Mujundar, CE

### NATIONAL ACADEMY OF SCIENCES, INDIA (NASI)

Prof. M Giridhar, CH  
Prof. Pradip Dutta, CiE  
Prof. Basudeb Datta, MA

### INDIAN NATIONAL ACADEMY OF ENGINEERING (INAE)

Prof. Chiranjib Bhattacharyya, CSA  
Prof. Neelesh B Mehta, ECE  
Prof. D Roy, CE

## Other Fellowships

---

### INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERING (IEEE)

Prof. K V S Hari, ECE

### RAMANUJAN FELLOWSHIP OF DST

Dr. Arnab Bhattacharyya, CSA

### HUMBOLDT FELLOWSHIP

Prof. Sunil Chandran, CSA

### LIVERPOOL INDIA RESEARCH

Dr. Atanu Bhattacharya

### WEST BENGAL ACADEMY OF SCIENCE & TECHNOLOGY

Prof. Bikramjit Basu, MRC

### BIOMATERIALS & ARTIFICIAL ORGANS, SOCIETY FOR BIOMATERIALS & ARTIFICIAL ORGANS (INDIA)

Prof. Bikramjit Basu, MRC

## Awards

---

### PROF. G. MUGESH, IPC

Prof. S K Pradhan Endowment Lecture Award, ICT, Mumbai

### PROF. S RAMAKRISHNAN, IPC

Distinguished Alumnus Award, IIT Bombay

### PROF. ANINDA J BHATTACHARYYA, SSCU

Indo-American Frontiers of Science Award 2013

### PROF. D D SARMA, SSCU

Honoris Causa Doctorate Degree, Uppsala University, Sweden.

“Knight of the Order of the Star of Italy” by the President of the Republic of Italy.

CSIR Foundation Day Lecture, CSIR.  
11th Prof. S Chandrasekhar Memorial Lecture, CNSMSR, Bangalore.  
H K Firodia Award 2013 for Excellence in Science and Technology.  
Distinguished Alumnus Award, IIT Kanpur

**PROF. JAYANT HARITSA, CSA**

Best Software Tool Award for the Database tool QUEST in the International Conference on Very Large Databases (VLDB)

**PROF. Y NARAHARI, CSA**

ACCS – CDAC Foundation Award, 2014  
Shared University research (SUR) Grant (2014-2016) from IBM Research Labs, India  
Faculty Award from Adobe Research Labs, Bangalore (2014-2016)

**DST INSPIRE FACULTY AWARD**

Dr. Chandan Saha, CSA  
Dr. Arpita Patra, CSA  
Dr. Bhavana Kanukurthi, CSA  
Dr. Aditya Gopalan, ECE

**PROF. CHANDRA R MURTHY, ECE**

NCC 2014 Best Paper Award in the communications track, IIT Kanpur, Feb 2014

**PROF. BHARADWAJ AMRUTUR, ECE**

Prof. Satish Dhawan Award, GOK

**PROF. K J VINOY, ECE**

Ulrich L. Rohde Innovative conference Paper Award, Hong Kong

**DR. DIPANJAN GOPE, ECE**

Cisco Best Student Paper Award, IEEE EDAPS 2014

**DR. SUBBA REDDY, EE**

For “Outstanding service to Indian Insulator Industry” from M/s. Aditya Birla Insulators, Kolkata

**PROF. A G RAMAKRISHNAN, EE**

Manthan Award 2014

**DR. CHANDAN SRIVASTAVA, MTE**

DAAD (German Academic Exchange) Fellowship award  
‘Certificate of Excellence’ award by the Ministry of Steel, GOI (2014)

**PROF. DIPANKAR BANERJEE, MTE**

Lifetime Achievement Award from DRDO

**DR. PARTHA TALUKDAR, SERC**

A Focused Research Award from Google Research which included an unrestricted gift of USD 50,000

**DR. SAI SIVA GORTHI, IAP**

Best Innovators Pitch Award by BIRAC, New Delhi, 22-23 Sept, 2014

Innovative Young Biotechnologist Award (IYBA 2013) by DBT, Biotechnology Ignition Grant (BIG) & BIG Innovator Award by BIRAC

**PROF. AJAY KUMAR SOOD, PHY**

Secretary General, The World Academy of Sciences (2013-15)

Indian Science Congress Award for outstanding contributions to Science (2014)

R.D. Birla Award for excellence in Physics – 2012 by Indian Physics Association (2014)

**DR. ATANU BHATTACHARYA, IPC**

Young Scientist Research Award, DAE, India

**PROF. NEELESH B MEHTA, ECE**

NASI-Scopus Award 2014 in the Engineering Category

**DR. SURYASARATHI BOSE, MTE**

Polymer Processing Society (PPS) Young Scientist Travel Award

**PROF. PRADIP DUTTA, ME**

INAE Outstanding Teacher

**DR. PHANEENDRA K YALAVARTHY, SERC**

(NASI) – Platinum Jubilee Award for the year 2014 in the field of Physical Sciences

**DR. SOUMYA DAS, MA**

INSA Award 2014

**DR. RAVI SUNDERESAN, MCB,**

Innovative Young Biotechnologist Award, DBT

**PROF. ANNAPOORNI RANGARAJAN, MRDG**

Young Woman Bioscientist Award, DBT

**PROF. TG SITHARAM, CiE**

Gopal Rajan Research Award, IIT Rourkee

**Prizes / Medals**

---

**PROF. B R JAGIRDAR, IPC**

A.V. Rama Rao Foundation Prize Lecture

**PROF. S RAMAKRISHNAN, IPC**

Silver Medal from CRSI

**PROF. JAYANT HARITSA, CSA**

Infosys Prize in Engineering and Computer Science 2014

**PROF. P P MUJUMDAR, CiE**

Humboldt Medal

**DR. PRABEER BARPANDA, MRC**

Dr. R L Thakur Award, Indian Ceramic Society

**DR. SANTANU MUKHERJEE, OC**

INSA medal

**PROF. SHALABH BHATNAGAR, CSA**

Rajib Goyal Prize in Applied Sciences

**DR. SURYASARATHI BOSE, MTE**

INSA medal for Young Scientist, 2014

**Others**

---

**PROF. BIKRAMJIT BASU, MRC**

Associate Editor, International Journal of Applied Ceramic Technology

**DR. ANSHU PANDEY, SSCU**

Associate, Indian Academy of Sciences, Bangalore

**DR. SHIVANI AGARWAL, CSA**

Associate, International Center for Theoretical Sciences (2014–2017)

**PROF. GOPALAN JAGADEESH, AE**

Hon. Professor, School of Engineering, Univ. of Glasgow – Sept. 1, 2014 to Dec. 31, 2017

**DR. ASHISH VERMA, CH**

Associate Editor of Urban Rail Transit Journal, Springer Publications

**PROF. C S MANOHAR, CiE**

Associate Editor, Journal of Structural Engineering, American Society of Civil Engineers

**DR. CHANDAN SRIVASTAVA, MTE**

Young Associate of the Indian Academy of Sciences (2014-2017)

**PROF. ALOKE PAUL, MTE**

Metallurgist of the Year, Ministry of Steel, Govt. of India

**PROF. U RAMAMURTY, MTE**

Editor of Acta/Scripta Materialia Journals

**DR. ARVIND AYYER, MA**

Associate of the Indian Academy of Sciences, 2014-17

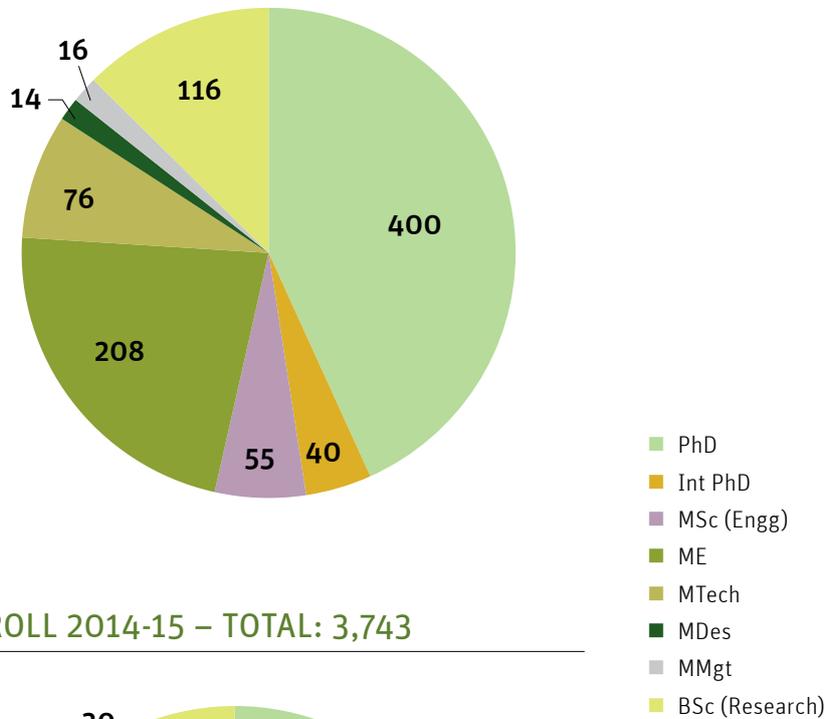
# 5

# STUDENTS

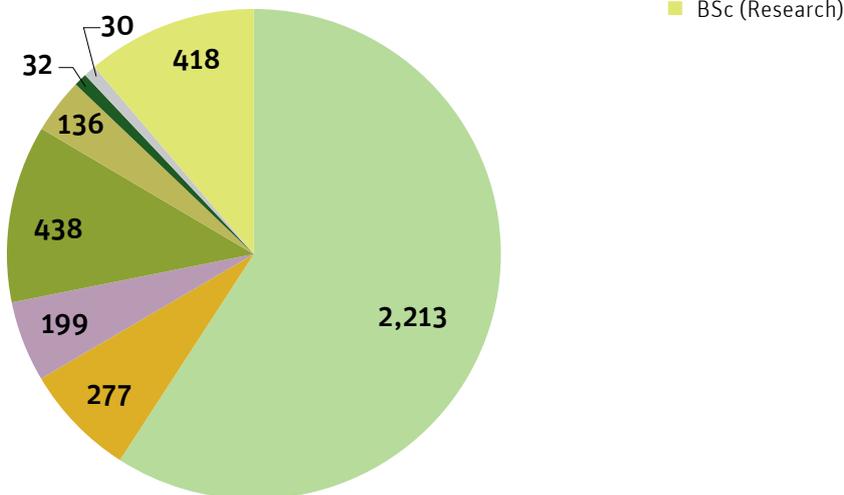
## 5.1 Admissions and On Roll

During the year, 925 students (455 for research, 40 for Integrated, PhD, 314 for course programmes and 116 undergraduate programme) joined the Institute taking the number “On Roll” to 3743 (2412 students in research, 277 in Int. PhD, 636 in post graduate and 418 in undergraduate course programme).

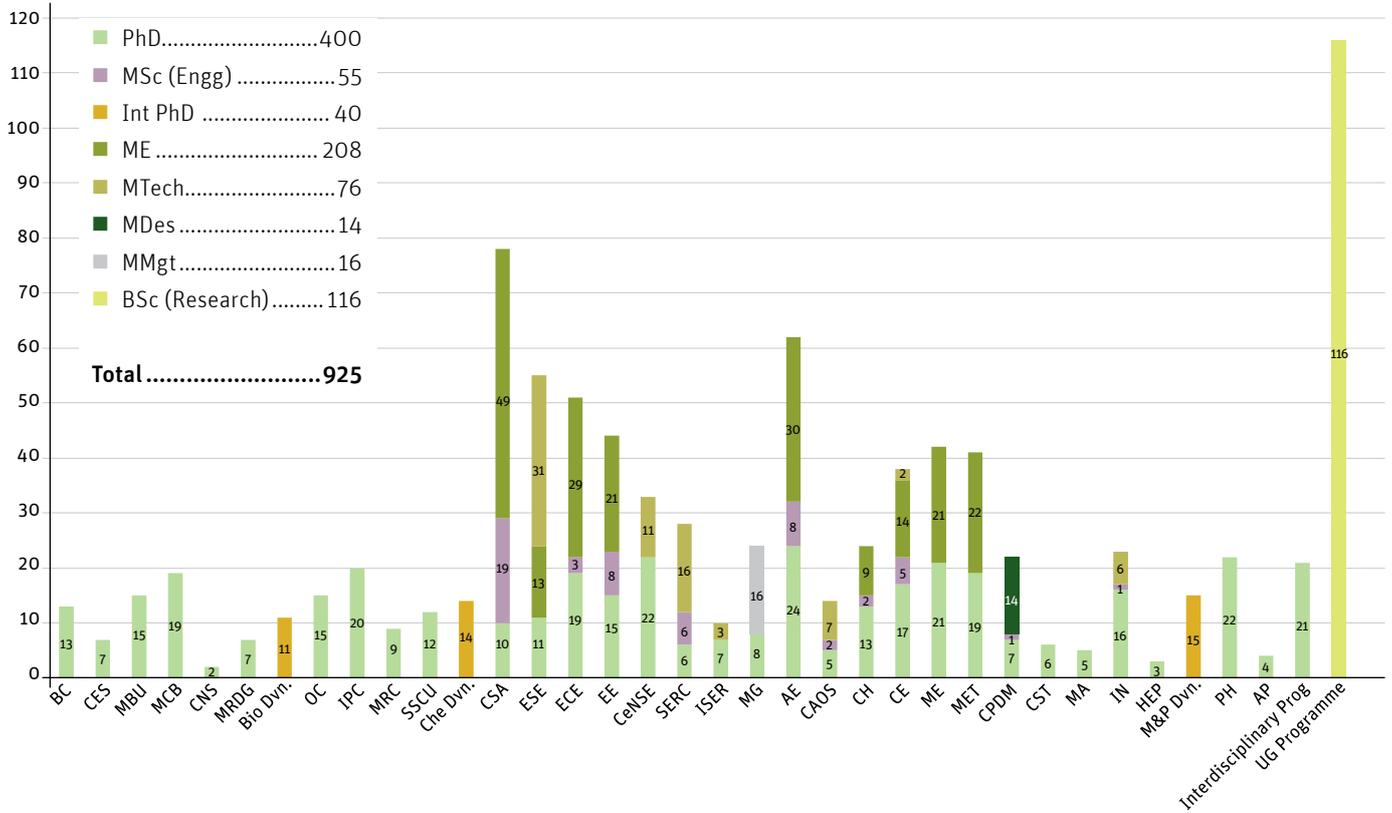
### ADMISSIONS 2014-15 – TOTAL: 925



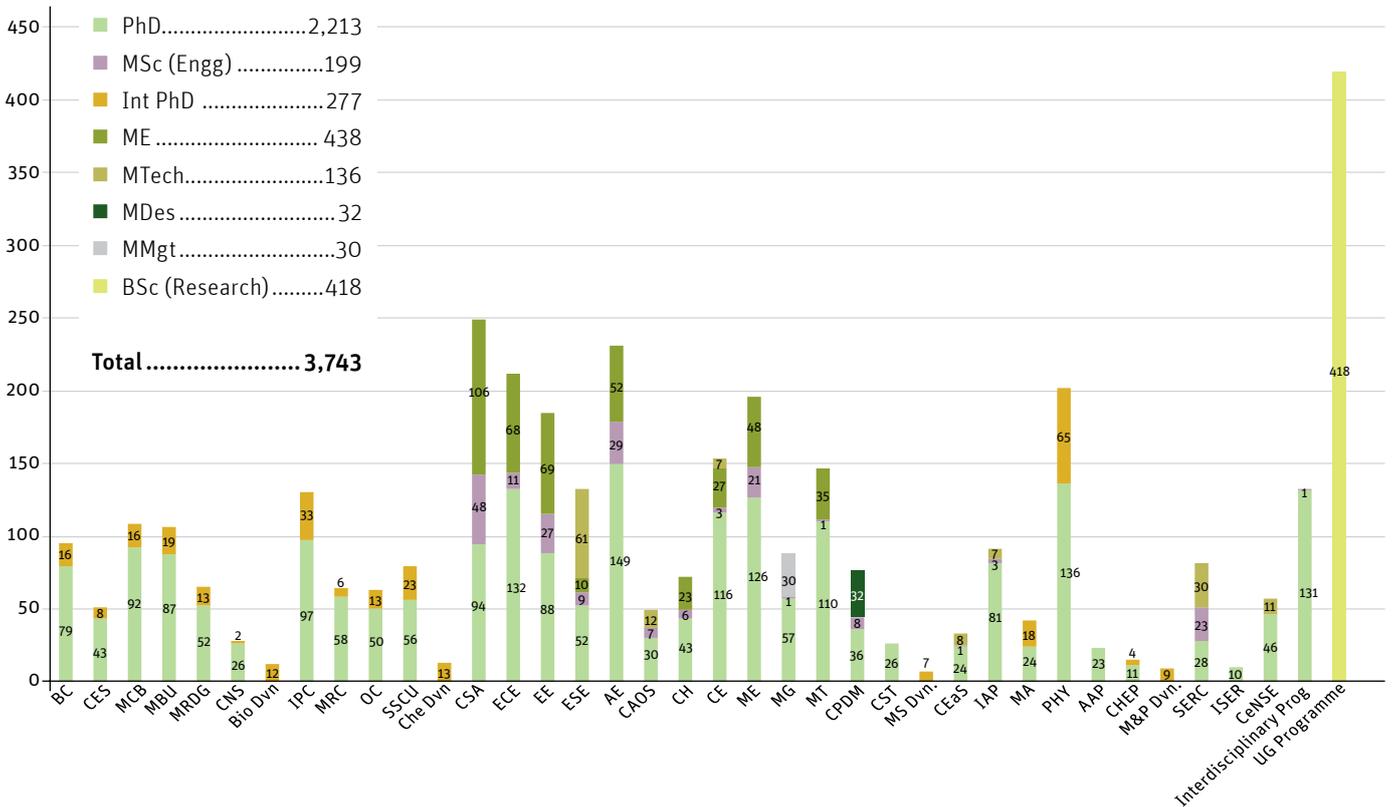
### ON ROLL 2014-15 – TOTAL: 3,743



## STUDENTS ADMISSIONS 2014-15



## STUDENTS ON ROLL 2014-15



Students



## 5.2 SC/ST Students

54 students belonging to SC/ST in research, 59 in the course programme and 24 in the undergraduate programme joined the Institute in the current year and, in all 251 research students, 40 Int. PhD and 129 course students, 86 undergraduate students were “On Roll” during the year.

### ADMISSIONS:

**Research:** Out of 846 applicants, 575 were called for an interview; 56 were offered admission and 45 joined.

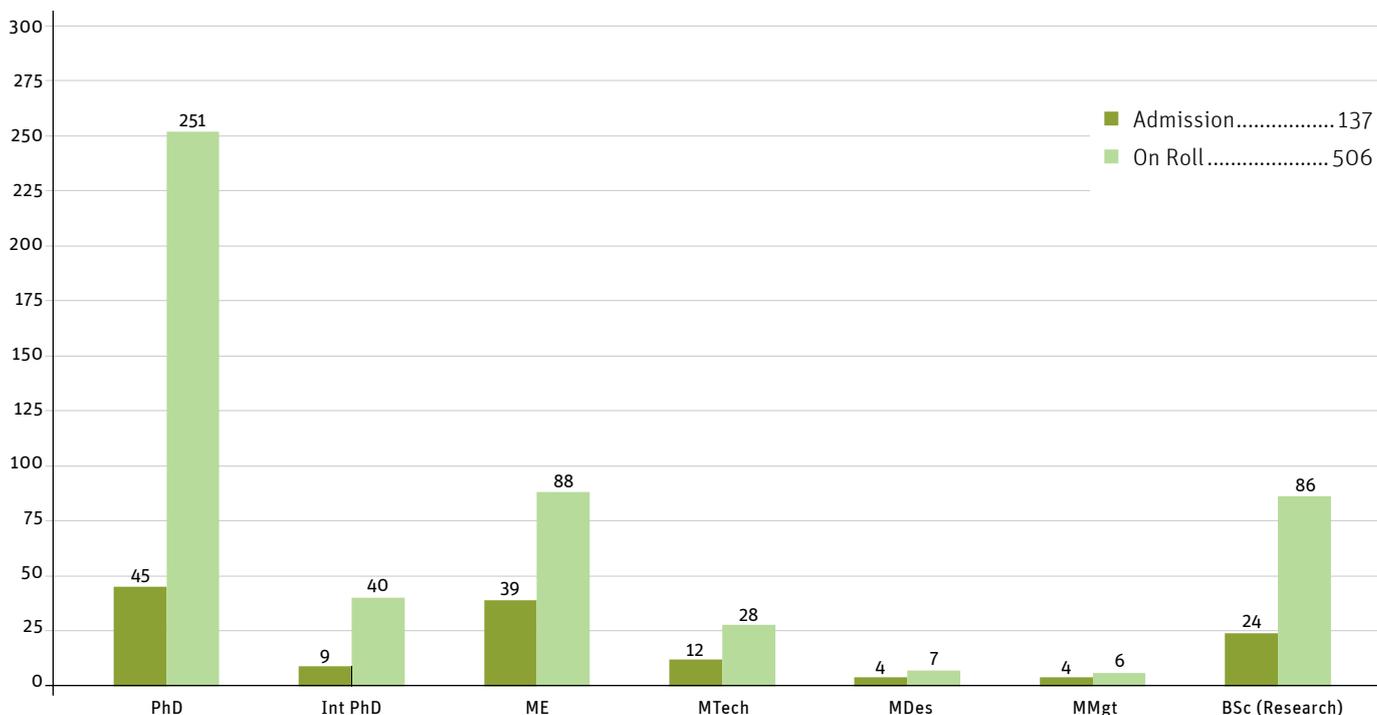
**Integrated PhD:** Since 2013, admission is through JAM (Joint Admission Test for MSc), 71 of them were short-listed and called for an interview, 10 were offered admission and 9 joined.

### COURSES:

**ME/MTech/MMgt/MDes:** Out of 1223 applicants, 175 were offered admission and 59 joined.

**BSc (Research):** Out of 1405 applicants, 169 were offered admission and 24 joined.

## SC/ST STUDENTS ADMISSIONS AND ON ROLL 2014-15



---

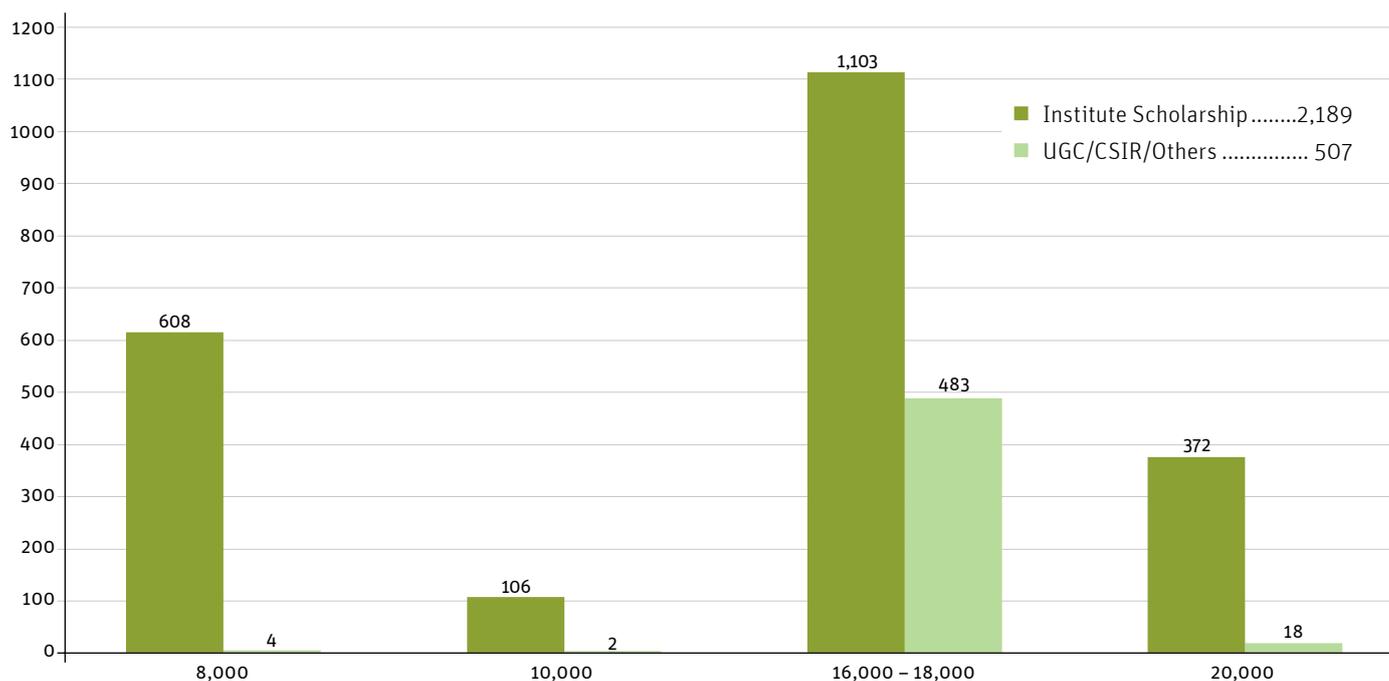
## 5.3 Scholarships/Fellowships

---

The students participating 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.

### SCHOLARSHIPS 2014-15

---



---

## 5.4 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.

**Students Aid Fund:** This is a co-operative scheme (each student subscribes ₹ 100/- annually) 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 2014-15, 231 students availed themselves of the loan to the extent of ₹ 65,75,000/-.

---

## 5.5 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.

---

## 5.6 Hostels

---

The Students' Hostel consists of 10 Gents and 4 ladies Hostel Blocks. Students, Research Associates and Short Term Workers totaling 2,850 (2,106 Gents and 744 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 Chairperson and team.

---

## 5.7 Institute 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	Dept/Centre
<b>FOR THE BEST PhD THESIS</b>			
1.	Prof. A K Rao Medal	Dr. Vijay Kumar Sutrakar	AE
2.	Prof. B K Subba Rao Medal	Dr. Deepu P	ME
3.	Prof. K P Abraham Medal	Dr. Ranjith K	MT
4.	The Alumni Medal	Dr. R Manikantan	CS
5.	The Seshagiri Kaikini Medal	Dr. N Lakshmi Prasad	EC
6.	Prof. D J Badkas Medal	Dr. Preetha P	EE
7.	Prof. N S Govinda Rao Medal	Dr. Shaik Rehana	CE
8.	Prof. Giri Memorial Medal	Dr. Mrinal Srivastav	BC
9.	Mrs. C V Hanumantha Rao Medal	Dr. Ankur Sharma	MD
10.	The Shamrao Kaikini Medal	Dr. Hari Sridhar	ES
11.	The M Sreenivasaya Medal	Dr. Anirban Mitra	MC
12.	Prof. B H Iyer Medal	Dr. Bhaskara Ramachandra Moorthy	MB
13.	Dr. J C Ghosh Medal	Dr. Devendra Mani	IP
14.	Prof. S Soundararajan Medal	Dr. Debasish Manna	IP
15.	The Guha Research Medal	Dr. Sandip Bhowmik	OC
16.	The Toulouse Medal	Dr. Catherine Kanimozhi	SS
17.	The Martin Forster Medal	Dr. Jaikrishnan J	MA
18.	Prof. Anil Kumar Memorial Medal	Dr. Sayantan Majumdar	PH
19.	Kumari L A Meera Memorial Medal	Dr. Bidya Binay Karak	PH/HE

---

**FOR THE BEST INTEGRATED PhD STUDENT (MS LEVEL)**

20.	Dr. R K Maller Memorial Medal	Ms Deshpande Neha Umakant Varsha	Biological Scs.
21.	Dr. A Nagaraja Rao Medal	Sharon Priya Gnanasekar	Chemical Scs.
22.	Kumari L A Meera Memorial Medal	Mr Saurav Islam	Physical Scs.

**FOR THE BEST PhD / MSc (Engg) STUDENT**

23.	Prof. N R Kuloor Memorial Medal	Dr. Siva Rama Krishna Perala	CH
24.	The Sudborough Medal	Dr. Gadige Paramesha	MR

**FOR THE BEST MSc (Engg) THESIS**

25.	ME Department Alumni Medal	Mr V Kaushik	ME
26.	Dr. M N S Swamy Medal	Mr Thejas C R	CS
27.	Prof. F M Mowda-walla Medal	Mr Rajat Talak Rajendra	EC
28.	The Hay Medal	Mr Sunder Ram K	EE
29.	Prof. P S Narayana Medal	Mr Karthikeyan Lanka	CE
30.	Subramanian Rajalakshmi Medal	Mr Mohit Dhingra	SE

**FOR THE BEST ME/ MTech/ MDes/ MMgt STUDENT**

31.	Dr. D Narayanamurti Medal	Mr Abhishek Mishra	AE
32.	Prof. N R Kuloor Memorial Medal	Mr Arun G	CH
33.	The N S Lakshmana Rao Medal	Mr Saurabh Singh	CE
34.	The Computer Society of India Medal (Bangalore Chapter)	Mr Arpit Agarwal	CS
35.	The K K Malik Medal	Mr Sudipta Pramanik	MT
36.	S V Sastry Memorial Medal	Mr Santanu Pramanik	ME
37.	The Alumni Medal	Mr Bikash Kumar Thakur	EC/ED
38.	Prof. I S N Murthy Medal	Ms Geethu Joseph	EE/EC
39.	The N R Khambhati Memorial Medal	Mr Aritra Ghosh	EE
40.	The N R Khambhati Memorial Medal	Mr Shahjahan Ahmad Syed	EE
41.	Prof. S V C Aiya Medal	Mr Patchava Raviteja	EC
42.	Motorola Medal	Mr Aditya Acharya	SE
43.	The CEDT Design Medal	Mr Anish G S	ED
44.	H R Babu Seetharam Medal	Mr RaviKumar Keshavappa	IN
45.	The Nikhil Memorial Medal	Mr Suhas D L	AS
46.	MAA Communications Medal	Mr Nilaventhan I	PD
47.	Prof. B G Raghavendra Memorial Medal	Mr Abhay Raj	MMgt

---

## 5.8 Awards and Distinctions

---

### Fellowships

---

#### **MR SUFYAN ASHHAD, MBU**

International Brain Research Organization (IBRO) fellowship for attending the Society for Neuroscience annual meeting, Washington D.C., USA

#### **NIKITA ZACHARIAH, CES**

Dr. Shyama Prasad Mukherjee (SPM) Fellowship

#### **MS M GEETHIKA, IPC**

#### **CHIRANJEEVI YARAA, EE**

Prime Minister's Fellowship for Doctoral Research

#### **PANKAJ LOCHAN BORA, MRC**

Masaryk University, Brno  
Czech Republic (Jan. 2014)

#### **MR CHANDRA BHUSHAN TRIPATHI, MRC**

Bristol Myers Squibb Fellowship, 2014

#### **ROHITH D VALLAM, CSA**

#### **SWAPNIL DHAMAL, CSA**

#### **GAURAV PANDEY, CSA**

#### **ANIRUDH SANTHIAR, CSA**

IBM Doctoral Fellowship

#### **SHWETA JAIN, CSA**

Microsoft Ph.D. Fellowship

#### **PALLAVI MAIYA H P, CSA**

Google Indian, PhD fellowship (2014-18)

#### **ASHWIN GUHA, CSA**

TCS, PhD Fellowship

#### **DR. AMRETASHIS SENGUPTA, ESE**

(DST Nano S&T post doctoral fellow), DST Faculty Inspire Award

#### **RITIKA KAUSHAL, CEaS**

ITCE (Inter-university Training for Continental scale Ecology), University of Utah, US, May-June, 2014

#### **YOGARAJ BANERJEE, CEaS**

Goldschmidt fellowship and grant from Divecha Centre for attending the Goldschmidt conference in Sacramento, June 8th- June 13th, 2014

#### **ARPITA SINGH, CST**

SERIIUS Mageep fellowship

#### **MARIA FRANCIS, CSA**

Google Anita Borg Memorial Scholarship

### Best Paper Awards

---

#### **R WAGHMARE, D MISHRA, G R K S SUBRAHMANYAM and S S GORTHI, IAP**

Eighth International Conference on Image and Signal Processing (ICISP), Bangalore, India, 2014.

#### **M SAXENA and S S GORTHI, IAP**

International Conference on Light, 19-21 March (2014), NIT-Calicut, Kerala

#### **AVANISH TRIPATHI and G NARAYANAN, EE**

In technical session: (ICAECC), Bangalore, Oct 2014

#### **AMARNATHA HEGDE, CiE**

IGS – YGE, Biennial Award awarded by Indian Geotechnical Society at IGC 2014 in Kakinada

#### **L SHREYAS and L KANWAR, CE**

Published during 2013 in the Indian Chemical Engineer

#### **AJAY KUMAR PRAJAPATI, ME**

National Tribology Conference

#### **ZAFIR ALAM, MT**

Acta Award for “Tensile behavior of a free-standing Pt-aluminide (PtAl) bond coat” published in Acta Materialia in 2013

#### **A NANDY, CeNSE**

ICMEMS 2014, IIT Madras, Dec 18-20, Chennai, India

**S D VISHWAKARMA, A K PANDEY, J M PARPIA, D R SOUTHWORTH and H G CRAIGHEAD, CeNSE**  
Journal of Microelectromechanical Systems, 2014 for Excellence in Paper Quality

**RAMMOHAN S and SHREEVAR RASTOGI, CeNSE**  
2nd IEEE International Conference on Emerging Electronics 'Materials to Devices', December 4-6, 2014, Bangalore

**REVATHY PADMANABHAN, CeNSE**  
(ICICDT), USA

**DAS K, BC**  
83rd Annual Meeting of Society of Biological Chemists, India and Symposium on Evolution: Molecules to Life, Dec 18th -21st, 2014 held at KIIT, Odisha, India.

#### **Best Poster Awards**

---

**MR YEDU PRASAD, BC**  
83rd Annual Meeting of Society of Biological Chemists India.

**MR SUMITH KUMAR, BC**  
(EMBO reports) and also Nucleic Acids Research, FEBS EMBO Conference, Paris, France, Sept'2014

**MR GAJENDRADHAR DWIVEDI, BC**  
International Conference on Genome Architecture and Cell fate regulation, Hyderabad, Dec'2014

**SANIYA M JAVADEKAR, BC**  
**SATHEES C. RAGHAVAN, BC**  
12th winter symposium, CMC Vellore, Feb 10-12, 2014

**POONAM DHILLON, MCB**  
3rd prize in the symposium on Recent trends in Molecular Virology, Jamia Millia Islamia, New Delhi, Nov. 17-19, 2014

**PRIYANKA TARE, MCB**  
International Conference on "Bacterial Expressions", NCBS, Bangalore, India (2014)

**MADHANGI M, MRDG**  
83rd SBC(I) Meeting, KIIT University, Bhubaneswar, 18th–21st December, 2014

**JHONSA R, MRDG**  
Platinum Rose International Award at 5th International Congress on Cell membranes and Oxidative Stress: Focus on Calcium Signaling and TRP channels, Isparta, Turkey, 9-12th September 2014

**RITTIK DEB, CES**  
Commonwealth Science Conference

**BISWARANJAN DASH, MT**  
EMSI 2014

**PRIYANAK AGRAWAL and SRIRAGHUNATH JOSHI, MT**  
ISRS 2014

**ANGSHUMAN MODAK, CAOS**  
5th National Research Conference on Climate Change, Indian Institute of Technology, New Delhi, 19-20, December 2014

**PRIYADARSHINI GHOSH, CeNSE**  
Graphene Conference in Toulouse, France, 2014

**ABINASH TRIPATHY and SINDHULAKSHMI KURUP, CeNSE**  
**ANKUR GOSWAMI C, NAGARAJ K S, KARTHICK J, ANITHA S, SUMA B N, G M HEGDE and SNEH VASWANI, CeNSE**  
ICEE-2014

#### **Best Oral Presentation Awards**

---

**RAJIV JHA, MCB**  
83rd Society of Biological Chemists, Annual meeting, Bhubaneswar (2014)

**DEYA DAS, MRC**  
Indo-US Workshop on Engineered Electrodes for Electrochemical Energy Storage (April 2014), Chennai



**V S S PAVAN KUMAR HARI and G NARAYANAN, EE**

IEEE Applied Power Electronics Conference and Exposition 2014 (IEEE APEC 2014), Fortworth, Texas, March 2014

**J INDU, CiE**

ISPRS Technical Commission VIII Symposium, Hyderabad, India, December 09-12, 2014

**K V LALITHA, MT**

Conference on Applications of Polar Dielectrics 2014, Lithuania

**BISWARANJAN DASH, MT**

ISRS 2014

**ALISON E VIEGAS, DEBADITYA CHATTERJEE and TANUSHREE H CHOUDHURY, CeNSE**  
**RAMMOHAN SRIRAMDAS, SHREEVAR RASTOGI, MANIKANT, NAGABOOPATHY MOHAN, ROHITH SOMAN and HAREESH CHANDRASAKER, CeNSE**  
ICEE-2014

**Best Researchers/Thesis Awards**

---

**DEBASISH MANNA, IPC**

Eli Lilly and Company Asia Outstanding Thesis Award for the year 2014

**AADITYA MANJANATH, MRC**

DST-JSPS Exchange Researcher Exploratory Visit Program (February 2014)

**SACHIN CHOUDHARY, NMR**

Jharana Rani Samal award for the best student researcher at the 20th conference of the National magnetic Resonance Society, Tezpur, Feb 5-8, 2014

**PRASHANTH L A, CSA**

Third prize for, PhD dissertation from the IEEE Intelligent Transportation Systems Society

**SOUMITRA DAS, EE**

POSOCO Power Systems Award (PPSA) 2014

**Travel Awards**

---

**SUMITH KUMAR, BC, DBT**

FEBS EMBO conference, Sept'2014  
At Paris, France

**RAHUL KUMAR RATHOUR, MBU, DST**

Society for Neuroscience annual meeting held at Washington D.C., USA

**AANCHAL KATOCH, MCB**

“16th International p53 Workshop” held at Stockholm, Sweden June 15-19 2014

**SHREEKANT DEODHAR, CES**

Jayabharathy Ranganathan, CES  
ISBE 2014, New York

**PRARATHANA GOWDA, IAP**

CSIR travel award (2014)

**SIVA KUMAR REDDY, IAP**

DST travel award (2014)

**MANISHA SINHA, MBU**

“Neural Systems and Behavior” and “Methods in Computational Neuroscience” courses, Marine Biological Laboratory, Woods Hole, USA

**Award and Medals**

---

**MEETALI SINGH, BC**

Bristol Meyers Squib Science Award

**KOHAL DAS, BC**

Dr. A S Perumal Award, 2014

**DR. SANCHARI BHATTACHARYYA, MBU**

Prof. B H Iyer Medal award

**TITASH SEN, MCB**

Selected EMBO course on molecular genetics with fission yeast

**ANUJ KUMAR, MCB**

Ranbaxy Science Scholar Award in Biomedical Sciences 2014

**DURGA MADHAB MAHHAPATRA, CES**

Gandhi Young Technological Innovation Award 2014, IIM-Ahmedabad

**PRARATHANA GOWDA, IAP**

Selected to participate in ESCONN 2014 (European School of Nanosciences and Nanotechnologies) School, Grenoble.

**PRARATHANA GOWDA, IAP**

Gandhian Young Technological Innovation Award 2014

**SIVA KUMAR REDDY, IAP**

Selected for participation in Winter School-2014 (JNCASR)

**SANJOY MUKHERJEE, IPC**

Selected to attend Nobel Laureates' meeting at Lindau

**AHIN ROY, MRC**

Shell India Computational Talent Prize (2014)

**DR. SANDIP BHOWMIK, MRC**

Prof. Guha Research Medal, 2014

**CATHERINE KANZIMOZHI, SSCU**

Toulouse Medal for the year 2014

**MS TANUJA GANU, CSA**

(Former Student, currently employed at IBM – India Research Lab, Bangalore)  
MIT TR35 Innovator under 35 award

**MRINAL KANTI DAS, CSA**

Yahoo award

**ARPIT AGARWAL, CSA**

Computer Society of India (Bangalore Chapter) Medal for Best Course ME student, 2014

**SYED SHAHJAHAN AHMAD, EE**

Second position (jointly) among the post-graduate projects by the National Mission on Power Electronics Technology (NaMPET).

**RANGESH BABU, EE****SAIKAT SUBHRA GHOSH, EE**

Certificate of Appreciation under the POSOCO Power Systems Award (PPSA) 2014: ME

**DR. REKHA VERMA, EE**

TechnoInventor Award from Indian Electronics and Semiconductor Association (IESA)

**DIPTIMAYEE SAMANTARAY, ME**

YOUNG METALLURGIST OF THE YEAR 2014, conferred by the Indian Institute of Metals

**D VEERABABU, ME**

“3-D FEM as well as 1-D analysis of three-pass double reversal muffler,” NSA 2014, Mysore, Nov. 12-14, 2014

**D M MAHAPATRA, CST**

Gandhi Young Technological Innovation Award, IIM Ahmedabad, 2014

---

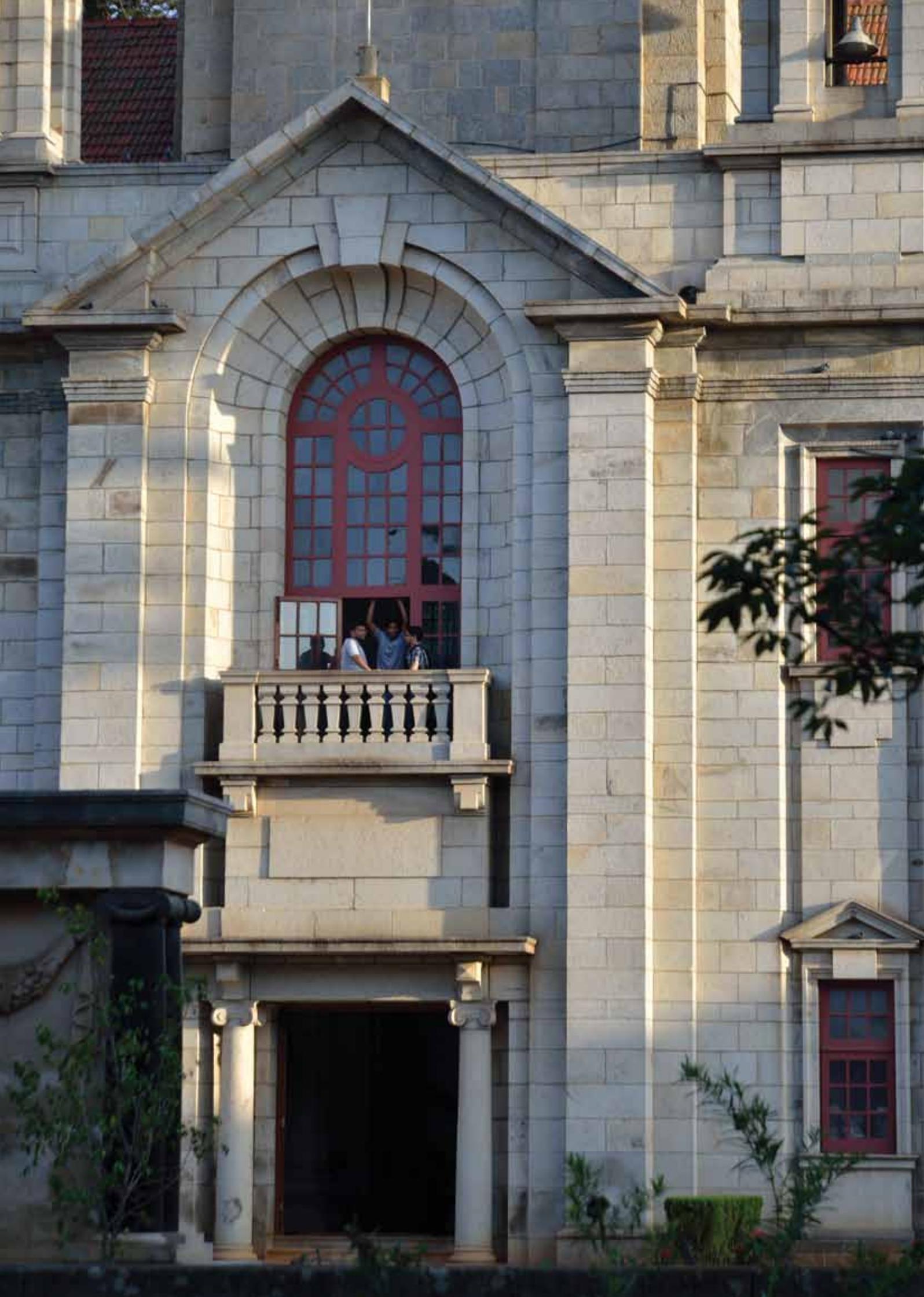
## 5.9 Placement

---

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 2014-15, about 105 organizations conducted campus interviews. A few organizations invited students to their offices for this purpose. 214 students registered for placement, out of whom 199 participated and 191 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 2014-15 was effective and satisfactory.





# 6

# RESEARCH AND TEACHING

## 6.1 Division of Biological Sciences

(Chairperson: 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 Unit
- Centre for Ecological Sciences
- Centre for Infectious Disease Research
- Centre for Neuroscience
- Central Animal Facility

### BIOCHEMISTRY

Staff: Academic: 16

Students: PhD: 79; Int PhD: 16

Degrees Awarded: PhD: 11

Publications: 67

The Department has been focusing on the following four important areas:

- Secondary metabolites, enzymes and metabolic engineering
- RNA, DNA repair and genomic stability
- Biology of chaperones
- Host-pathogen interactions Immunobiology

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

### SECONDARY METABOLITES, ENZYMES AND METABOLIC ENGINEERING

A non structural protein – m (NSm) encoded by the M RNA of ground nut bud necrosis virus, predicted to be involved in cell to cell movement of the virus, was shown to be associated with membranes when expressed in *E.coli* or *in planta* as well as with artificial liposomes. Sesbania mosaic virus RNA dependent RNA polymerase was shown to interact with P10 domain of polyprotein 2a via its C-terminal disordered domain

and such an interaction lead to a tenfold increase in RdRP activity.

Biochemical analysis of purified *Neisseria gonorrhoeae* UvrD helicase suggested that it behaves as a dimer in solution, exhibits 3'-5' polarity on ssDNA, can unwind blunt end duplex DNA as well as different recombination intermediates such as overhand containing DNA and Holliday junction in an ATP dependent manner.

Thirty seven fungi from various tissues of *Saracaasoca* were isolated and these fungi were characterized taxonomically by their morphology and sequence analysis of ITS region of the rDNA operon. Fungal extracts were screened for the cytotoxicity against human cancer cell lines by the MTT assay. Among the isolates screened, *Lasiodiplodia theobromae* which exhibited the highest cytotoxicity was selected for extensive studies. The cytotoxic compound was isolated using bio-assay-guided isolation methods. The isolated compound was subjected to LC-MS, IR, NMR and UV absorbance spectroscopy and its structure was elucidated. The purified cholesterol glucoside was then investigated for its cytotoxicity, apoptotic and antioxidant activities.

In the methylotrophic yeast, *Pichiapastoris*, three zinc finger proteins (Mxr1p, Rop1p and Trm1p) were found

to regulate the expression of genes of the methanol utilization pathway.

The identification and functional characterization of diacylglycerol acyltransferase (DGAT), a member of the 10S cytosolic TAG biosynthetic complexes (TBC) in *Rhodotorulaglutinis* has been demonstrated.

Polypharmacology is beginning to emerge as an important concept in the field of drug discovery. A structural-proteomics approach that utilizes the structural information of the binding sites at a genome-scale obtained through in-house algorithms to characterize the pocketome, yielding a list of ligands that can participate in various biochemical events in the mycobacterial cell has been proposed. The study presents a rational approach to identify targets with polypharmacological potential along with possible drugs for repurposing, while simultaneously, obtaining clues on lead compounds for use in new drug-discovery pipelines.

#### **RNA, DNA REPAIR AND GENOMIC STABILITY**

A new phenomenon in protein-DNA interaction has been uncovered: A biological role for mechanical force in the interaction of RecX and RecA with DNA, and between RecA and RecX has been elucidated. Genetic and biochemical analyses show eubacterial RecA as a potential target for anti-bactericidal drug discovery. A new class of *benzamidazole-carbazole conjugates* have been designed and synthesized for the stabilization of human telomeric DNA, telomerase inhibition and demonstrated their selective action on cancer cells.

Initiated experiments to understand a) the functional significance of sumoylation of specific Mms21-mediated sumoylation targets by creating putative non-sumoylatable variants of various Mms21 targets e.g. Smc5, Smc6, the cohesin Scc1, etc. b) role of two Nse (Non-Smc elements) subunits of the Smc5/6 complex by creating mutations in conserved residues that result in a temperature sensitive phenotype and sensitivity to genotoxic agents.

A study of RAD51 paralogs (RAD51B, RAD51C, RAD51D, XRCC2 and XRCC3) implicated in DNA damage signaling and repair by homologous recombination (HR) showed

that cells expressing RAD51C pathological mutants can be targeted by a “synergistic approach” using low dose of PARP inhibitor and low dose of ionizing radiation. Work on *M.tuberculosis* recently showed that *M. tuberculosis* DinG helicase unwinds G-quadruplex DNA.

In an interesting study, it was reported that regulation of recombination activating Gene (RAG) binding and cleavage on heteroduplex DNA is dependent on length, sequence and phasing of the double-stranded flanking region. In addition, the synthesis and characterization of encapsulated version of SCR7 (an NHEJ inhibitor) using nano polymers, was found to make the compound 5 times more effective.

#### **BIOLOGY OF CHAPERONES**

A point mutant in human ISCU scaffold protein which is essential for the Fe/S cluster biogenesis process and associated with mitochondrial myopathy has been characterized. These findings provide first time evidence in-favour of involvement of a member of J-class protein in regulating apoptotic pathways. An artificial nanowire from  $V_2O_5$  that mimics cellular glutathione peroxidase (GPx) which possesses a high therapeutic potential in treating multiple stress related disorders as well as premature ageing has been developed.

#### **HOST PATHOGEN INTERACTION IMMUNOBIOLOGY**

Abrin exposure to cells results in accumulation of unfolded proteins in the Endoplasmic reticulum (ER) leading to ER- stress that triggers the unfolded protein response (UPR) pathway. Persistence of the UPR activates the stress kinases that lead to the activation of the initiator caspases 2 and 8 which cleave the molecule Bid leading to loss in the mitochondrial membrane potential.

Interferon-gamma is important host immunity to intracellular pathogens. Two distinct host responses were studied during *Salmonella typhimurium* infection. First, a model of infection-induced thymic atrophy was established and the critical roles of cortisol and interferon-gamma were shown. In addition, the role of interferon-gamma in repressing the production of two chemokines, CcI3 and CcI4, were shown. Thymic atrophy is known to occur with aging, treatment

with some chemotherapeutic drugs and infections. We have standardized a model of thymic atrophy during infection with *Salmonella typhimurium*. In the process, we have shown that c-jun N-terminal kinase (JNK) is induced in thymocytes upon infection with *S. Typhimurium*. Importantly, treatment with a specific inhibitor to JNK lowered thymic atrophy.

Productive infection of human amniotic and endothelial cell lines with Japanese encephalitis virus (JEV) was established leading to the induction of NF $\kappa$ B and HLA-F, a non-classical MHC molecule. ShRNA targeting lentivirus-mediated stable knockdown of the p65 subunit of NF $\kappa$ B inhibited JEV-mediated induction of HLA-F both in the amniotic cell line, AV-3 as well as the human brain microendothelial cell line, HBMEC.

Inhibition of SLPI expression by siRNA resulted in inhibition of morphological differentiation of BeWo cells suggesting an important role for SLPI during differentiation of cytotrophoblasts into syncytiotrophoblasts.

#### **Planned future research areas:**

To understand mechanisms of mRNA fate decisions upon arrival into the cytoplasm, mRNA can have different fates. It can a) get translated b) remain stored in a translationally inert state c) get degraded. The aim is to understand the mechanistic basis of mRNA fate decisions by focusing on interactions among mRNA-binding proteins with RGG- motifs that facilitate the functional transitions of mRNA.

## **MICROBIOLOGY AND CELL BIOLOGY**

---

**Staff: Academic: 15; Scientific: 2; Technical: 1**

**Students: PhD: 92; Int PhD: 16**

**Degrees Awarded: PhD: 12**

**Publications: 56**

The Department of Microbiology and Cell Biology (MCB) is celebrating 75 years of its excellence. We are the nodal point within the Institute for research in the areas of bacterial and viral infectious diseases, cellular processes, cancer biology, gene regulation and

development. The major advances made in these areas are summarized as follows.

### **STUDIES ON BACTERIAL PATHOGENS/SURROGATES/ DISEASES**

The major findings in this area are: i) small molecule inhibitors of mycobacterial topoisomerase I have been developed; ii) structure and function relationship of different nucleoid associated proteins of mycobacteria has been investigated; iii) *Mycobacterium tuberculosis* has been targeted by inhibiting HU; iv) chemical perturbation of topology and topology modulation by regulation of strand passage activity of topoisomerases have been investigated; v) molecular mechanism of how the glycoprotein of *M. tuberculosis* tampers with multiple cells of innate immune system in a differential manner has been investigated and it has been found that the glycoprotein suppresses dendritic cell function, activates inflammatory response of macrophages, inhibits cytokine secretion by neutrophils, and down regulates MHC class II expression by B cells within 24 hours of infection; vi) it has been demonstrated that a very small proportion of both pathogenic and non-pathogenic mycobacteria and the enteric bacterium, *Escherichia coli* undergo highly deviated asymmetric cell division to generate a short cell and a long cell from every division. The short cells have the ability to regenerate an entire population wherein again a small proportion undergoes highly deviated asymmetric cell division. The proportion of the cells that undergo highly deviated asymmetric division has been found to increase as the culture approaches stationary phase. The physiological significance of the highly deviated asymmetric cell division is being presently addressed; vii) immune modulators affected by pathogen entry, and the signaling cascades initiated by pathogens such as *M. tuberculosis*, *Shigella*, *Listeria*, *Candida albicans*, *Aspergillus flavus*, *A. fumigatus*, etc., and the various immune evasion strategies employed by them have been identified; viii) the role of two WhiB family members (WhiB3 and WhiB4) in modulating *M. tuberculosis* persistence in human tissues for decades without replicating in a state of "drug unresponsiveness" has been investigated; and, ix) in the context of salmonella pathogenesis, it has been shown that the metabolic pathways which play an essential role in the



life of the pathogen at various stages also get modulated during pathogenesis. One such pathway, which leads to production and detoxification of methylglyoxal plays crucial role in the pathogenesis by exerting differential lifestyles in different cell types.

### STUDIES ON VIRAL PATHOGENS/DISEASES

Studies on Japanese encephalitis virus (JEV), hepatitis C virus (HCV), rotavirus and enteroviruses have led to: i) understanding of the mechanisms and determinants of virulence of JEV using the live attenuated vaccine strain. It is shown that the increased autophagy stimulated by the virus is actually responsible for increased CD8+ T cell response elicited by the vaccine strain, leading to its attenuation; ii) development of highly potent small molecule inhibitors of HCV from pomegranate fruit (*Punica granatum*), which blocks virus entry to liver cells and impedes virus replication by inhibiting the HCV-NS3 protease; iii) investigation of serum proteome profile of HCV-infected Indian population which has revealed that retinol-binding protein 4 (RBP4) is highly up-regulated upon viral infection, an observation which can be implicated for insulin resistance witnessed in HCV infection; iv) detailed long-term molecular epidemiological investigations which demonstrated for the first time that enteroviruses are a major cause of acute and persistent diarrhea, and revealed a new clinical symptom termed Non-diarrhoeal Increased Frequency of Bowel Movements (IFoBM-ND); v) demonstration of several nuclear proteins translocation to cytoplasm, which is of fundamental significance in understanding the regulation of rotavirus gene expression in virus infected cells; and vi) an extensive study of the role of redox chemistry in the context of HIV infection to understand the reasons why HIV infected patients suffer from chronic oxidative stress.

### CELLULAR PROCESSES AND CANCER BIOLOGY

The major advances in this area are: i) understanding of the basis of topology-transcription coupling, function of nucleoid associated proteins and mechanism of inhibition of topoisomerases; ii) demonstration that the 3 consecutive GC (3GC) base pairs in the anticodon stem of the tRNA<sup>fMet</sup> play a critical role in its retention in ribosome during the conformational changes that mark transition of 30S pre-initiation complex into elongation-

competent 70S complex. *In vivo*, the 3GC mutant tRNA<sup>fMet</sup> occurred less abundantly in 70S ribosomes but normally on 30S subunits. However, the extended SD: anti-SD interaction increased its occurrence in 70S ribosomes. Furthermore, the mutations in mRNA or 16S rRNA that extend interaction between the Shine-Dalgarno (SD) and anti-SD sequences rescue a mutant tRNA<sup>fMet</sup> lacking the highly conserved feature of the presence of the 3GC base pairs in its anticodon stem; iii) revelation that under glucose-deprivation the cytoplasmic abundance of SMAR1 protein increases, which in turn binds to p53 RNA and enhances its translation. These results have provided new physiological insights into the translational control of p53 mRNA in nutrient starvation; iv) characterization of the miRNA turnover complexes – ‘miRNasomes’, which have the potential to be the core constituents of the miRNA turnover pathway. This study would reveal how these regulatory RNAs themselves get regulated by the turnover pathway in *Caenorhabditis elegans*. The ‘microRNase’, exoribonuclease 2 (XRN-2), containing ‘miRNasomes’ are being purified towards biochemical elucidation of the role of each of those components in the respective miRNasomes and establishing their physiological significance; v) studies on splicing of mini- intron containing reporter transcripts have revealed that multiple intronic features confer dependence on fission yeast SpSlu7. Strains with conditional expression of pombe wild type and a mis-sense mutant in splicing factor SpPrp18 were also studied to decipher its essential, non-ubiquitous splicing roles and effects on cell-cycle; vi) Elucidation of the role of endosomal SNARE STX13 in regulation of two different trafficking steps from recycling endosomes to melanosomes. vii) in the field of cancer biology, department has mostly focused studies on glioma, the most common and aggressive brain tumor. Autophagy can help in cell survival mechanism and oncogenic process, particularly under nutrient limiting conditions and thus help in the tumor growth. However, it has also been shown, that autophagy is tumor suppressive and needs to be inhibited to achieve transformation. Recent study from our department demonstrated that autophagy inhibition to facilitate astrocyte transformation is achieved by promoter methylation and the consequent transcriptional downregulation of the ULK2, as upstream autophagy inducer gene.

## GENE REGULATION AND DEVELOPMENT

The key studies in this area relate to: i) analysis of chromatin occupancy of OsMADS1, a rice Sepallata class, in rice panicles with developing floral meristems and organ development to decipher some key target genes; ii) demonstration that miR319-targeted *TCP* genes code for transcription factors that regulate leaf morphogenesis in *Arabidopsis*. By using a combination of phenotypic characterization, transcriptome profiling and biochemical studies, it has been demonstrated that TCP4 promotes brassinosteroid-dependent cell enlargement and suppresses auxin-dependent cell proliferation in *Arabidopsis* leaves; iii) exploration of the role of SIRT6, a chromatin associated histone deacetylase in aging-related muscle degeneration; and iv) initiation of the studies on the molecular signaling pathways that link diabetes to cardiac fibrosis.

## MOLECULAR REPRODUCTION, DEVELOPMENT AND GENETICS

---

**Staff: Academic: 11**

**Students: PhD: 52; Int PhD: 13**

**Degrees Awarded: PhD: 3**

**Publications: 33**

Research in the Department of Molecular Reproduction, Development and Genetics is diverse, ranging from bacterial and human genetics to signal transduction, mammalian reproduction, developmental biology, stem-cells, and cancer. Progress made in the different areas is summarized below.

In the area of microbial genetics, physiology and evolution, bacteria have been shown to evolve new metabolic capabilities by mutationally modifying pre-existing genetic systems involved in the metabolism of similar substrates by increasing the promiscuity of the catabolic enzyme. Furthermore, live cell biosensors have been developed for studying two-component systems of *M. tuberculosis in vivo* to profile system-wide communication networks encoded in its genome.

In the area of cancer biology, the nuclear function of a well-known tumor suppressor TSC2, which functions as a

negative regulator of mTORC1 in complex with TSC1 in the insulin signaling pathway has been elucidated. The results have shown for the first time that TSC2 also functions as a transcription factor and regulates the expression of epiregulin. The well-known tumor suppressor gene WT1 (Wilms tumor 1) has been shown to function as an oncogene in oral cancer. Novel mechanisms downstream of AMPK activation involved with anoikis-resistant growth and metastasis have been identified. A single chain antibody that inhibits the tumorigenic actions of IGFBP2 in glioblastoma cells has been identified and characterized. A role for IGFBP2 mediated beta-catenin expression in the invasive properties of glioblastoma has been demonstrated. In addition, the role of areca nut and TGF-beta on the activation of fibroblasts has been elucidated in the context of oral submucous fibrosis. One of the Notch monoclonal antibodies have been shown to specifically target cancer stem cells while another antibody preferentially targeted mutant Notch associated with hematological malignancies for cancer immunotherapy.

In the area of signal transduction, novel mutations in GCC associated with congenital sodium diarrhoea were characterised. All mutations were found to be activating and the cause of the secretory diarrhoea observed in these patients. Utilising GCC knock out mice, the regulation of colon cell proliferation by GCC was found to be mediated by hyper expression of p21, that lead to cell cycle arrest and senescence. Finally, further studies on cAMP in Mycobacteria identified the novel and non-catalytic roles of a phosphodiesterase, the characterisation of cAMP receptor protein in Mycobacteria and a novel member of the universal stress protein family as being a high affinity cAMP binding protein in Mycobacteria. Further, the regulation of fatty acid metabolism in Mycobacteria by the acetylation of active site residues in FadD enzymes was shown to be mediated by cAMP-regulated protein acetylation.

In the area of Reproductive and developmental biology, guanylyl cyclases (GCs) have been shown to differentially regulate immune response of *C. elegans* to Gram negative and Gram positive bacteria as well as control its life span. In *Drosophila*, the function of the transcription co-activator Beadex in motor neurons has been shown to



be essential for female reproduction. Also an egg-derived tyrosine phosphatase has been identified as a potential biomarker for muscle ageing and degeneration. Towards understanding the molecular basis of early mammalian development and differentiation, (1) during blastocyst hatching, the embryo-uterine expression of estrogen receptor and regulatory cytokines was examined and their functional roles being investigated; (2) enrichment of neural progenitors and neuronal cells, differentiated from embryonic stem cells, was achieved and also the neurogenesis-associated molecular markers' expression. Studies in the area of metabolism-related changes in insulin sensitivity during pregnancy and lactation in mammals indicate that changes in the expression of glucose transporter and estradiol receptor  $\alpha$  and  $\beta$  genes in skeletal muscle participate in decreased insulin sensitivity during pregnancy.

## MOLECULAR BIOPHYSICS UNIT

---

**Staff: Academic: 12; Technical: 1**

**Students: PhD: 87; Int PhD: 19**

**Degrees Awarded: PhD: 18**

**Publications: 65**

Research in the last year provided insights into the mechanism of action of many molecules, relationship between conformation and activity, functioning of neuronal networks and resulted in designing and developing methods to improve the efficacy of compounds to be used in treating cancer, bacterial and viral diseases.

Interactions between the cytosolic domain of the histidine kinase AgrC (AgrC<sub>Cyto</sub>) and the response regulator domain of AgrA (AgrA<sub>RR</sub>) of the quorum sensing system of *Staphylococcus aureus agr* were shown to dictate the spontaneity of the cellular response to AIP (auto-inducing peptides) stimuli. The crystal structure of AgrC<sub>Cyto</sub> provided a basis for a mechanistic model to understand AgrC-AgrA interactions. Two novel crystal structures, a monomer and a head-to-head swapped dimer, of Rv1625c, one of the 16 adenylyl cyclases present in *Mycobacterium tuberculosis*, revealed structural determinants of the oligomeric nature of

the enzyme, which in turn dictates its activity. New insights on the catalytic residues of adenylosuccinate lyase from *M. smegmatis* and *M. tuberculosis* were provided by structural and kinetic studies. Crystal structure of the lectin domain of MSMEG\_3662 from *M. smegmatis* and its complexes with mannose and methyl- $\alpha$ -mannose, the first effort of its kind on a mycobacterial lectin, reveals a structure very similar to  $\beta$ -prism II fold lectins from plant sources, but with extensive domain swapping in dimer formation, providing valuable evolutionary insights.

High resolution solution NMR methods have been applied to determine the sequence of events that lead to association of aromatic amines and phenols as a function of concentration. The mechanism of the diazo transfer reaction has been studied. Retention of amine nitrogen in the amine, and transfer of the two terminal nitrogen atoms of the imidazole-1-sulfonyl azide to the product, were unambiguously established. In other studies, biophysical characterization of the binding of inhibitors of *M. tuberculosis* have been carried out.

MD simulations have been performed on *M. tuberculosis* IdeR (iron-dependent transcription factor) and its complexes with DNA. The role of iron in stabilizing the protein-DNA interaction has been examined. Protein structure validation and ranking methods have been developed on the basis of network concepts. This work enabled the participation in community-wide structure prediction (CASP11) experiments to assess the quality of modelled structures.

Export of mature, fully processed tRNA molecules from nucleus to cytoplasm is carried out by Exportin-t (Xpot) protein in mammals. By studying a range of molecular complexes, gross structural motions in Xpot after cargo release were illustrated and various molecular determinants responsible for tRNA binding were identified, by MD simulations.

Fine-level features in the complex of genomic RNA of hepatitis C virus and human ribosome have been deciphered by integrating atomic representations of components of the assembly with low-resolution cryoEM density map. New methods have been

developed to design sequences of artificial proteins and for the classification of multi-domain proteins. Analysis of sequences of multi-domain kinases revealed the presence of kinases with hybrid properties of two different kinases subfamilies and with highly divergent properties compared to canonical members of the subfamily.

A histidine – aspartate ionic clusture in mycobacterial Dps (DNA binding protein from starved cells)-2 was observed to modulate the rate of iron entry and exit. Substitutions that disrupt the clusture interface alter the iron uptake/release. MsRbpA, an RNA polymerase binding protein in mycobacteria rescues rifampicin – induced transcription inhibition upon binding to the enzyme and was also observed to be a transcription activator. The protein DcpA involved in c – di – GMP synthesis in mycobacteria exists in both monomeric and dimeric forms with different activities. The protein is involved in the change in cell length and colony morphology of *M. smegmatis*.

An immunogen which mimics the native-influenza virus Hemagglutinin stem and binds conformation-specific broadly neutralizing antibodies (bnAbs) with high affinity was rationally designed. The immunogen elicited bnAbs and conferred robust protection against lethal, heterologous virus challenge *in vivo*. Soluble bacterial expression of such a thermotolerant, disulfide-free immunogen allows for rapid scale-up during pandemic outbreaks and represents a new modality for combating influenza virus infection.

The role of rhodanines and designed curcumins as anti-cancer and anti-bacterial compounds was demonstrated. Basic residues of transit peptide in PfENR and Hsp70-1 were shown to be essential for targeting of PfENR to apicoplast in *Plasmodium falciparum*. It was shown that hierarchical sampling defines conformational selection and metastable states for malectin-N-glycan interaction for the quality control of glycoprotein export out of endoplasmic reticulum.

A method to successfully incorporate thiamide bonds onto a growing peptide chain on solid support was

developed to improve pharmacological properties of peptides. A peptide based selective Protein Phosphatase-1 inhibitor with nanomolar inhibition has been developed and currently the introduction of cellular permeability characteristic to this compound is being attempted.

Plasticity of intrinsic excitability has been found in the Fast spiking interneurons in the dentate gyrus of the hippocampus that are important in maintaining network oscillations. Tonic GABAergic inhibition was found to actively modulate subthreshold properties, including resonance due to HCN channels. It was successfully demonstrated that the neuronal network culture can be used as a kernel to transform inputs which are not linearly separable in a low dimensional space, into outputs in a high dimension where they are linearly separable. Thus simple linear discriminants can now be directly connected to outputs of the neuronal culture and allow for implementation of any function for a neuro-electronic hybrid system.

By assessing the role of interactions between voltage-gated ion channels on neuronal information processing, it was demonstrated that functional homeostasis need not necessarily imply that individual channels are maintained at specific densities or properties; the presence of dendrites and dendritic ion channels significantly alter the STA (spike triggered average) of a neuron; and the activation of inositol trisphosphate receptors is sufficient to induce intrinsic plasticity. The results on inositol trisphosphate receptors reveal novel regulatory roles for the endoplasmic reticulum in neural coding and homeostasis.

Peptides with  $(\alpha\gamma)_n$  sequences were designed and their solution and crystal structures were determined. Secondary structure formation in oligopeptides can be induced by short nucleating segments with a high propensity to form hydrogen bonded turn conformations. Type I/III turns facilitate helical folding while type II/I' turns favour hairpin formation. This principle was experimentally verified by studies on two designed dodecapeptides.



## CENTRE FOR ECOLOGICAL SCIENCES

---

**Staff: Academic: 11; Scientific: 2; Technical:1**

**Students: PhD: 43; Int PhD: 8**

**Degrees Awarded: PhD: 5**

**Publications: 108**

CES has continued to do cutting-edge research in diverse areas of ecology, behaviour and evolutionary biology. We study a range of systems from insects, herpetofauna and birds to the largest land mammals, the Asian elephant, including climate change. We employ diverse tools from molecular ecology to mathematical modeling of ecosystems.

### ECOLOGY

Anthropogenic fires in seasonally dry tropical forests are a regular occurrence during the dry season. Forest managers in India, who presently follow a fire suppression policy in such forests, would benefit from a system of assessing the potential risk to fire on a particular day. CES faculty examined the relationship between weather variables (seasonal rainfall, relative humidity, temperature) and days of fire during the dry seasons of 2004–2010, based on MODIS fire incident data in the seasonally dry tropical forests of Mudumalai in the Western Ghats, southern India. Logistic regression analysis showed that high probabilities of a fire day, indicating successful ignition of litter and grass fuel on the forest floor, were associated with low levels of early dry season rainfall, low daily average relative humidity and high daily average temperatures. These weather conditions are representative of low moisture levels of fine fuels, suggesting that the occurrence of fire is moderated by environmental conditions that reduce the flammability of fine fuels in the dry tropics. A quantitative framework was proposed for assessing risk of a fire day to assist forest managers in anticipating fire occurrences in this seasonally dry tropical forest, and possibly for those across South Asia.

Faculty at CES made significant contributions to the chemical ecology of plant–insect interactions. It was established that ant-plants actively synthesise components such as amino acids and sugars that are added to exudates from extrafloral nectaries; therefore extrafloral nectar is not mere phloem sap

but its composition is actively modulated by plants to attract symbiotic ants with which the plants have a mutualistic relationship. Plants and ants exchange nutrition (provided by plants) to protection (provided by ants). It was also established for the first time that non-protective ants and other inhabitants of ant-plants plant can be mutualists of ant-plants by contributing to the absorption of nitrogen from domatia (housing provided by plants). Such trophic benefits accrued by plants can explain why plants are willing to house non-protective interlopers in domatia; the nitrogen benefits are particularly important for leguminous non-nodulating ant-plants which cannot benefit from nitrogen-fixation by nodulating bacteria. Research on another plant–insect system indicated that insects are deploying plant metabolic pathways in sophisticated niche construction and are also capable of shifting plant developmental pathways to suit their own needs. Therefore galling insects may shorten the development of plant inflorescences while parasitoid insects may lengthen the time spent in development of inflorescences. These results have opened new avenues of investigation into how insects can manipulate plant development.

A four-year project on addressing the Wallacean and Linnean shortfall for frogs, lizards and snakes of the Western Ghats was concluded. Extensive distribution data was collected and collated, resulting in the creation of an online distribution database and atlases for lizards and frogs. Multiple new lineages have been discovered in numerous genera, and nine new species of bush frogs were described in the journal *Zootaxa*. Leatherback turtles were monitored and satellite tagged in Little Andaman Island, with two of the tagged turtles migrating to Madagascar and Mozambique.

A systematic analysis of the breeding phenology of the the rock agama, *Psammophilus dorsalis*, was completed. Such analyses are scarce for tropical species and provides a baseline for monitoring changing breeding patterns with climate change. Analyses of male mating strategies and personality in the rock agama and on the dynamics and consequences of interactions between male blackbuck antelope on costly lekking territories are ongoing. Experiments on social behaviour in mosquitoes revealed influences of social behaviour on

habitat use and showed that group-formation may carry costs in terms of exploring and utilising risky habitat. In projects on applied evolutionary ecology, CES faculty are analyzing the influence on invasive plants on butterfly habitat use and distribution, and the influence of grazing by livestock and habitat management strategies on grassland ecology.

CES faculty developed methods to analyze spatial patterns in ecology that will enable detection of potential catastrophic events. These methods together with codes have been published on an open source platform so that any researcher can employ them for their research.

### BEHAVIOUR AND EVOLUTION

Using the tropical, primitively eusocial polistine wasp *Ropalidia marginata* and by comparing wasps held in isolation and those kept as pairs in the laboratory, it was demonstrated that social interactions affect ovarian development of dominant and subordinate wasps among the pairs in opposite directions, suppressing the ovaries of the subordinate member of the pair below that of solitary wasps and boosting the ovaries of dominant member of the pair above that of solitary females. In addition to being of physiological interest, such mirror image effects of aggression on the ovaries of the aggressors and their victims, suggest yet another mechanism by which subordinates can enhance their indirect fitness and facilitate the evolution of worker behavior by kin selection.

Over the past year, faculty at CES completed a number of studies that examined the ecological context of mate attraction, mate search and mate choice in crickets. In the field cricket *Plebeiogryllus guttiventris*, we completed studies on chorus dynamics in wild cricket populations. Together with Prof. Chandra Sekhar Seelamantula of the Electrical Engineering Dept, IISc., an algorithm was also developed to localize individual calling males in cricket choruses that we hope will allow automation and non-invasive sampling of cricket calling activity. In the tree cricket *Oecanthus henryi*, we have completed a study on active signal amplification by males using leaf baffles, including its function and the factors that could have led to the evolution of this unique behaviour.

## CENTRE FOR INFECTIOUS DISEASE RESEARCH

---

### Publications: 3

The renovated Centre for Infectious Disease Research (CIDR) is involved in two primary activities: First, providing the intellectual and infrastructural support for infectious disease research. Second, enable researchers to perform studies in the Biosafety Level-3 (BSL-3) facility, a state-of-the-art biocontainment space to perform research with highly infectious organisms.

Studying the roles of WhiB transcription factors in *Mycobacterium tuberculosis* which may facilitate physiological adaptation of *Mycobacterium tuberculosis* required for its entry, maintenance, and emergence from a latent state.

Developed a series of non-invasive biosensors to measure oxidative changes associated with HIV infection in real-time which study will provide mechanistic understanding of redox basis of HIV-1 infection and lead to better development of more affordable anti-oxidant based strategies for the control of AIDS.

To deconvolute the CD4+ T cell response in infection; specifically in HIV-TB infections, thereby extending ongoing human clinical immunology work to the Indian setting. Ps20 overexpression in DU145, PC3 and WPMY-1 cells highlighted cell-specific anti-proliferative effects of ps20 with only ps20<sup>hi</sup> WPMY-1 cells exhibiting reduced proliferation, largely due to increased apoptosis. Whole genome differential transcriptome analysis of WPMY-1-EV v WPMY-1-ps20FL/WPMY-1-ps20TR cells identified numerous soluble factors, including IL-8, IL-32, COX2, and SerpinF1 to be specifically upregulated in ps20<sup>hi</sup> WPMY-1 cells. A systems biology approach to comprehensively define baseline innate and TB-specific immunity in young adults, and to determine how BCG revaccination alters that immunity has been undertaken. The clinical arm of the study has been successfully set up at Aryogavaram Medical Centre, Madanapalli with volunteers. Current plans include validation of multi-colour flow cytometry panel to enumerate functional immune subsets.



Work is focused on (i) Understanding the significance of metabolic pathways in the sexual and asexual stages of the malaria parasite and (ii) Deciphering the molecular mechanisms involved in the vesicular trafficking pathways of the malaria parasite.

The potential of *Plasmodium berghei* lacking ALAS sporozoites as a genetically attenuated sporozoite vaccine is being tested in mice. The results obtained have suggested the ability of *Plasmodium berghei* lacking ALAS sporozoites as a genetically attenuated sporozoite vaccine.

## CENTRE FOR NEUROSCIENCE

---

**Staff: Academic: 9**

**Students: PhD: 26; Int PhD: 2**

**Publications: 14**

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. An activity dependent protein translation at the synapse has been shown to be impaired in AD far before the manifestation of disease pathology and behavioural deficits.

- A novel triple step task to show how exocentric representations in the oculomotor system could facilitate the parallel programming of sequential tasks has been demonstrated.
- During the investigation of 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 the role of beta-catenin as a cell fate determinant for granule neuron progenitors in the developing murine cerebellum has been elucidated. Levels of beta-catenin were checked in progenitor rich cultures versus differentiated neuronal cultures and it was found that the amount of beta-catenin was significantly more in progenitor cultures. It was observed that upregulating beta-catenin prevented cells from exiting the cell cycle (marker used- Ki67).

- A novel transcriptional pathway regulated by GSK3 kinase and Serum Response Factor (SRF) that is critical for axon growth during development has been identified. Efforts are underway to identify the target genes of this pathway and to determine the role of this pathway in axonal regeneration after injury.
- Several major insights into neuronal basis of object recognition using the activity of single neurons in the monkey inferotemporal cortex have been studied. (1) Texture perception in humans can be predicted using neuronal activity in monkey inferotemporal cortex; (2) IT neurons encode the relative size of parts in a display, thus forming a potential neural substrate of size constancy; (3) IT neurons exhibit a dramatic transition from view dependence to view invariance over the course of the visual response, thus elucidating a long-standing debate about whether object representations are invariant to three-dimensional view.
- Neuronal mechanisms of selective attention using computational and neurophysiological techniques, with a focus on neuronal oscillations thought to play a role in cortical processing are being studied. Mathematical techniques used to quantify frequency specific phase relationships between brain areas has been established.
- Neuronal basis of learning and memory has shown that new learning is faster if it is acquired in relation to pre-existing knowledge using mice models and training them to acquire information in a relational manner.
- The role of organization and recycling of synaptic molecules in transmission and plasticity will utilize ultra-high resolution imaging approaches to investigate assembly and regulation of synaptic transmission machinery. 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.
- The new faculty, **Sridharan Devarajan** seeks to understand how cognitive behaviors associated with attention and decision-making emerge from neural computations at various spatial and temporal scales.

An interdisciplinary approach involving a combination of theory and experiments will be employed. Electroencephalography (EEG) and functional magnetic resonance imaging (fMRI) are used to monitor brain activity at fine spatial and temporal scales.

## CENTRAL ANIMAL FACILITY

---

**Staff: Scientific: 2; Technical 1**

**Publications: 5**

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 (IFNg 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 over **10,000** animals during the year.

A barrier facility with controlled environment and germ free atmosphere is available for breeding special strains of immuno-compromised mice (nude mice), knockout mice and parent stocks.

## PRIMATE RESEARCH LABORATORY

The Primate Research Laboratory (PRL) currently has adult, sub-adult, juvenile and infant bonnet monkeys (*Macaca radiata*). Research related to neuronal basis of object recognition, visual perception, generation of motor behavior, 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 gaseous anaesthetic machine with precision vapourizer and multiparameter health monitoring system for conducting sterile surgeries in non-human primates.

---

## 6.2 Division of Chemical Sciences

(Chairperson: S Ramakrishnan)

---

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

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

### INORGANIC AND PHYSICAL CHEMISTRY

---

**Staff: Academic: 19; Scientific: 3**

**Students: PhD: 97; Int PhD: 33**

**Degrees Awarded: PhD: 18**

**Publications: 102**

Established in 1909, the department is currently one of the finest in the country with 20 teaching faculty, 4 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 period of five years in April 2012. Recently, department entered its third phase of support from the DST under its Funds for Improvement of Science & Technology (FIST) program.

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

#### SPECTROSCOPY

Microwave spectrum of propargyl alcohol dimer was assigned and the structure proved to be stabilized by O–H...O, C–H... $\pi$  and O–H... $\pi$  hydrogen bonds. This appears to be a smallest molecule to be stabilized by a three-point contact. The ‘carbon bond’ that was proposed by Prof. Arunan has now been experimentally verified by several researchers, including Prof. Guru Row, in crystals. This was featured in a story in the American Chemical Society’s news magazine Chemical and Engineering News titled ‘Defining a new carbon bond’ (C&E News, 2014, 92(1) pages 25-26). It has been

followed up by many researchers subsequently leading to a broader definition and understanding on bonding. Ultra-fast sub-femtosecond hole migration from one monomeric unit of the ammonia borane dimeric cluster to the other upon prompt vacuum ultraviolet (VUV) valence photoionization has been studied based on highly correlated ab-initio calculations. This is the first report of ultra-fast hole migration at the vertical ion (VI) point in an unusual dihydrogen-bonded cluster.

Some experiments and calculations to identify Fermi resonances in the IR spectra of large aromatic hydrocarbons, like naphthalene and its derivatives, have been carried out. A mixed local mode/normal mode formulation for calculating the Fermi resonance frequencies has been implemented.

#### SENSING

Organic and organometallic luminescent materials have found immense interest in recent times as many of their optoelectronic features have found suitable applications in modern display and lighting systems (e.g. OLED and LCD etc.), biomedical imaging, security systems, sensors etc. By systematic synthetic structural alterations in molecular dyes, a greater understanding of their luminescent properties in molecular as well as condensed bulk-states has been gained, thereby providing useful insights into the structure-property relationships of the compounds. These studies have lead to the development of novel functional materials e.g. sensors, solid-state emitters, broad visible and NIR emitters etc. Several extended open frameworks as well as supramolecular polymers have been developed as potential materials for sensing nitroaromatic explosives in solution and vapour phase.

## ORGANOMETALLIC CHEMISTRY AND CATALYSIS

With a view to gain insight into the mechanism of sigma-bond metathesis reaction, which has deep implications in catalysis, cis-dihydrogen/hydride complexes of ruthenium bearing phosphine and N-N bidentate ligands and studied the dynamics of H-atom site exchange between  $H_2$  and hydride. Several sigma- $H_2$  and silane complexes of transition metals were prepared. These complexes serve as models for the binding of  $CH_4$  to a metal center and its subsequent activation the study of which is important from the standpoint of activation and functionalization of methane. As part of ongoing studies on the mechanism of organic and organometallic reactions, the diazo transfer reaction promoted by copper complexes has been investigated; this was shown through isotopic labeling that the attack of an amine on the azide occurs at the terminal position. This allows isotopically labelled amino acid azides to be prepared.

## BIOINORGANIC AND MEDICINAL CHEMISTRY

A new bis-thiosemicarbazone complex that can be delivered smartly through dendrimers, gold nanoparticles and polyethylene glycol linked to targeting agents has been developed. To verify targeted and effective delivery to solid tumors, test against a few cell lines and in animal models have been carried out; efficient reduction of tumor volume has been achieved.

Curcumin-based metal complexes as photo-chemotherapeutic agents that show significant photo-induced cytotoxicity under visible light, while being minimally toxic in the dark, have been developed; since these complexes have suitable fluorophores, their cellular localization in cancer cells were readily imaged. Specific molecular designs to selectively target the mitochondria or endoplasmic reticulum (ER) has been developed; as desired by the oncologists, it has thus been possible to preclude nuclear excision mechanism.

$V_2O_5$  nanowires (Vn) were shown to functionally mimic the antioxidant enzyme glutathione peroxidase by using cellular glutathione. Although bulk  $V_2O_5$  is known to be toxic to the cells, the property is altered when converted into a nanomaterial form. The Vn nanozymes readily internalize into mammalian cells of multiple

origin (kidney, neuronal, prostate, cervical) and exhibit robust enzyme-like activity by scavenging the reactive oxygen species when challenged against intrinsic and extrinsic oxidative stresses.

## NANOSCIENCE AND ELECTROCHEMISTRY

Surface plasmon resonance of Ir and Os nanochains in the visible region has been used for surface enhanced Raman scattering studies. Additionally, oxygen reduction using various morphologies of Ir has been studied. In collaboration with other researchers, -ion gating through nanochannels using electrochemical techniques, has been explained. Layered solid solution of MoSSe has been shown to be an excellent catalyst for hydrogen evolution.

Nanoclusters of Pt were electrochemically deposited on a conducting polymer poly (3,4-ethylenedioxythiophene) (PEDOT), which in turn was electrochemically deposited on a carbon paper substrate. A thin layer PEDOT on a carbon paper substrate facilitates the formation of uniform, well-dispersed nanoclusters of Pt. In the absence of PEDOT, the clusters are unevenly distributed on carbon paper. Cyclic voltammetry studies suggest that peak currents for formic acid oxidation are several times greater on Pt-PEDOT/C electrode than on Pt/C electrode. Comparison studies for electrooxidation of  $C_1$ ,  $C_2$  and  $C_3$  alcohols on nanodendritic Pd-PEDOT surface are carried out. Owing to enhanced surface area and surface defects on dendritic Pd, the Pd-PEDOT/C electrode exhibits greater catalytic activity than the Pd/C electrode for all the alcohols.

## POLYMER CHEMISTRY

A novel design for a periodically grafted amphiphilic copolymer bearing hydrocarbon backbone and fluorocarbon side chains was conceived and synthesized; it was demonstrated that immiscibility between the hydrocarbon and fluorocarbon segments drives the chain to fold in a zigzag fashion that helps collocate the two immiscible segments in alternate lamellae and interestingly both segments crystallize independently and exhibit two distinct melting points. The remarkable feature was that the polymer exhibited a liquid crystalline phase at temperatures between the two melting transitions.

## THEORETICAL CHEMISTRY

The average time for one end of a long self-avoiding polymer to interact for the first time with a flat penetrable surface to which it is attached at the other end, was theoretically examined.

In order to use single-molecule (SM) junctions for as optical switches and other optical devices, it is important to analyse the optical response of molecule at current carrying junctions; a theoretical method has been formulated to study stimulated and spontaneous optical signals of molecular junctions. This provides an opportunity to study properties of not only the neutral but also the charge states of the molecule in a nonequilibrium environment; this formulation was extended to understand the time-resolved properties of SM junctions. Further, efforts to understand quantum properties of OH..O<sup>-</sup> hydrogen bonds that are found in crystals of many inorganic and organic salts have been made.

The structure and reactivity problems of molecules, clusters and solids using theoretical techniques ranging from the simplest of molecular orbital methods to sophisticated electronic structure theory have been studied. Some of the topics emphasized include three membered rings involving hypercoordinate sulphur, generalization of H-Bond (X-H---Y) to Z-Bond (X-Z---Y) where Z is any element of the periodic table of elements, designing strain-free boron fullerenes and C-H Bond activation. The relaxation of a particle subject to a harmonic potential and Levy noise in the over-damped limit was examined; the eigenvalue spectrum of the operator describing the relaxation was found to be very unusual, in that even though the problem is one dimensional, the eigenvalues were dependent on two "quantum numbers". A theoretical model was constructed for the passage of a protein through the nuclear pore complex, which is known to be a very selective filter.

**New facilities created during the year:** Cell culture and ultrafast laser facilities have been created by the departmental faculty members.

## ORGANIC CHEMISTRY

---

**Staff: Academic: 10**

**Students: PhD: 50; Int PhD: 13**

**Degrees Awarded: PhD: 8**

**Publications: 65**

The Department of Organic Chemistry is one of the oldest departments in the campus and in the country. Currently, the department has nine faculty members, one honorary professor, about 65 PhD students and about twelve project assistants and twelve research associates. Research carried out in the Department covers almost all areas of Organic Chemistry including the emerging and interfacial subjects. The department publishes around 70 papers per year.

During 2014-15, several accomplishments have been made in a variety of areas including design, synthesis, and structural characterization, analysis of multi-molecular interactions and elucidation of physical and biological properties of small organic and macromolecules.

### ORGANIC SYNTHESIS AND MOLECULAR DESIGN

Developing strategies for asymmetric synthesis and their application to the stereo-selective total synthesis of natural products of therapeutic significance continues to be central theme. In this context, the enantiospecific total synthesis of structurally complex natural products from abundant chiral pool compounds is actively pursued. The total synthesis of several natural products, namely a macrolactone (Sch725674), a polyhydroxy lactone (+)-anamarine, and indole alkaloids henrycinol A and B, was accomplished from tartaric acid, whereas the synthesis of decanolactone seimatopolide A and the polyketide unit present in HIV-inhibitory depsipeptides Aetheramide A and B, was accomplished by the elaboration of a chiral furylcarbinol.

In the area of Molecular Design, the synthesis of the following were accomplished: (a) linear and cyclic cationic antimicrobial peptides, that have shown excellent and very selective activities against MTB with no cytotoxicity; (b) various sugar amino acid based anticancer molecules that target microtubule dynamics,

c-MYC and other gene promoters, VIP receptors, HDAC and other targets; (c) fully amide-linked RNA mimics of small oligonucleotides for miRNA modulation. Synthesis of natural products using a radical mediated method, was developed to construct chiral 1,3-diols by opening epoxy alcohols using Ti(III) reagent. A sesquiterpenoid molecule, penifulvin A having a highly complex dioxane (5.5.5.6) fenestrane skeleton has also been synthesized using this Ti(III)-mediated epoxide opening to stereoselectively construct the most important central quaternary centre of the molecule. The chemistry is being extended now for the synthesis of other fenestrane-type molecules.

The first experimental understanding of the conformational consequences of introducing a disallowed conformation of Aib on the 3, 10-helical fold of a peptidomimic has been accomplished and the origins of disallowed conformations in folded proteins have been established. The first switch peptide templates have been designed and synthesized, that can bias coupled peptides to exist in dynamic equilibrium between two distinct states; these could be at the origin of amyloid protofibril formation in proteins. 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. 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.

### PHYSICAL ORGANIC CHEMISTRY

A method for the direct formation of urea inclusion compounds has been developed. Thus, channel complexes between urea and over a dozen linear host molecules were prepared by the direct admixture of the components. This method represents a substantial improvement over the existing crystallization strategies, which are time-consuming and laborious.

A kinetic study of hydrolytic stabilities of mono-, di- and 2-chloro-2-deoxy septanosides, under an acid-catalysis was undertaken. Comparison of rate of glycosidic bond stabilities showed that show glycosidic bond in

the un-natural septanoside disaccharide was more stable than the monosaccharide. The orientation of the exo-cyclic hydroxymethyl group and the inductive effect are suggested to play a role in the rates of hydrolysis.

The first systematic design and synthesis of model systems expressing the weak C-H...p interactions has been accomplished and exact energies of C-H...p interaction energies have been determined experimentally, as a function of steric bulk at the C-H center.

### CHEMISTRY OF NEW MATERIALS

Photocatalytic disassembly of tertiary amine-based poly (propyl ether imine) dendrimers, in presence of either 9,10-anthraquinone or riboflavin tetra-acetate and O<sub>2</sub> was demonstrated; this disassembly was successful up to three generations. A “catch and release” of a dye was demonstrated using this photo-disassembly. Poly (ether imine) dendritic macromolecules were shown to undergo reversible dendrimer monomer-megamer assembly-disassembly in aqueous solutions. Kinetics of the aggregation behavior was followed using turbidity measurements, light scattering and atomic force microscopic techniques. Inherent luminescence behavior of PETIM dendrimer monomers was retained in the dendrimer megamers, which allowed visualization of the megamers through confocal microscopy.

A series of bile-acid conjugates of amino acids and short peptides were synthesized and their gelation behavior was studied; these functioned as organo or hydrogelators depending on their hydrophobicity/hydrophilicity balance. One of these molecules exhibited an unusual, isomer-selective, gelation of aromatic solvents. These gels were utilized for the in-situ generation of silver and gold nanoparticles; the silver nanoparticle embedded gels were coated on glass surfaces, and preliminary results indicate significant antibacterial properties.

The smallest self-assembling molecules that represent the optimal balance between their intermolecular interactions and interacting surface have been identified. The controlled homodimensional self-assembly of these molecules into hollow horizontal



and vertical tubular forests has been achieved. The origins of holes formed on Graphitic surfaces have been determined; the mechanisms of the oxidative and reductive reactions that generate holes on graphitic surfaces have been elucidated; and the debris resulting from graphitic surfaces have been determined to be chemical byproducts – rather than adsorbed artifacts – in a first finding of its kind.

Over the past decade 3-D nano-structures have been highlighted for their exceptional properties which have allowed their use in areas that were not fathomable for bulk materials. However, recent research on 2-D nano-structures has brought to the forefront completely different properties compared to their corresponding 3-D nanostructures. Current research focuses on the development of supramolecular chemistry using two dimensional (2D) material platforms, including graphene oxides (GO), chemically exfoliated MoS<sub>2</sub> (ceMoS<sub>2</sub>) and anisotropic lamellar hydrogels. In this field, the assembly of discrete small and large molecules by engineering their surface chemistries is being actively pursued; the drive is to enable better solution processability and to improve the physical and electronic properties of these 2D colloids for relevant applications.

### 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. Some of these were employed as new carriers of p53 based chimeric-GFP plasmids which showed impressive tumor suppression properties *in vivo*.

Synthesis of new cyclic di- and tetra-saccharides, inserted with methylene moiety at the inter-glycosidic bond, was achieved in good yields through a one-pot condensation of a disaccharide monomer. Solubilities of free hydroxyl group containing amphiphilic cyclic tetrasaccharide in aqueous solution and in organic solvents has provided a new platform for host-guest studies.

Supported lanthanide cholate derived xerogels were made in the presence of pro-sensitizers, and

these materials were used for the direct sensing/ assay of a few representative enzymes either in the isolated form, or in biological fluids. A simple test for confirming Pasteurization of milk was devised by this methodology. This technique is now being investigated for the detection of a few clinically used drugs.

### SYNTHETIC METHODOLOGY DEVELOPMENT AND ASYMMETRIC CATALYSIS

A mild and convenient oxidative transformation of secondary alcohols to 1,5-disubstituted tetrazoles was achieved by employing TMSN<sub>3</sub> as a nitrogen source in the presence of catalytic amount of Cu(ClO<sub>4</sub>)<sub>2</sub>·6H<sub>2</sub>O (5 mol%) and DDQ (1.2 equiv) as an oxidant.

Transition metal-free acylation of isoquinoline, quinoline and quinoxaline derivatives has been developed employing a cross dehydrogenative coupling (CDC) reaction with aldehydes using sub-stoichiometric amount of TBAB (tetrabutylammonium bromide, 30 mol %) and K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> as an oxidant. The application of this CDC strategy for acylation strategy has been illustrated in synthesizing isoquinoline-derived natural products. A new route for the synthesis of vinyl sulfones via a copper-catalyzed, ligand-promoted decarboxylative coupling was developed; the salient feature of this method is that it furnishes exclusively the (*E*)-isomer.

A highly regioselective C-H functionalization reaction with electron rich aromatic systems, including heteroaromatics, was achieved by reversing the reactivity of sulfur in the presence of suitable oxidant and strong acid; this strategy provides a rare opportunity of using thione in CDC reaction to form C-S bonds to obtain arylthiobenzoxazoles, hetero-arylthiobenzoxazoles and arylthiobenzthiazoles, which are pharmaceutically valuable compounds. A rapid, metal-free and effectively solvent-free reaction conditions for synthesizing thioamides and amides using the Bronsted super acid, such as triflic acid has been developed. This method shows a broad substrate scope with a variety of electron-rich.

The first catalytic enantioselective iodoetherification of oximes, a ketone-derived nucleophile, to produce Δ<sup>2</sup> isoxazolines containing a quaternary stereogenic center, in high yield with good to excellent

enantioselectivity, was developed. This approach was extended to achieve catalytic enantioselective iodoaminocyclization of  $\beta$ ,  $\gamma$ -unsaturated hydrazones and allows for the direct access to  $\Delta^2$ -pyrazolines containing a quaternary stereogenic center in high yield with good enantioselectivity (up to 95% yield and 95:5 er). 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 enantiogroup differentiating organocatalytic allylic alkylation. Densely functionalized products with two vicinal stereocenters were obtained generally with good to excellent diastereoselectivity (up to >20: 1 dr) and superb enantioselectivity (up to >99: 1 er). Besides, an efficient, robust and highly enantioselective catalytic desymmetrization of 2,2-disubstituted cyclopentene-1,3-diones has been developed via direct vinylogous nucleophilic addition of deconjugated butenolides. This reaction, catalyzed by a tertiary amine-thiourea bifunctional catalyst, generated products containing two quaternary and a tertiary stereocenter in outstanding diastereoselectivity (up to >20:1 dr) and excellent enantioselectivity (up to 99:1 er). A remarkable influence of the secondary catalyst site on the enantioselectivity points towards an intriguing mechanistic scenario, possibly by triggering a change in catalyst conformation.

Spirooxindoles are an important structural motif present not only in natural but also in many unnatural biologically active compounds; in this context, a diastereo- and enantioselective spiroannulation cascade between 3 isothiocyanato oxindoles and nitroolefins, using a cinchonidine-derived bifunctional catalyst, has been demonstrated. A variety of 3,3'-pyrrolidonyl spirooxindoles containing three contiguous (one quaternary and two tertiary) stereogenic centers were obtained in high yield with good to excellent diastereo- and enantioselectivities.

### NEW FACILITIES CREATED

Inverted Microscope with Fluorescence Microscopy and Photographic attachments: Olympus Model XI 73 – DST-FIST.

## SOLID STATE AND STRUCTURAL CHEMISTRY UNIT

---

**Staff: Academic: 11; Scientific: 6**

**Students: PhD: 56; Int PhD: 23**

**Degrees Awarded: PhD: 9**

**Publications: 90**

The Solid State and Structural Chemistry Unit, founded at the Institute in 1976 by Professor CNR 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.

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, experimental verification was provided on the importance of co-operative utilization of  $\sigma$ -hole and  $\pi$ -hole in holding the molecules of an isothiocyanate-based peptide together in its crystal lattice, thereby showcasing the importance of weak, but highly directional interactions in structure-activity relationships. This was highlighted as “ $\sigma$  meets  $\pi$  for a hole lot of bonding” in “Chemistry World” in December 10, 2014. Another novel finding is the chemical modification of the commercially available and expensive stress-activated protein JNK inhibitor SP600125 to help treatment of disorders caused due to sepsis.

A new type of interaction, referred to as the “Carbon Bond”, has been reported; this was evidenced in the context of dimethylammonium 4-hydroxybenzoate, which clearly showed a clear bond path between a dimethylammonium carbon and an oxygen of the benzoate’s carboxylate group, and was termed as “Carbon bonding”. Several new concepts related to structural landscape have been explored in crystal engineering. Halogen bonding and systematic design strategies have also been devised to design new ternary cocrystals and novel characterization techniques



have been employed to probe the energetic of compound formation.

It was demonstrated that semiconductor quantum dots can react with each other in the same manner as atoms, leading to the formation of stoichiometric compounds where quantum dots take on the role of ions. This extends the range of chemical bonds to an unprecedented length scale, leading to novel, unexpected physical properties.

Novel tin-based compounds for high energy and high rate capability rechargeable batteries based on lithium and sodium chemistries have been developed for prospective large scale applications, such as electric vehicles.

For the first time, valence bond method has been used to obtain exact solution of a system with over 0.9 billion basis functions. Quantum phase diagram of a frustrated spin chain has been studied using entanglement entropies to characterize the phases.

### FUNDING STATUS

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. 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 Ministry of Human Resources and Development (MHRD) and Department of Science and Technology (Intensification of Research in High Priority Areas, IRHPA) have been sanctioned and ongoing with SSCU acting as the nodal department for the projects. A Thematic Unit of Excellence (TUE) on Computation of Materials Science (TUE-CMS) funded by DST-Nano Mission of the Department of Science and Technology has been set up and SSCU is the nodal department for the TUE-CMS.

### MATERIALS RESEARCH CENTRE

---

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

**Students: PhD: 58; Int PhD: 6**

**Degrees Awarded: PhD: 9**

**Publications: 64**

To promote Materials Science activities in a coordinated manner, the Materials Research Laboratory was established 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 with 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 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 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 integrated Ph.D., undergraduate and bioengineering 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 and substantial funding, which are both among the highest in the Institute.

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 the state-of-the-art research facilities in the broad areas of magnetic materials and Li-ion batteries.

### **PENTAHEXOCTITE – A NEW TWO-DIMENSIONAL ALLOTROPE OF CARBON**

The ability of carbon to exist in many forms across dimensions has spawned search in exploring newer allotropes consisting of either, different networks of polygons or rings. While research on various 3D phases of carbon has been extensive, 2D allotropes formed from stable rings are yet to be unearthed. A new sp<sup>2</sup> hybridized two-dimensional allotrope consisting of continuous 5-6-8 rings of carbon atoms, named as “pentahexoctite”, was reported. The absence of unstable modes in the phonon spectra ensures the stability of the planar sheet. Furthermore, this sheet has mechanical strength comparable to graphene. Electronically, the sheet is metallic with direction-dependent flat and dispersive bands at the Fermi level ensuring highly anisotropic transport properties. This sheet serves as a precursor for stable 1D nanotubes with chirality-dependent electronic and mechanical properties. With these unique properties, this sheet becomes another exciting addition to the family of robust novel 2D allotropes of carbon.

### **STRAIN-INDUCED ENHANCEMENT OF THERMOPOWER OF TiS<sub>2</sub>:**

Using first-principles density functional theory calculations, a semimetal to semiconducting electronic phase transition for bulk TiS<sub>2</sub> by applying uniform biaxial tensile strain was demonstrated. The electronic transport calculations show a large anisotropy in electrical conductivity and thermopower, which is due to the difference in the effective masses along the in-plane and out-of-plane directions. Strain-induced opening of band gap together with changes in dispersion of bands lead to threefold enhancement in thermopower for both p- and n-type TiS<sub>2</sub>. It was further demonstrate that the uniform tensile strain, which enhances the thermoelectric performance, can be achieved by doping TiS<sub>2</sub> with larger iso-electronic elements, such as Zr or Hf at Ti sites.

### **PRESSURE-DEPENDENT OPTICAL AND VIBRATIONAL PROPERTIES**

Controlling the band gap by tuning the lattice structure through pressure engineering is a relatively new route for tailoring the optoelectronic properties of two-dimensional (2D) materials. The electronic

structure and lattice vibrational dynamics of the distorted monolayer 1T-MoS<sub>2</sub> (1T') and the monolayer 2H-MoS<sub>2</sub> via a diamond anvil cell (DAC) and density functional theory (DFT) calculations were examined. The direct optical band gap of the monolayer 2H-MoS<sub>2</sub> increases by 11.7% from 1.85 to 2.08 eV, which is the highest reported for a 2D transition metal dichalcogenide (TMD) material. DFT calculations reveal a subsequent decrease in the band gap with eventual metallization of the monolayer 2H-MoS<sub>2</sub>, an overall complex structure–property relation due to the rich band structure of MoS<sub>2</sub> was noticed. Remarkably, the metastable 1T'-MoS<sub>2</sub> metallic state remains invariant with pressure, with the J<sub>2</sub>, A<sub>1g</sub>, and E<sub>2g</sub> modes becoming dominant at high pressures. These results present an important advance toward controlling the band structure and optoelectronic properties of monolayer MoS<sub>2</sub> via pressure, which has vital implications for enhanced device applications.

The transition metal silicides for high temperature thermoelectric applications have been investigated in detail. In particular, the effect of co-substitution of Mn and Al in the crystal lattices of Cr<sub>2</sub>Si on the thermoelectric properties is studied. Gas sensors based on oxides have been developed. The detailed structural /microstructural and dielectric properties of titanates have been studied. The effects of doping of nanocrystalline SnO<sub>2</sub> has been investigated with regard to its thermal stability and optical properties.

Theoretical and experimental studies on ultrathin metal nanowires have been 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 modifies the electronic states of the wire and hence their transport behaviour.

High activity CeO<sub>2</sub>/Pt catalysts were synthesized using microwave method. The effect of the morphology of the ceria on the catalytic efficiency was investigated in detail. The impact of aspect ratio of ZnO nanorods on their photocatalytic activity was demonstrated. Highly active TiO<sub>2</sub>/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<sub>2</sub> were grown using vapor phase techniques and investigated for various energy-related device applications. New techniques for growth of ultralong ZnO nanowires and single step technique for the growth of branched carbon nanotubes were developed. Ge/GeO<sub>2</sub> 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.

The effectiveness of intermittent delivery of pulse electric/magnetic stimulation to modulate neurogenic/osteogenic/myogenic differentiation of human mesenchymal stem cells, in vitro (without differentiation inducers), was demonstrated. Using extensive experimental framework involving various cell lines (osteoblast, fibroblast, myoblast, neuroblastoma) and material substrates (elastically compliant or stiff), an understanding has been developed of the complex synergistic interaction among electrical conductivity/magnetization properties of biomaterials and stimulation parameters towards cell fate processes. Together with first principle calculations, a clear understanding of the critical role of bioelectric stresses on the cell fate processes in stimulated culture conditions was attained. Scaffolds, with highly interconnected complex pore structures that mimic bone properties, was fabricated using additive manufacturing techniques (three dimensional printing); along with a team of clinicians and entrepreneurs, efforts are being made to translate this into implantable biomedical devices for orthopedic and dental restorative applications.

### FUNCTIONAL MATERIALS IN THIN FILM CONFIGURATION

The thin films and multilayer heterojunctions 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 electrical transport (InGaN/Si), infrared detectors (HgCdSe, CZTS, Cu<sub>3</sub>BiS<sub>3</sub>) photovoltaics (In<sub>2</sub>O<sub>3</sub>/p-Si), electrocaloric (0.85PMN-0.15PT) and magnetic (La<sub>0.6</sub>Sr<sub>0.4</sub>MnO<sub>3</sub>) applications.

The materials fabricated at different length scales in MRC were employed in the fabrication and demonstration of the functionalities of the following devices: Electro-optic light intensity modulators, Bragg-like gratings, Vibration sensors, Pyroelectric sensors, Gas sensors and White-light emitting devices.

## NMR RESEARCH CENTRE

---

**Staff: Academic: 4; Scientific: 1**  
**Publications: 23**

At NMR Research Centre the focus is on the development of new NMR methods and their application to important and challenging chemical and biological systems. During the last year several novel methods have been developed by faculty of the centre. Some of the important recent developments include: (i) a method for rapid characterization of diffusion in molecules; (ii) characterization of the structure and detailed dynamics of an intrinsically disordered domain of human IGFBP-2; (iii) new methods for testing enantiopurity of chiral amines; (v) new experimental schemes have been proposed that by using <sup>1</sup>H decoupled <sup>1</sup>H spectra; it is now 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 <sup>1</sup>H and the quadrupolar nucleus <sup>11</sup>B were developed and applied; (viii) development of frequency-selective ultrafast 2D, spectroscopy in inhomogeneous magnetic field; (ix) implementation of a double-quantum experiment that provides proximity and correlation information using low rf radiation without compromising on the bandwidth and (viii) new methods and new directions in metabolomics.

---

## 6.3 Division of Electrical Sciences

(Chairperson: Y Narahari)

---

The Division consists of the following Departments:

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

### COMPUTER SCIENCE AND AUTOMATION

---

**Staff: Academic: 23; Scientific: 1; Technical: 1**  
**Students: PhD: 94; MSc (Engg): 48; ME/MTech: 106**  
**Degrees Awarded: PhD: 8; MSc (Engg): 9; ME: 57**  
**Publications: 132**

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

#### INTELLIGENT SYSTEMS

**Q-learning:** We have developed a provably convergent variant of Q-learning with function approximation that leads to an optimal policy. The algorithm is a stochastic recursive inclusion and tracks an associated differential inclusion. We applied this algorithm to the problem of intrusion detection in wireless sensor networks and observed that the algorithm provides good sleep-wake schedules for the sensor nodes. We also studied the problem of traffic signal control when each junction makes its own decisions based on local state information on congestion, and then passes that information to neighbouring junctions. Each junction is assumed to have its own local clock with respect to which updates are performed. The resulting algorithm has much less complexity than a centralized control setting, as is currently the practice. Moreover, what is also interesting is that the converged policies invariably result in green corridors.

**Multi-armed Bandit Mechanisms:** We have designed *intelligent* mechanisms that combine machine learning with mechanism design in the context of multi-armed bandit models. This work is motivated by modern crowdsourcing applications.

**Networks with Strategic Agents:** Using game theory, we have designed novel, non-trivial mechanisms for networks with strategic agents arising in applications such as online educational forums, smart grids, and crowdsourcing networks.

**Structured Output Learning:** Our research focus was in developing efficient algorithms for structured output learning using Gaussian Processes. The proposed approach is based on a pseudo-likelihood model which enables it to capture long range dependencies. The approach was found to be very effective for sequence labelling problems. We also considered semi-supervised structured learning problems and provided a simple label switching algorithm to solve a large-margin formulation involving domain constraints. The proposed algorithm is simple, easy to implement and has been found to be competitive.

**Algorithmic Algebra:** The highlights of our research are: (i) generalization of Macaulay-Buchberger theorem for residue class rings with torsion over Noetherian rings, (ii) multivariate ideal lattices and their applications in cryptography, and (iii) a faster algorithm for testing polynomial representability of functions over finite integer rings.

**Statistical Learning:** Our research highlights are the following: (i) development of multi-point Jensen-Shannon kernels and their applications to spectral clustering, (ii) a notion of stretching deep neural networks and related results, (ii) generalized tensor spectral methods and applications to clustering.

**Algorithmic Graph Theory:** This year we have made progress on two foundational problems in Machine



Learning. In the past year we had made a connection to the famous Lovasz theta function, in algorithmic graph theory, to SVM, an important tool in Machine Learning. This year we studied the problem of learning labels on vertices of a graph and for the first time have been able to relate key learning related measures to structural properties of graphs. This has allowed us to draw new insights, such as sample complexity, and have improved results after several years.

**Topic Modelling:** Existing models are rooted in probabilistic machinery leading to two significant drawbacks. First and foremost they lead to NP hard inference problems and secondly they are slow due to adoption of MCMC techniques for inference. Recently there is a surge of interest from theoretical CS Community in designing topic models which bypasses the NP hardness and one could prove guarantees on the topics learnt. It has been nothing less than folklore that SVD type techniques cannot learn topics. We show that by using a simple threshold procedure one can use SVD to learn topics with provable guarantees.

**Machine Learning Theory:** We have made various fundamental advances in machine learning/learning theory, including: (i) solving an open problem related to understanding when output code based methods for multiclass learning problems work; (ii) understanding consistency of learning algorithms for non-decomposable performance measures.

**Machine Learning Applications:** We have also applied machine learning methods in some interesting contexts in the life sciences: (i) Design of machine learning methods for automatically learning score tables for ICU mortality prediction, which are important for monitoring quality of care in ICUs and improve upon standard ICU scoring systems; (ii) application of a new machine learning algorithm developed in our research group to predict anticancer drug response in patients based on an ex vivo platform.

**Other Topics:** We have also worked on the following problems: Information diffusion and community detection in social networks; Feature based classification of time series data; Classification using Random Forests and rough set theory; Prototype selection for large data

and streaming data; Anomaly detection using neural networks; and Multilabel classification.

## COMPUTER SYSTEMS

**Heterogeneous computing:** The High Performance Computing (HPC) Lab continued its research focus on: (i) compiler and runtime systems for GPGPU Computing; (ii) Memory hierarchy design for multicore architectures; and (iii) compiler analysis. We have developed FluidiCL, a runtime system for executing of Open CL kernel on multiple heterogeneous devices in a co-operative and transparent manner. We have developed compiler schemes for reducing the impact of control divergence in GPUs through control flow linearization. In the area of memory hierarchy design for multicore architecture, our group has developed an analytical model, called ANATOMY, for evaluating memory system performance. The model has been extended for stacked DRAM caches. We have also proposed Bi-Modal Cache, an efficient stacked DRAM Cache design.

**Cache Analysis:** We have conducted research on: (i) Precise shared cache analysis using optimal interference placement. This is useful in getting precise worst case execution time estimations for parallel programs. (ii) Exploiting critical data regions to reduce data cache energy consumption. Less critical data is placed in a drowsy cache.

**Data Characteristics:** We have studied: (i) Data longevity issues; (ii) Effective synchronization in large scale SMP systems; (iii) Analysis of multiple sensor data for a class of health applications; (iv) Analysis of security of power systems.

**Database Engines:** Selectivity estimates for optimizing OLAP queries often differ significantly from those actually encountered during query execution, leading to poor plan choices and inflated response times. We proposed a conceptually new approach to address this problem, wherein the compile-time estimation process is completely eschewed for error-prone selectivities. 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 isocost surfaces projected onto the optimal performance profile. We proved that this construction results in bounded overheads for the selectivity discovery process and consequently, guaranteed worst-case performance. In addition, it provides repeatable execution strategies across different invocations of a query. Overall, the bouquet approach provides novel guarantees that open up new possibilities for robust query processing.

**Sensor Networks:** We have worked on a variety of topics related to sensor networks, including: TDMA-based MAC protocols for wireless sensor networks, Improving synchronization accuracy of weighted average based clock synchronization protocols using TDMA-based MAC protocols, Efficient key management and intrusion detection protocols for enhancing security in mobile adhoc networks, Secure routing protocols for mobile adhoc networks, and Static and dynamic partitioning based scheduling schemes for real-time tasks in multicore Linux OS with fair share for Linux tasks.

**Software Verification:** We implemented a multi-core version of the popular embedded operating system FreeRTOS. An important issue in such a design is the possibility of data-races and deadlocks while accessing the kernel data-structures. The implementation was formally verified for freedom from deadlocks and data-races. We also proposed a novel way of doing efficient shape analysis for multi-threaded heap-manipulating programs.

**Library Testing:** We designed and implemented a novel, scalable and efficient tool for synthesizing multithreaded tests to enable deadlock detection in multithreaded libraries. Our approach is able to leverage existing sequential tests to derive complicated multithreaded tests. We show the practicality of our approach by applying it on popular open source Java libraries and detect a number of previously undetected deadlocks.

**Multi-core Programming:** We continued to conduct research on design of languages, compiler optimization,

and runtime techniques for effectively programming multi-core processors. The key works include: (i) design of a new domain-specific language and compiler, PolyMage, for image processing pipelines; (ii) developing new techniques to model the space of affine transformations for parallelism and locality; (iii) developing new tiling techniques for stencil computations defined over periodic domains; and (iv) developing a new approach for computation placement and data allocation for distributed-memory parallelization.

**Concurrency Bugs:** We developed novel techniques for identifying concurrency bugs in Android applications, program repair, algorithm selection and synthesizing code snippets using math APIs. These results were published in top-tier conferences and journals and 3 software tools, DroidRacer, MintHint and MathFinder, were released based on this work.

**Memory Savings:** We rolled out an initial version of a tool to detect memory savings opportunities in Java programs. We came up with a generic approach and tool for analysis of large programs, which is more scalable than comparable previous techniques, while being nearly as precise. We began work on a project where the objective is to verify key correctness properties of web applications. We rolled out an improved version of a tool that we have been working on for some years now on matching requirements documents with code. We also initiated work to devise an approach to identify runtime savings opportunities in Java programs.

**Visualization:** We developed a flexible method for identifying symmetric patterns in scalar fields at multiple scales, which also enables query based exploration of time-varying scalar fields. Further, we proposed a novel approach based on the design of derived fields to visualize multi-field data.

## THEORETICAL COMPUTER SCIENCE

**Graph Properties:** We proved the following geometric properties on graphs: (i) The boxicity of any cubic graph is at most 3; (ii) The cubicity of any graph  $G$  is  $O(d \log n)$  where  $d$  is the degeneracy of the graph; (iii) Designed a constant factor approximation algorithm for circular arc graphs; (iv) Answered a question posed by Therese



Biedl, by showing how to augment the edge set of an outer planar graph to make it 2-connected, without losing outer planarity or blowing up its tree width.

**Graph Coloring:** In the area of rainbow coloring, we proved a tight upper bound for the rainbow connection number of bridgeless graphs in terms of radius. We also obtained strong results regarding the rainbow connection number of graph powers and products.

**Gabriel Graphs:** For the important class of Gabriel graphs, we have: (i) Proved hardness of computing dilation and edge complexity in locally Gabriel graphs; (ii) Showed combinatorial bounds on edge complexity and independent sets of locally Gabriel graphs; (iii) Proved non-trivial bounds on small strong epsilon nets for various geometric objects; (iv) Proved the existence of strong center points with exact constants; and (v) Designed an FPT algorithm for computing vertex cover on graphs of maximum degree 4.

**Fourier Analysis:** Our main contribution was to develop the algorithmic potentials of higher-order Fourier analysis, a set of techniques developed over the last few years. We showed efficient algorithms for decomposing polynomials and for correcting errors in codes using these new techniques.

**Algebraic Complexity:** We have worked on certain lower bound problems in algebraic complexity theory. Our work has shown strong lower bounds for small depth arithmetic circuits that come tantalizingly close to the required lower bounds to prove VP not equal VNP (the algebraic analogue of the P versus NP problem). The proof techniques used to obtain these results have generated renewed interests in the complexity theory research community for further investigations on these and related problems.

**Cryptographic Protocols:** The emphases of our research were (i) critical analysis of provably secure cryptographic protocols and (ii) design of efficient and secure protocols. We analysed structure-preserving signatures (SPS) in the Type 2 pairing setting and formally established that all Type 2 SPS can be converted into Type 3 without any penalty in security

and efficiency but the converse is not true. Our result refutes prior claims regarding the utility of Type 2 pairing setting. We analysed the security definition of property preserving encryption and showed that there is no concrete evidence to assert that there is a gap in the Left-or-Right and Find-then-Guess notions of security as claimed in the previous work. On the design front, we worked on efficient framework for query processing on encrypted data with potential application in the cloud environment as well as private set intersection with common set-up.

**Secure Multi-party Computation:** We have investigated a number of aspects of secure multi-party computation (MPC). MPC allows a set of mutually distrusting parties to compute a function on their private inputs without the need of compromising the privacy of their inputs. It can model any secure distributed computing problem and is among the most fundamental problems in cryptography. We have shown that the adaptive adversarial model is much stronger than the static adversarial model which is usually considered as the standard model in MPC. We have also worked on communication efficient MPC with a large population where the corruption threshold is relatively low. We have worked on Byzantine Agreement (BA) and Anonymous Authentication (AA).

**Cloud Protocols:** We worked on building protocols that enable users to outsource computations and data storage to the cloud. To enable the former, our research gave solutions for ensuring that a client can run any task on a cloud while having an assurance that the computation was done correctly. Furthermore, this secure solution is also more efficient than any prior solution. To enable efficient storage of dynamically changing data, our research initiated a formal study of error models for which one can guarantee reliability.

## ELECTRICAL COMMUNICATION ENGINEERING

---

**Staff: Academic: 21; Scientific: 6; Technical: 1**  
**Students: PhD: 132; MSc (Engg): 11; ME: 68**  
**Degrees Awarded: PhD: 28; MSc (Engg): 7; ME: 36**  
**Publications: 104**

## INFORMATION THEORY AND CODING

We have determined an exact expression for the capacity of a 'no-adjacent-ones' input-constrained binary erasure channel with feedback, and found an elegant capacity-achieving coding scheme. We have proved various 'goodness' properties for lattices obtained by a lifting construction from non-binary low-density parity-check (LDPC) codes. We have determined the exact communication complexity of achieving secret key capacity for certain multi-terminal source models derived from hypergraphs. This is the first exact result of its kind in the literature. We have developed Markov Chain Monte Carlo methods for sampling from a target probability distribution on grain models for two-dimensional magnetic media. This is a very useful tool for simulating random magnetic code.

A matroidal framework for network coding and network-error correcting coding has been proposed. Also, possible reduction in field size for certain network coding problems has been achieved.

## GAME THEORY APPLICATIONS IN COMMUNICATIONS

India's largest telecom provider Bharti Airtel made an announcement in the last week of December 2014 that their customers will be charged more for voice-over-IP (VoIP) calls. Their justification was that they have made investments to the tune of ₹ 1.4 lakh crores, have paid an additional ₹ 0.5 lakh crore as government levies, and that offering VoIP services for free was not a tenable business model. They subsequently rolled back the plan for such charges citing reports that TRAI would issue a consultation paper shortly on the matter. We had already been studying such models of non-neutrality. We studied the effect a non-neutral network may have on end-users. We analysed two-sided market models and identified pure-strategy Nash equilibria, and further studied their relevance to existing broadband markets.

A fast fading interference channel with channel fade state known to all users was studied, treating interference at receivers as noise. The problem of state-dependent transmitter power allocation for achieving high average rate under average power constraint for each user was formulated as a stochastic

game, assuming that the state distribution is known. Nash equilibria for the game were shown to be the solutions of an affine variational inequality. Sufficient conditions were found for a projection algorithm with regularisation to converge close to a Nash equilibrium, which are significantly weaker than conditions known previously for converging to Nash equilibria.

We considered the problem of fair scheduling when mobiles can be strategic in reporting their true channel states. We investigated interesting equilibria that arise in such a network, and proposed mechanisms that were robust to such strategic behaviour.

With applications to computational linguistics and semantic projection in mind, we studied the asymptotic optimality of belief propagation algorithms for finding the optimal edge cover in a random graph mean-field model. This provides an additional clue about the circumstances when belief propagation algorithms can be effective.

## LEARNING ALGORITHMS

We studied the problem of distributed computation of a desired average on a network. We highlighted the issues with a classical asynchronous gossip scheme, proposed an alternative scheme based on reinforcement learning, and proved its convergence to the desired average. We proposed another reinforcement learning algorithm for distributed computation of the dominant eigenvector of a nonnegative matrix. This has applications to a wide variety of settings of current interest such as in ranking schemes, reputation networks, and principal component analysis. We developed techniques for analysing the performance of Generalized Belief Propagation algorithms for estimating the partition function of Ising models.

## SIGNAL PROCESSING FOR COMMUNICATIONS

Spectrum sensing for cognitive radio: We considered the case where the primary transmitter's signal occupies a large bandwidth, but with a high power narrowband component. Such a signal opens up two possibilities for detection: one could either try to detect the entire wideband signal, or one could filter out only the narrowband component and detect its presence



or absence. The fact that the signal propagation characteristics of narrowband and wideband signals are quite different leads to an interesting tradeoff between the two options. We analytically characterized this tradeoff, and determined which of the two options offers better detection performance. Achievable rates and outer bounds for the interference channel with cooperation and privacy constraints. In this line of research, we first developed algorithms for interference alignment in a multiuser MIMO interference constant channel setup. Next, we analyzed the generalized degrees of freedom of the K-user MIMO interference channel. Finally, we considered the 2-user interference channel with rate-limited cooperation between the transmitters and secrecy constraints at the receivers. We were able to derive achievable schemes and outer bounds on the rate pairs first for the so-called deterministic approximation of the interference channel, and then extended the results to the Gaussian interference channel.

### ALGORITHMS FOR SPARSE SIGNAL RECOVERY

We developed algorithms for wideband channel estimation exploiting the sparsity of the channel in the time-domain. Starting from algorithms for channel estimation in the single-antenna case, we extended our algorithms to track time-variations in the channel, to exploit “cluster sparsity”, where the signals arrive in clusters of closely separated delays, and to multiple antenna systems where the signals between different pairs of transmit and receive antennas have a common sparsity structure (support). Fusion strategies to improve performance of greedy pursuit algorithms.

Developed parameter estimation algorithms based on the detection paradigm and demonstrated improved performance at the cost of computational complexity. Developed spatial modulation techniques for reducing the number of antennas and using the antenna index to convey information.

### ELECTRONICS

For the first time, we have been able to develop electrochemical technique for Microalbuminuria, utilizing binding properties of albumin with redox active elements. We have also developed novel electrochemical technique to sense Albumin, Haemoglobin, Glycated

Hemoglobin, and Myoglobin. We are in the process of developing a hand held device to sense a range of bio analytes using electrochemical technique. We have developed backgated graphene oxide using an optimized HfO<sub>2</sub> gate dielectric, to achieve the best reported transconductance till date (60  $\mu$ S.). This outperforms the conventional SiO<sub>2</sub> back gated devices and Al<sub>2</sub>O<sub>3</sub> back gated device.

Process development of Silicon Micro-Ring Resonator (Si-MRR) fabrication was carried out. We were able to achieve Quality Factors as high as 64000 using the electron-beam lithography based process which compares very well to the values reported from other research groups. We intend to use the Si-MRR platform as a high resolution biosensing tool. We developed a theoretical model to describe the performance of Diffractive Interference Optical Analyzer platform which was demonstrated earlier in our lab. We developed a technique for tracking vertical diffusion through nano-scale polymer matrices based on the dependence of fluorescent emission on the thickness of the fluorophore from a metal surface.

A frequency discriminator circuit has been synthesized using RF all pass filters for real time Fourier transformation. A spectral stochastic finite element method has been developed for handling uncertainties in electromagnetic scattering problems.

The Analog/RF systems research group at IISc has been working on the development of a wide-band amplifier (2-20 GHz) with Bharat Electronics Limited (BEL) identified as the end-user. This component is of much strategic importance, as its indigenous development will pave the way for the future import substitution of a family of RF components, which could potentially be developed in India. After two silicon design turns, spread over two years, we were successful in meeting most of the specifications of the amplifier chip. BEL management has agreed to take this technology from IISc, and move this to their microwave modules in production. This is extremely encouraging to find that a technology that we have developed at IISc, will soon be readied for production, in an area, that is of strategic importance to the nation.

We have been working on connected wearables for healthcare, specifically for new borns, in collaboration with St. Johns Research Institute. One of the key technical challenges is related to low power operation, in order to reduce battery and hence the device size. We have developed proof of concept devices for measuring temperature, pulse, breathing rate, oxygen saturation and ECG. Some of these are currently undergoing testing in the hospital.

Another focus area is low power IoT devices, with a specific focus on water management systems. We have developed a non-contact, water level sensor powered by a solar panel that is connected to the internet via a sub-GHz radio. A proof of concept device is currently deployed in the ECE dept and discussions are currently underway with outside companies to convert it into a product.

### COMPUTATIONAL ELECTROMAGNETICS

In 2014 we have conducted research and development work in the following aspects of Computational Electromagnetics.

#### Faster Design Tools

##### (a) Learning based acceleration in design iterations:

In a typical design cycle many iterations on the package-board-system layout may be performed to meet design specifications. In the process, the analysis step needs to be repeated as many times as the number of layout variants. The cost of analysis, especially if using a 3D fullwave extraction methodology, therefore becomes prohibitive for large-scale analysis in the design process. We propose a methodology to expedite analysis of subsequent layout iterations based on information stored from previous layout solution. In this work, eigen-vectors from a previously solved layout is augmented to the Krylov subspace to expedite the convergence of a Generalized Conjugate Residual (GCR)-based iterative solution. Numerical results demonstrate up to 40% improvement in the convergence properties using the proposed GCR method.

##### (b) Neural networks in time-domain design:

Signal speeds of high speed serial data links double almost every generation and with increasing speeds,

simulation and modeling challenges are getting more complex. The present popular and widely accepted metric for simulating a high speed link from signal integrity (SI) perspective is Bit Error Rate (BER) testing. End to end channel simulation in frequency domain is much faster and less resource intensive. We propose a multi-layer perceptron (MLP) type of artificial neural network (ANN)-based mapping to predict eye-height from frequency domain metrics like return loss (RL) and insertion loss (IL).

#### Faster Simulation Engines

(a) **Hardware acceleration of EM solver:** We propose a Field Programmable Gate Array (FPGA) based hardware accelerator for 3D electromagnetic extraction, using Method of Moments (MoM). The method is applied to accelerate electrostatic parasitic capacitance extraction of multiple-nets in a Ball Grid Array (BGA) package. The acceleration is shown to be linearly scalable with FPGA resources and speed-ups over 10× against equivalent software implementation on a 2.4GHz Intel Core i5 processor is achieved using a Virtex-6 XC6VLX240T FPGA on Xilinx's ML605 board with the implemented design operating at 200MHz clock frequency.

(b) **Adaptive mesh refinement:** 3D full-wave Method of Moments (MoM) based electromagnetic analysis is a popular means towards accurate solution of Maxwell's equations. However, the accurate solution of 3D full-wave MoM on an arbitrary mesh of a package-board structure does not guarantee accuracy, since the discretization may not be fine enough to capture spatial changes in the solution variable. At the same time, uniform over-meshing on the entire structure generates large number of solution variables and therefore requires an unnecessarily large matrix solution. We propose a suitable refinement criterion for MoM based electromagnetic package-board extraction. The advantages of this adaptive strategy are demonstrated for accuracy and speed.

### OPTICAL COMMUNICATION

Multi-level modulation formats with coherent detection is studied and compared with the conventional IM/DD scheme. 4x4 MIMO and 6x6 MIMO system level performance are studied with Few Mode Fiber as transmission medium.





is studied. Allowing wind generators to work at maximum reactive power limit may cause the system to operate near the steady-state stability limit, which is undesirable. This necessitates proper coordination of reactive power output of wind generators with other reactive power controllers in the grid. A trust region framework approach for coordinating reactive power output of wind generators with other reactive power sources for voltage stability enhancement is developed. Case studies on 418-bus equivalent system of Indian southern grid indicate the effectiveness of the developed methodology in enhancing the steady-state voltage stability margin.

In the past few years, the penetration of wind energy to the grid has been sharply increased. Voltage and reactive power control are necessary in grid connected wind farms due to the stochastic nature of wind speed. The system may consist of large number of voltage controllers such as on-load tap changing transformers (OLTC), generator voltage and switchable var compensators (SVC). From the operator's point of view, it is difficult to move so many controllers in a short period of time. Hence, it is important to optimize not only the reactive power dispatch for voltage control but also the total number of controllers to reduce the complexity of the problem. An approach using fuzzy logic inference system is used to curtail the number of controllers in wind connected power system is developed. In this approach, load bus voltage deviations are minimized by changing the controllers according to their sensitivity.

### **POWER ELECTRONICS**

Novel pulse width modulation (PWM) methods were proposed and evaluated for multilevel inverters. PWM schemes have also been developed to reduce pulsating torque in inverter fed induction motor drives. A simplified model for switched reluctance motor has been developed and validated based on analysis. An off-line simulation and real-time simulation of power converters and electric motors for electric vehicle applications has been carried out. Experimental study on switching characteristics of high-current insulated gate bipolar transistors (IGBTs) has been conducted. A hardware setup has been built to evaluate the performance of LCL filters in single-phase inverters.

Technical advice to industry has been provided on control of induction motor drives, analysis and design of current sensors, high voltage power supplies and other components of power conversion systems.

Necessary funding has been obtained towards the following new project: "Investigations on gallium nitride (GaN) devices for power electronic switching applications and design and development of a high frequency GaN converter topology" to be executed jointly by C-DAC Thiruvanthapuram and IISc (Department of Electrical Engineering, Department of Electronic Systems Engineering, and Centre for Nanoscience and Engineering).

### **HIGH VOLTAGE ENGINEERING**

A new time-domain based method was developed for estimating series capacitance of a transformer winding. A prototype of pulse-based gas-cleaning reactor has been developed. A high efficiency in NO<sub>x</sub> pollutant removal has been achieved with enhanced electric field.

Detection and location techniques for buried landmines, using pulsed electromagnetic field, are being developed. An ultra-wideband source based on Impulse Radiating Antenna (IRA) for generating short duration pulsed electromagnetic field is being developed. Filled polymer composite based material with high conductivity has been developed for electromagnetic shielding, camouflage and chaffing applications. Silicone rubber based filled polymers with improved thermal conductivity are being developed for high voltage power transmission line outdoor insulator applications. Bio-degradable oil with improved thermal conductivity is being developed for use as insulating fluid for high voltage power apparatus.

Lightning shielding failure analysis of the 1200 kV AC Indian experimental high voltage power transmission line and 800 kV DC line is being carried out. Induced current in the down conductor due to a nearby lightning strike to ground has been evaluated considering the effect of upward leader for the first time. Total field due to an isolated electron avalanche has been derived. A novel efficient numerical approach has been developed for the magnetic flow problem with high magnetic Reynolds number.



## SIGNAL PROCESSING

New sparsity-driven algorithms are developed for phase retrieval of signals and are shown to be effective in optical imaging applications. A new method is developed for super-resolution reconstruction within a sub-Nyquist sampling framework with applications in microscopy and ultrasound imaging. A methodology to quantify vocal mimicry in the Greater Racket-Tailed Drongo is developed (with collaborators from Center for Ecological Sciences, IISc). Two new temporal features, namely, Plosion index (PI) and maximum normalized cross-correlation (MNCC) are proposed for the problem of detecting the closure-burst transitions of stops and affricates from continuous speech. These features are computationally simple and the performance achieved with them is as good as that of the state-of-the-art algorithms and it has also been shown to be scalable to other languages and conversational speech. Dynamic plosion index, derived from PI, was applied for QRS detection in ECG and, unlike most other algorithms, does not make use of any thresholding or differencing operations. Still, its performance on the MIT-BIH database is better than the best algorithms in the literature using differentiation and thresholds.

## IMAGE AND VIDEO PROCESSING

New techniques are developed for head pose estimation from images obtained using Far-Field cameras under blur/motion artifacts in real environment using Transfer learning techniques and Correlation subspace analysis. A seam carving solution for video summarization using content-aware information from users is developed. The model proposed makes use of efficient fusion of bottom-up and top-down cues obtained from image data. New algorithms are proposed for human action recognition using novel covariance and causality descriptors for trajectories by capturing the occurrence and inter-dependence of motion patterns in human actions. Novel techniques are developed to improve compression of Multiview Plus Depth (MVD) data and to speed up depth estimation in multiview videos through multi-sensor fusion and depth prediction. Given RGBD video streams from multiple calibrated cameras looking at the same scene, a fast algorithm that synthesizes a video for any given virtual viewpoint using the two nearest neighboring cameras has been developed. A

distributed target tracking algorithm in camera networks is developed where each camera does processing on its own and also cooperates with other cameras using the principles of unscented Kalman filter and average consensus algorithm. Bayesian non-parametric based dictionary learning is used for object recognition in videos and characteristic pose estimation of objects. New techniques are developed for image denoising under multiplicative noise conditions that outperform the state of the art in the area. A “SmartSurface”, an OpenCL Based Implementation of a Virtual Touch Input Device on GPU, has been developed. Real Time face recognition and Image denoising algorithms have been ported onto GPU.

## PATTERN RECOGNITION

Using bigram language models and reevaluation strategies, the recognition accuracy for open vocabulary, online handwritten Tamil words has been significantly improved. Some sufficient Conditions on the loss function are derived so that the risk minimization under the loss function is robust to label noise in the training examples. New algorithms for robust learning of classifiers are proposed based on this.

## ELECTRONIC SYSTEMS ENGINEERING

---

**Staff: Academic: 10; Scientific: 6**

**Students: PhD: 52; MSc (Engg): 9; ME/MTech: 71**

**Degrees Awarded: PhD: 6; MSc (Engg): 2;**

**ME/MTech: 50**

**Publications: 39**

The technical activities in the Department of Electronic Systems Engineering span the whole range from nano-scale devices to Internet-scale communication networks.

## NANOELECTRONICS

**Nanoelectronics Devices and Circuits:** We have explored, for the first time, the Electrostatic Discharge (ESD) behavior of Carbon Nanotubes (CNTs). A novel ESD failure mechanism of subsequent shell burning was discovered in this work. It was discovered that CNT interconnect resistance changes in steps of the

fundamental quantum resistance ( $h/2e^2$ ) after individual shell burning. An extraordinary ESD failure current density of MWCNT of  $1.2 \cdot 10^9$  A/cm<sup>2</sup> was also shown, which shows promise for beyond-CMOS technologies.

By using nanosecond pulse measurements, we have obtained new insights into metal-to-CNT contact behavior. Clear signatures of two very different transport mechanisms were revealed. By determining the time-to-failure, a unique Arrhenius like relation was reported, which was not expected in the past.

We have demonstrated a Drain extended MOS (DeMOS) device integrated radio frequency power amplifier in 28nm node CMOS technology for the first time. Such a scaled device-circuit co-design was reported to be a breakthrough for advanced system-on-chip applications. This experimental work reported simultaneous improvement of device-circuit performance and 5× increase in device reliability.

### COMPUTATIONAL NANOELECTRONICS

We have made the following significant contributions.

We have developed a new compact model (named as indDG) for common double gate (CDG) MOSFETs and implemented it in professional circuit simulation for community usage. Unlike the other models in this genre, indDG is not based on the usual approximation of equal oxide thicknesses for both gates. Several novel techniques are used to capture the oxide asymmetry effects naturally, while preserving computational efficiency at the same level as in other existing models.

Using analytic modelling along with atomistic simulation, for the first-time, we have analyzed the performance of monolayer Transition Metal Dichalcogenide (TMD) channel-based tunnel transistors. This work has garnered significant attention in the community.

### STORAGE SYSTEMS AND QUANTUM INFORMATION PROCESSING

**Physical Level Data Storage:** We have developed many novel methods for signal processing and coding towards two dimensional magnetic recording channels. This is the first time such a thing has been conceived. Notable among these are: (1) Noise prediction maximum

likelihood soft detection algorithm, (2) A novel 2D generalized partial response equalization technique for immediate applications in TDMR, (3) A novel 2D timing interpolated recovery technique, (4) A new class of rate compatible LDPC code designs (encoding and decoding procedures) for applications in data storage. Along with the algorithmic and theoretical work, we have implemented 1D timing recovery modules on an FPGA board. We have implemented also the LDPC code on an FPGA board.

**Quantum Information Processing:** We have developed theoretical analysis for evaluating the classical assisted quantum capacity using hyper entangled states over noisy channels. The idea is to convey more bits using non-commutative measurements than using single degree of freedom for entangled states.

### VLSI ENGINEERING

**Co-processor for SVM Applications:** Support Vector Machines (SVMs) are well established tools in machine learning and are used as off-the-shelf classification methods across a wide range of applications. However, the use of compute-intensive learning algorithms for training limits the applicability of SVMs in real-time applications. We have worked on accelerating the whole process by implementing the compute-intensive tasks in hardware, as a coprocessor to the host CPU. We have extended the popular decomposition technique, Sequential Minimal Optimization (SMO), which we call the Hybrid Working Set (HWS) algorithm, to effectively utilize the benefits of cached kernel columns and the parallel computational power of the coprocessor. The coprocessor has a fully scalable parallel architecture which computes multiple rows of the kernel matrix in parallel. The coprocessor is implemented on Xilinx Virtex 7 Field-Programmable Gate Array (FPGA) based VC707 board and achieves a speedup of up to 25× for kernel computation over single-threaded computation on Intel Core i5. An application speedup of up to 15× over software implementation of LIBSVM and speedup of up to 23× over SVMlight were achieved using the HWS algorithm in unison with the coprocessor. The work takes a step further in uniting dedicated hardware and the software to accelerate the SVM learning process and improving the performance of the current state-of-the-art in dedicated VLSI hardware for SVM.



## BOARD LEVEL PACKAGING

Prototyping of Micro-Circuits with Embedded Passives: We have worked with M/s KHMD, a Bangalore-based leader in microcircuits fabrication technologies on ceramic bases, as our implementation partner to implement our research work on embedded passives for organic substrates. A voltage regulator circuit for automobile applications was chosen for the trials. The objective was to convert all SMD and PTH resistors to embedded resistors and SMD and PTH capacitors to embedded capacitors to miniaturize the circuit. The standard ceramic process requires longer process times due to higher temperature (900°C) for curing/firing. Our strategy was to work on new materials and processes that require lower temperatures for curing/firing of resistors and capacitors (200°C). This involved evaluation of new resistor pastes and foils for organic substrates and also the compatibility of these materials with PCB processing. Reliability testing was the key factor and many of the standard reliability tests prevalent in the industry were passed during the first evaluation. Further tests are on to validate the highly critical passive components. This can be extended to hand-held products in the future.

## ELECTROMAGNETIC INTERFERENCE

**Active filters for noise suppression:** We have studied issues related to conducted and radiated EMI in electronic equipment. Switched mode power converters are a major source of conducted EMI. EMI filters are a popular technique for mitigation of conducted EMI. Active EMI filters are a promising alternative to the traditional bulky passive filters. However, issues like cost, reliability, component count and circuit complexity have made it difficult to use and adopt active EMI filters. Using unique and novel system design approaches, many of the problems of active EMI filters have been solved to make them practically and commercially viable.

## MECHATRONICS

We have worked on a number of projects in collaboration with the Christian Medical College (CMC) Vellore, Raman Research Institute (RRI), Anna University, as well as the CENSE and IAP departments in IISc.

The *Experience Mapped Predictive Controller (EMPC)* is a new intelligent control system that has been developed. It works on the knowledge base developed by interacting with the physical system to be controlled. The system has been developed for motion control systems. An *Intelligent Spastic Walker* has been developed and it has gone through successful initial clinical trials at the CMC, Vellore. This type of walker is developed for the first time. Critical components for a drug delivery system have been developed in collaboration with CENSE and IAP. The system has undergone animal trials. A spin-off technology – Milli-bar pressure calibrator which uses the drug delivery pump – has been patented. Padma-pada, a clubfoot brace, has been developed in collaboration with CMC Vellore. This brace is the first of its kind in the world. It has gone through clinical trials in CMC Vellore. The technology is patented and will be transferred to an industry for production. A device for the *detection of adulterated milk* has been developed in collaboration with RRI and Anna University. It has undergone field trials and is in the process of being transferred to an industry. A device for *Diabetic Foot Pressure Monitoring* has been developed in collaboration with CMC Vellore. A device for *anti-biogram for urinary track infection* has been developed in collaboration with RRI and Anna University, and is undergoing trials at Chennai.

## NETWORKED EMBEDDED SYSTEMS

We have investigated novel hardware/software designs to address requirements in several application areas such as healthcare, automotive, smart grids, security, power management systems and embedded communication.

**Healthcare:** We have designed and developed an Electro Dermal Activity (EDA) based wearable system to *detect drowsiness in automobile drivers*. The system alerts the user based on the inputs available on the skin in terms of their skin conductance level and skin conductive response. Our preliminary tests are encouraging and we hope to scale up the test deployments. This is perhaps the first time such a device is being tested with the goal to reduce road accidents.

In large public hospitals, care givers are expected to complete regimen-based vital parameter monitoring.

This includes blood pressure, pulse, body temperature, oxygen saturation or SpO2 levels etc. We have developed a battery-less wearable thermometer that can be worn by in-patients. Care givers use a standard mobile phone device to read the temperature using NFC technologies. We also built a battery-less IR thermometer which uses hand crank mechanisms to generate electricity. This is for rural applications.

We have developed a wearable device named *Health Mote* that is custom-built, energy-efficient, battery-operated, 6LoWPAN and Bluetooth 4.0 enabled and has biomedical sensors attached to it, The HealthMote runs on customized open-source Contiki OS. It is capable of measuring blood pressure, heart rate, body temperature and oxygen saturation in blood (SpO2). It also supports third-party 1 lead ECG sensor over Bluetooth 4.0. The hardware design addresses low power requirements of the system. The industrial design of the enclosure considers wearability aspects. The device requires no intervention from the end-user at all. Compared to other motes available in the market, these motes have much more computing power and memory to accommodate large code size. This allows us to implement more complex algorithms on the mote.

**Automotive:** We have developed a battery-less and energy-harvested “passenger service system” for aircraft/automobile seats, where users can request for an attendant using the “calling light.” Here, mechanical energy which results from the switch press is converted into electricity. This electricity is used to drive a small embedded board with radio communication. A similar service is available for the “reading light.” This is perhaps the first time that inductive energy and mechanical energy domains are combined for a common task.

**Smart Grids:** We have developed a single-phase energy meter for pluggable loads. The hardware and accompanying Android application can be used to visualize the peak power, energy in units, power factor corruption on power lines etc. The unique feature of this device is that electrical appliances can be “baselined” for their performance.

We have developed the *Primary Load Management Unit (PLMU)*, which is an embedded PoE device that can be used to monitor and control electrical appliances and power distribution boards. Many such devices form an IPv4 SCADA network to monitor and control the electrical network in a building. Policies can be downloaded from the master SCADA server. The PLMU also provides a wireless web-based user interface. This device can detect events like fire and cut off power to a section of the building automatically in real-time. It keeps uploading the logged data to the master SCADA server where administrator can view it. The master SCADA server also provides control functionality to the administrator.

**Security:** We have implemented algorithms for reducing signal jamming based “Denial of Service” attacks by adversaries in a sensor network. We have compared the computed jamming probabilities with our implementation on a live sensor network testbed.

We have built a novel PIR sensor based tower which provides algorithm designers with 8 analog signals. Using these signals, the idea is to differentiate among intruders and classify them as either human or animal intrusions. The tower has an impressive range of about 20 meters with sufficiently good signal quality.

**Unified Cognitive Radio Platform:** We have developed a cognitive radio platform for continuous monitoring of the radio spectrum and simultaneous characterization of user needs. User experience is defined in a novel way as a function of a number of channel-related parameters. User requirements are then stated for a given application. Using spectrum availability and its statistics as well as user demands, a novel spectrum allocation scheme is evolved. A prototype as well as a simulation platform are used to implement the algorithms and observed performance is compared with theoretical results. To the best of our knowledge, this is the first time that a unified approach combining several system requirements has been attempted to achieve a high-performance cognitive radio system.



## INDUSTRIAL ELECTRONICS

**Multiphase Drives:** Multiphase drives are increasingly considered for industrial applications, due to their improved reliability and the possibility of realizing the inverter structures with lower voltage devices. We have made substantial novel contributions in the area of space vector PWM control of asymmetrical six-phase induction motor drives. Methods for controlling asymmetrical (split-phase) six-phase induction motor drives, based on the current source inverter fed scheme as well as a single voltage source inverter supply, have been developed. The existence of fully decoupled dynamic control of two machines has been demonstrated both theoretically and experimentally.

**Multi-level Inverters:** Our work on multi-level inverters has resulted in numerous new topologies, with voltage space vector structures up to nine levels, for an open-end winding three-phase IM drive. The topologies are realized by cascading conventional two-level and three-level topologies with symmetrical and asymmetrical DC-link voltages. Such topologies have a

simple power bus structure, with an increased number of switching state redundancies when compared to any conventional multilevel scheme for IM drives with isolated neutral point.

## ALTERNATE ENERGY

**Photovoltaics:** 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. In this context, a 25kW roof top photovoltaic system has been designed and developed not only to supplement the building energy requirements, but also as a platform for photovoltaic power integration studies. This system consists of five 5kW vector-control-based inverters modulated using space vector PWM strategy. A novelty in the proposed scheme is that the interface between the grid and the inverters uses *leakage inductances of the isolating transformer*, thereby eliminating the bulky and expensive inductance component.





---

## 6.4 Division of Interdisciplinary Research

(Chairperson: Govindan Rangarajan)

---

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

- Management Studies
- Centre for Contemporary Studies
- Centre for Infrastructure, Sustainable Transportation and Urban Planning
- Centre for Nano Science and Engineering
- Interdisciplinary Centre for Energy Research
- Robert Bosch Centre for Cyber Physical Systems
- Supercomputer Education and Research Centre

### MANAGEMENT STUDIES

---

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

**Students: PhD: 57; MSc(Engg): 1; MMgt: 30**

**Degrees Awarded: PhD: 3; MMgt: 13**

**Publications: 41**

Technological obsolescence has been a major factor affecting the economic performance of SMEs in India. To overcome this problem, government of India has initiated several programmes for technology up-gradation and modernization of technologies in SMEs. Given this, a study was carried out to know what factors prompt SMEs to go for technology up-gradation and modernization and how do they carry out external technology absorption, how does it help to improve their economic performance, in the context of machinery industry SMEs of Bangalore. In addition, the role of institutional credit in promoting start-ups and the role of start-ups in promoting the growth of small scale industries in India was analyzed. Further, the opportunities, barriers and policy imperatives were analyzed for the adoption of ICT and E-Commerce in Indian SMEs, among others.

A study was conducted on “Online consumer marketing analysis for Indiaplaza.com” thereby helping in understanding the psychographics of consumer behavior in online marketing.

Algorithms for Bayesian analyses were developed and applied to two class of problems. The first one belongs to those arising from accelerated life testing (ALT)

of series systems, and the second one pertains to the class of stochastic volatility models (SVM). While for ALT, new algorithms were developed afresh; for SVM, existing ones were modified to address the issue of assessing change in volatility of the underlyings, post derivative introduction. Apart from these, models for assessing qualities of IPOs launched in NSE w.r.t. various characteristics, were also developed.

Research in energy, environment and technology management has focused on sustainability assessment of various sub-systems of the Indian economy. The subsystems included for assessment are megacities, urban mobility, national and rural energy systems, corporate sector and urban waste. Research focused on design of policy and institutional mechanisms, and development & demonstration of hybrid energy enterprise models for productive and livelihood access to modern energy carriers for rural population in India.

### CENTRE FOR 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 provided opportunities to the scientific community in IISc., to experience a sample of the best scholarship and creativity outside the traditional boundaries of natural science.



## CENTRE FOR INFRASTRUCTURE, SUSTAINABLE TRANSPORTATION AND URBAN PLANNING

---

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 was 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. The centre focused on four major thrust areas of research involving sustainable and transportation, development of smart and cities, disaster management and environment management.

The centre undertook a solid waste management initiative for IISc campus (SWaMII) with the main aim of providing an end-to-end solution to the waste generated at IISc through an environmentally sound processing and disposal technology. The final goal is to have “zero” waste taken out of IISc campus for disposal into municipal landfills. The waste-to-energy concept would be promoted in order to process the organic waste generated.

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 were carried out at this Centre. Detailed reports highlighting recommendations for improving the quality of life of the people were prepared and submitted to the concerned Government authorities.

The Transit Oriented Development (TOD) technique was 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) was developed. A methodology to access the extent of socio-economic inequality within Bangalore urban agglomeration was developed in order to help academicians and policy makers to 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 minimization of the extent of inequality within Bangalore urban agglomeration.

CiSTUP conducted 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 participated in meetings and discussions organized by the 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.

## CENTRE FOR NANO SCIENCE AND ENGINEERING

---

**Staff: Academic: 11**

**Students: PhD: 46; ME/MTech: 11**

**Degrees Awarded: PhD: 1**

**Publications: 90**

The Centre for Nano Science and Engineering (CeNSE) focuses on interdisciplinary research and education in the broad area of nanoscience and technology, covering topics such as nanoelectronics, devices, materials, micro and nanoelectromechanical systems, bio and nanophotonics, bio-electronic interfaces and integrated small-scale systems. In addition, the Centre runs an interdisciplinary research and training program involving more than 40 faculty members from various departments of engineering and basic science at the Indian Institute of Science (IISc). The Centre has

state-of-the-art nano-fabrication and characterization facilities to enable the development of cutting edge nanoscale technologies for various applications.

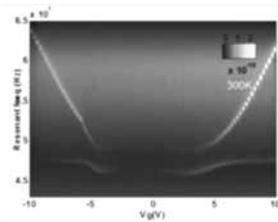
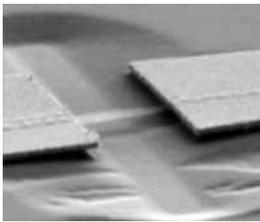
- A comprehensive model for squeeze film damping and acoustic damping in MEMS devices was developed.
- The need for integrating self-sensing in MEMS and NEMS devices prompted work at CeNSE on appropriate piezoresistive and piezoelectric materials that could be conveniently used in these devices. As a result, ways of enhancing piezoresistive sensitivity of thin metallic films and lines with nanoscale inhomogenization using electromigration were devised.
- Continuing work on controlled electromigration led to developing it as a tool for material transport at nanoscales with some fascinating applications in patterning. The result was a novel, fast, and inexpensive technique for lithography on the nanometer scale.
- Significant progress was made in the effort in mechanobiology, in understanding design templates of natural small scale transducers that animals and insects use; in the exploration of the dynamics of biological cells for developing mechano-diagnostic tools for pathology identification; in understanding the incredibly smart design of angular rate sensing halteres in dipteran insects.
- An electrochemical technique for detecting Microalbuminuria, utilizing binding properties of albumin with redox-active elements was developed. A novel electrochemical technique to sense Albumin, Hemoglobin, Glycated Hemoglobin, and Myoglobin was developed.
- The best reported transconductance to date (60  $\mu\text{s}$ ) in a back-gated graphene oxide transistor using an optimised  $\text{HfO}_2$  gate dielectric was achieved. This outperforms conventional  $\text{SiO}_2$  back-gated and  $\text{Al}_2\text{O}_3$  back-gated device.
- Successful trapping of multi-electron bubbles in liquid helium, a new system to study electrons on

curved surfaces in a wide range of densities, and a possible candidate to observe quantum melting in Wigner crystals, was achieved.

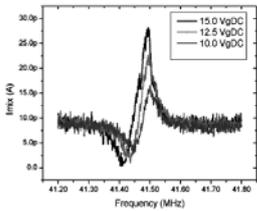
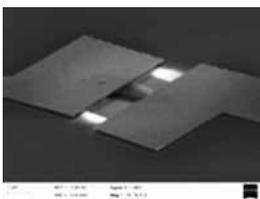
- A wafer scale method to fabricate plasmonic dimers using graphene as a spacer material was developed. This resulted in a photodetection efficiency about hundred times higher than all other graphene-plasmonic hybrid photodetectors developed to date.
- The first wirelessly controlled motion of an artificial “voyager” in human blood, signifying a new class of diagnostic and therapeutic agents was demonstrated. The same system can be used for the measurement of mechanical properties of complex and heterogeneous materials, a technique that could have commercial value.
- A process for the fabrication of Silicon Micro-Ring Resonators (Si-MRR) was developed. Quality Factors as high as 64000 were achieved using an electron-beam lithography-based process. This compares very well with QF values reported by other research groups.
- A theoretical model was developed to describe the performance of the Diffractive Interference Optical Analyzer Platform, which was demonstrated earlier in the CeNSE Biosensing Lab.
- A technique for tracking vertical diffusion through nano-scale polymer matrices was developed, based on the dependence of fluorescent emission on the thickness of the fluorophore from a metal surface.
- Electromechanical devices show tremendous potential as sensors and scaling down these devices dramatically enhances the sensitivity of these devices. They are now capable to measuring the mass of individual protein molecules and can have resolution down to a single Dalton. However, miniaturization also reduces the linear dynamic range of the devices due to faster onset of nonlinearity. The dynamic range issue is particularly severe in devices that are only a few atomic layers thick. In the work on suspended monolayer graphene devices, the ability to enhance their dynamic range by cancelling out two



different types of non-linearity was demonstrated. This dynamic range enhancement to about 100 dBm from 45 dBm, which is typically observed in ultrathin resonators, was a significant step towards utilizing these resonators as practical sensors.



- The first all-electrical actuation and detection of MoS<sub>2</sub> resonators was achieved. It was possible to observe piezoresistive behavior in these devices and utilize it for detection of the dynamic motion of the resonator. All-electrical actuation and detection of MoS<sub>2</sub> is the first step towards fully exploiting the potential of these devices and is expected to have tremendous impact in using these devices as sensors. Although graphene remains a highly studied material, transition metal dichalcogenides have attracted much attention due to their semiconducting properties. Furthermore, materials such as molybdenum disulphide (MoS<sub>2</sub>) are predicted to be better as materials for electromechanical resonators. As of today, all the research with ultra-thin MoS<sub>2</sub> resonators have relied on optical methods for detection. Thus, all-electrical detection was a significant accomplishment.



- Optical transport behaviour of organic photo-voltaic devices with transparent nano-pillar electrodes was investigated to understand possible enhancement of their charge-collection efficiency. Modeling and simulations of optical transport due to this architecture showed an interesting regime of length-scale dependent optical characteristics. Partial filling of gaps between the nano-pillars due to nano-fabrication was taken into consideration.

Results would facilitate appropriate design rules for nano-pillar electrodes as applied to photovoltaics.

- Fabrication, characterization and application of Ti- and Au-coated hollow silicon microneedles for transdermal drug delivery was achieved. To improve biocompatibility, the microneedles were coated with Ti (500 nm) by sputtering, followed by gold electroplating. A breaking force of 225 N was obtained for the microneedles, which is 10 times higher than the skin resistive force. Hence, fabricated microneedles can easily be inserted into skin without breakage. Application of the microneedles for drug delivery was demonstrated using artificial skin.
- Fabrication of polymethylmethacrylate (PMMA) nanogratings on silicon (Si) and glass substrates using electron beam lithography technique was accomplished. Both reflection and transmission-type gratings with nanometer periods were fabricated and their diffraction characteristic evaluated. These polymer nanogratings have widespread applications not only in nanophotonics but also in biology.
- Five different types of MEMS pressure sensor were designed and fabricated, involving innovative approaches that depend on the range of operation. All the five designs were implemented in process mask layouts and the sensors were processed after developing the adequate unit process steps suitable for achieving the designed structures with silicon-on-insulator (SOI) wafers of 100 mm diameter. The individual chips were separated by dicing the wafer, tested and packaged and calibrated. This work was carried out under NPMASS project to meet the requirements of ADA, viz., 0-150 mbar Differential, 0-600 mbar Differential and Gauge, 0-1.2 bar Absolute and 0-10 bar Gauge. Additionally, 0-200 bar and 0-400 bar sensors and packages were designed and fabricated at CeNSE and tested at both CeNSE and DEBEL for back-up oxygen pressure-monitoring applications. Two such devices were delivered to DEBEL One 0-400 bar sensor was delivered to TBRL Chandigarh for field trials.
- Silicon & stainless steel micro-needle arrays for drug delivery were successfully fabricated, in collaboration

with the Dept. of Instrumentation and Applied Physics (IAP) and Dept. of Electronics Systems Engineering (DESE). Under the NPMASS programme and in collaboration with IAP & DESE, a peristaltic micro pump was integrated with the micro-needle array for continuous insulin delivery & monitoring.

- 2014 saw 2-D materials, an emerging area of research, gain a strong foot hold in CeNSE with research activity emerging on all fronts starting from basic materials synthesis to understanding fundamental physics to developing devices. This resulted in world record photodetectors, bio-sensors and the possible emergence of a new class of materials for packaging everything from electronics to potato chips.
- III-nitride activity continued to be a mainstay and a team of eight faculty members and about 20 students were involved in developing a III-nitride electronic system, a 40 V- 5 Amp DC DC convertor. The highlight of 2014 was the development of a process for making high electron mobility transistor stacks on 2" Si wafers that is on par with the best in the world. The process was so consistent that these wafers were shared with Indian researchers at a fraction of the cost (~Rs. 15 thousand) of imported wafers (~Rs. 4 lakhs).

## INTERDISCIPLINARY CENTRE FOR ENERGY RESEARCH

---

**Students: PhD: 10**

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 faculties, which is 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. In addition to research activities, ICER has also started its Interdisciplinary PhD Programme since 2013. The programme is designed for candidates with diverse background in engineering or science, and with keen interest in energy research.

### SERIIUS

Indian Institute of Science, Bangalore, has been selected to lead a new joint U.S.- India research centre focusing on solar energy, named as Solar Energy Research Institute for India and the United States (SERIIUS). It is one of three consortia that will make up the US.-India Joint Clean Energy Research and Development Center (JCERDC). This joint centre on solar energy is co-led by National Renewable energy Laboratory (NREL) on the US side. Altogether, the consortium has 30 partners from both India and US sides, comprising of academic institutions, R&D laboratories and industries. The consortium received a funding of US\$25 million from US and Indian governments, along with matching funding from industry and other partners. The project, started in October 2012, is crossing its half way mark, and has already produced several significant outcomes.

Within IISc, several new innovative initiatives have been taken up as part of this consortium. A supercritical carbon dioxide (SCO<sub>2</sub>) Brayton cycle test loop is being set up at ICER, with about 100 kW of heat input. This is the world's first-of-its-kind SCO<sub>2</sub> test loop for solar applications, and will be able to test various components to be developed under this consortium. A molten salt based high temperature storage loop is also being constructed at ICER as part of the same effort. These laboratories will be completed during the early part of 2015 and a detailed report will be included within next year's annual report.

### NCCRD

The National Centre for Combustion Research & Development (NCCRD) is one of the major programs under the Interdisciplinary Centre for Energy Research. The goals of NCCRD are to address grand challenges in the area of combustion utilizing advanced and state-of-the-art facilities. A major infrastructure for this initiative is a large compressed air facility that has been installed. Specifically, this system consists of a screw



compressor for a large flow rates (up to 650 cfm) and a reciprocating booster compressor for providing air up to 40 bar pressure, along with 30 m<sup>3</sup> of air storage. Also, a full-fledged fuel characterization laboratory has been set up with several equipment installed and commissioned. Specifically, the equipment include differential scanning calorimeter (DSC), thermogravimetric gas analyzer combined with infrared spectrometer (TG-IR) coupled with simultaneous thermal analyzer (STA), FT-IR, and Gas Chromatograph with Mass spectrometer (GC-MS). These facilities are already being used by several Departments within IISc.

In addition, advanced diagnostic facilities such as the Phase Doppler Particle Analyzer (PDPA) system for measuring droplet size and velocities in sprays has been installed and a tomographic Particle Image Velocimetry (PIV) system has been procured. Currently, some of the major experimental facilities being setup in line with the objectives of NCCRD include those related to high pressure spray chambers, supersonic jet in cross flow, gas turbine combustors, and heavy fuel oil atomization & combustion. An international workshop on 'Combustion instability in swirl combustors' was held towards efforts on international networking. Also, a joint IISc-GTRE workshop on Gas Turbine Combustion Research was also conducted in ICER to discuss on potential collaborative efforts on advanced gas turbine combustor technologies.

### **RESEARCH CENTRE FOR SOLAR POWER IN CHALLAKERE CAMPUS**

This project, supported by Karnataka Government, is for research and development activities to set up a test and research facility which can and evaluate and test small scale distributed solar power generation systems. Such distributed systems would be ideal for rural and semi-urban areas where grid facility may be absent, or reliable grid power may not be available continuously. This requires evaluation of existing technologies and development of parameters for long term reliability as well as design and prototype systems with new concepts which can yield viable technologies under the conditions present in Karnataka. The primary focus of this programme is to set up research test beds in PV as well as distributed CSP for cutting edge solar power technologies which include activities such as data

generation, controls and monitoring of performance. Under this programme, a 100-KW Organic Rankine Cycle based CSP research test bed has been designed and the construction work at Challakere campus is in full swing. The expected completion date is April 2015.

## **ROBERT BOSCH CENTRE FOR CYBER PHYSICAL SYSTEMS**

---

### **Publications: 25**

The Robert Bosch Centre for Cyber Physical Systems has a unique charter with its focus on "Translating Technology for Impact". It uses a problem driven approach to identify areas where significant impact can be achieved by these technologies (sometimes also referred to as Internet of Things) and brings together outside companies, entrepreneurs, venture funders with faculty to create viable solutions for these problems.

The main focus of the centre was two fold: to establish a research & technology base for the key horizontal areas in sensors and networking; and to move one or more of its projects towards transfer. A subsidiary goal was to increase the visibility of the centre and to grow its external relationships.

In the sensors area, the centre continued to leverage its staff background in optics and relationships with faculty from instrumentation and CENSE to create capability in glass microfluidics (in partnership with Herriot Watt University) and diffraction based measurement. This resulted in commercial interest from a major life sciences firm for cervical cancer detection and another for diesel exhaust fluid analysis.

The centre sponsored project on malaria detection won proof of prototype funding from BIRAC and is now being incubated as a stand alone entity at the centre.

In the networking area, in conjunction with the DREAM Lab at SERC, the centre developed and proposed a new architecture for the Internet of Things. The centreproposed these ideas as part of invited input to DIETY to determine the future direction of IoT research in the country. A focus of the centre was the use of adhoc

networking strategies and beacon based technologies to achieve the low costs and simplicity required for the deployment of practical networks. A testbed project for these technologies was initiated with St. John's Research Institute on reducing hospital acquired infections in ICU's.

The centre filed four provisional patent applications for research & technologies from its projects.

The centre established research/technology relationships with Herriot Watt University, the Swedish Institute for Computer Science and Swissnex, the Swiss.

The centre project "Ambulet" that leveraged SEAMOS technology from ECE to create a reliable communication channel for communication between ambulances and hospitals was completed with the licensing of the base technology by the entrepreneur. The centre initiated negotiations towards a similar joint research project for the commercialization of technology developed for an endoscopic simulator with an external startup.

## **SUPERCOMPUTER EDUCATION AND RESEARCH CENTRE**

---

**Staff: Academic: 15; Scientific: 5; Technical: 2  
Students: PhD: 28; MSc (Engg): 23; MTech: 30  
Degrees Awarded: PhD: 2; MSc (Engg): 7; MTech: 10  
Publications: 81**

The Supercomputer Education and Research Centre (SERC) conducts advanced research in the areas of Computer Systems and Computational Sciences. A brief summary of some of the major thrust areas of SERC is given below:

### **COMPUTER AIDED DESIGN**

At the CAD Laboratory, research for "Supercomputing on Silicon" targets architecture exploration and compilation techniques for runtime reconfigurable accelerator for Exascale Computing.

### **DATABASE SYSTEMS**

Selectivity estimates for optimizing OLAP queries often differ significantly from those actually encountered

during query execution, leading to poor plan choices and inflated response times. A conceptually new approach to address this problem was proposed, wherein the compile-time estimation process was completely eschewed for error-prone selectivities. Instead, a small "bouquet" of plans was 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 were 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 was controlled by a graded progression of isocost surfaces projected onto the optimal performance profile. It was proved that this construction resulted in bounded overheads for the selectivity discovery process and consequently, guaranteed worst-case performance. In addition, it provided repeatable execution strategies across different invocations of a query.

### **HIGH PERFORMANCE COMPUTING**

The High Performance Computing (HPC) Lab continued its research focus on (i) Compiler and runtime systems for GPGPU Computing, (ii) Memory hierarchy design for multicore architectures, and (iii) Compiler Analysis. At the HPC Lab., FluidiCL, a runtime system for executing OpenCL kernel on multiple heterogeneous devices in a co-operative and transparent manner was developed. Compiler schemes for reducing the impact of control divergence in GPUs through control flow linearization were also developed. In the area of memory hierarchy design for multicore architecture, an analytical model, called ANATOMY, for evaluating memory system performance was developed. The model was extended for stacked DRAM caches. Bi-ModalCache, an efficient stacked DRAM Cache design was proposed.

### **MACHINE AND LANGUAGE LEARNING**

The Machine And Language Learning (MALL) lab focused on extraction of knowledge from Web-scale datasets (primarily textual) and application of such knowledge in various real-world applications. One of the primary goals of the lab was to overcome the knowledge-bottleneck problem in intelligent decision making. Research carried out in the lab spanned the areas of Machine Learning and Natural Language Processing.

## MIDDLEWARE AND RUNTIME SYSTEMS

Middleware and Runtime Systems Lab. conducted research in the following areas:

- Prediction of response times for supercomputing job submissions, and using these predictions for metascheduling and resource management.
- Load balancing strategies for graph applications on GPUs.
- Application signature matching for prediction of execution times.
- Efficient executions of regular and irregular message-driven parallel applications on GPU systems.

## VIDEO ANALYTICS

Video analytics lab developed “FeatureMatch” an efficient method to compute approximate nearest-neighbour field between images. Low dimension features were used in conjunction with kd-tree and image coherency, to compute Approximate Nearest Neighbor Field (ANNF) maps. Unlike other approaches, the proposed algorithm did not require related image pairs and can be generalized to any unrelated image pairs. This enabled the approach to handle a wider range of vision applications, which have never been tackled using the ANNF framework. The proposed approach could be used as a general tool for various image processing applications.

The algorithm was adapted for the following applications:

- i) Optic Disk detection
- ii) Super Resolution of synthetic images,
- iii) Video Object Segmentation and
- iv) Optical flow estimation.

## CLOUD COMPUTING

The Cloud Systems lab was engaged in conducting research on evaluating system architectures that support the cloud computing paradigm and innovate on building the key system characteristics to support QoS on these systems. One of the major focus areas on which research was carried out in the last few years was on disk virtualization on cloud systems and their efficacy to support performance specific QoS attributes of cloud workloads. As a result of this effort, an innovative

hypervisor level dynamic priority based disk scheduling algorithm called PriDyn was developed that can cater to differentiated service requirement on a multi-tenanted virtualized host.

Placement of workloads in a cloud setup, to meet performance guarantees, requires that the cloud scheduler consolidates the right mix of workloads to enable satisfaction of QoS on the virtualized servers. A policy engine called PECOS was designed to facilitate the cloud scheduler to decide the correct workload mix deployment to a virtualized server. The other dimension that was explored in the past year by this lab was to understand how a cloud setup can be used for IoT based application scenarios. Towards this, different projects namely, real-time routing for navigation application and efficient data storage for location based services were initiated specifically for GPS based navigation application services. Both these projects demonstrate how the compute cloud can bring improved utility and efficiency to an existing and widely used application like navigator.

## DISTRIBUTED SYSTEMS RESEARCH

Distributed Research on Emerging Applications and Machines Lab (DREAM) Lab commissioned its OpenStack private Cloud for research on distributed systems, with open-source Big Data platforms like Hadoop, Giraph and Storm deployed. Research was done on spot pricing on Clouds, stream processing for Internet of Things (IoT), and distributed graphs. The lab initiated research collaborations with researchers within and outside the institute on IoT, scalable graph processing and Cloud computing.

## BIOINFORMATICS 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 those 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 in 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. Several algorithms, web-based computing servers and databases to mine various biological sequence and structure databases were developed. The developed algorithms and computing engines would not only make sense of the complex biological data but also provide precise information.

### **MEDICAL IMAGING**

The medical imaging group primarily worked in medical imaging related areas with a focus on computational methods in biomedical optical imaging. The recent research contributions 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 last year contributions have been to eliminate the bias introduced by these reconstruction parameters, and even more potently, to facilitate their automatic setting through matching of experimental data with the computational models. Moreover, as image reconstruction involves 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, the Medical Imaging Group 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 included: (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.

### **SCIENTIFIC COMPUTING**

A decades-long open computational problem in vehicle dynamics stabilization was solved by using a dynamic optimization procedure with disjunctive algebraic constraints. This has major implication in enhancing safety of road vehicles against rollover.

### **COMPUTATIONAL PHOTONICS**

The computational photonics lab modeled interaction of light with highly non-homogeneous and non-isotropic materials. It developed new computational formulations for such problems using the relevant areas of applied mathematics. Ability to control structure of composite materials at nano-scale gives us new materials that impact all the optical applications. Recently a computational solution was provided to a general heterogeneous N-body emission problem that cannot be (and has not been) solved otherwise. Such solutions were used to understand some new physics of emission in strongly interacting heterogeneous nanoscale materials

---

## 6.5 Division of Mechanical Sciences

(Chairperson: K Chattopadhyay)

---

The Division consists of the following Departments/Centres:

- Aerospace Engineering
- Civil Engineering
- Chemical Engineering
- Mechanical Engineering
- Materials Engineering
- Centre for Atmospheric and Oceanic Sciences
- Centre for Earth Sciences
- Centre for Product Design and Manufacturing
- Centre for Sustainable Technologies
- Divecha Centre for Climate Change

### AEROSPACE ENGINEERING

---

**Staff: Academic: 24; Scientific: 10**

**Students: PhD: 149; MSc (Engg): 29; ME/MTech: 52**

**Degrees Awarded: PhD: 21; MSc (Engg): 5;**

**ME/M Tech: 33**

**Publications: 201**

The Department of Aerospace Engineering, Indian Institute of Science, Bangalore, is primarily known for its activities covering both academics and research, and continues to excel through very significant contributions to aerospace and allied fields. The research highlights of the department in four major areas during the year 2014 are presented in this report.

#### A) STRUCTURES

Large-scale atomistic/molecular and multi-scale simulation capabilities have been achieved with in-house computer cluster and computer codes for solving complex problems involving aerospace structural materials. Simulation and experimental testing capabilities developed are aimed at understanding response of high temperature materials and structures, high strain rate impact and fracture etc. New nano-composite materials for thermal protection, mechanical strengthening and integrated sensing have been developed. Several materials processing and integration at structural level are being standardized toward industry applications.

A software framework to integrate Structural Health Monitoring (SHM) involving inspection process automation for application in aircraft industry has been developed. This is an industry centric technology transition effort carried out in collaboration with Tech Mahindra Aerospace & Defence, Bangalore. A few other software products and tools in the area of Integrated Vehicle Health Monitoring (IVHM) are at the final stage of development and due for industry centric tests and deployment. Under an Indo-German collaborative project funded by DST, a simulation tool has been developed for ultrasonic wave scattering in complex structures for simulation driven optimization of non-destructive inspection process for aircraft structural components. Various specialized hardware are being designed and advanced sensing/imaging/diagnostics.

Novel sensing and detection technology based on nanomaterial integration in microfluidic chip has been developed for applications in biological pathogen detection and infectious disease diagnostics (Point-of-Care technology). The developed technology is being extended further for bio-exploratory and water/soil and air sampling based field instruments. A patent on the above has been filed.

Wave propagation studies has been undertaken in the context of bifurcation in triatomic granular cyclic chains, nonlinear dynamics of snap-through one-dimensional

lattices, wave stability analysis in droplet lattices in incompressible fluid, stability analysis of non-stationary regimes in nonlinearly coupled oscillators, and structural dynamics of thin membranes with embedded one-dimensional elements like strings.

Another important area of study, carried out through experiments, is on thermo-elastic wave generation using high power laser beam for structural health monitoring of polymer composites. Using the same technique non-destructive evaluation of hygro-thermal effects on polymer composite materials with varied porosity is being investigated. Effects of addition of plain and functionalised CNTs to polymer composite materials and NDE of composite-to-composite adhesively bonded joints are other areas of research. A new facility established under this group is the High Power LASER Set up for Thermo-elastic Wave Generation (Figure 1).



**Figure 1:** Nd-YAG LASER: R850mj @ 1064 nm; Beam Dia: 9.5mm, pulse 6-9 nsec; Reptn Rate 10 Hz

Research on nano-composites and composite structures is another main activity. Molecular mechanics based finite element analysis has been adopted for the studies related to Nano-composites. Failure Mechanism based failure theory studies have been carried out for the design of composite structures.

New closed form solutions were discovered for functionally graded beams and rotating beams. An approach for modal tailoring of beams was found using an analytical approach. Experiments were conducted on piezoelectric actuators to quantify hysteresis effects and a post-buckling based linear to rotary amplification mechanism was designed. Finite element approach

was used to investigate delaminated composite plates. Fractal dimension measure was investigated as a tool for damage detection in composites. Atomistic-continuum coupled simulations were used for wave propagation analysis.

## B) COMBUSTION AND PROPULSION

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.

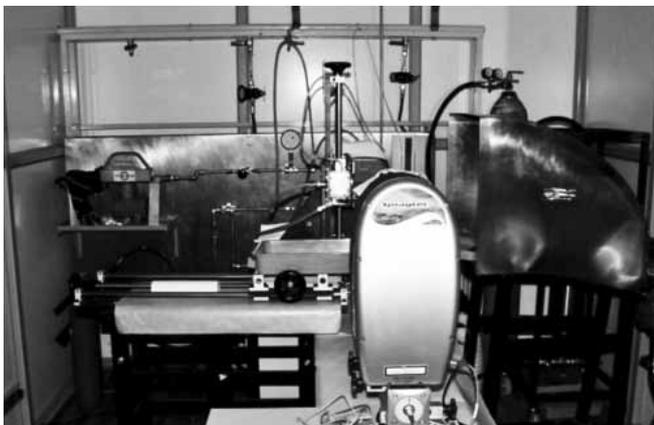
Computational investigations and stability analyses seeking to understand the role of hydrodynamic instability in promoting thermo-acoustic instabilities in combustion systems are ongoing. Recent research has made headway into understanding the unsteady dynamics of swirl flows in realistic combustors using local stability analysis tools. These tools have been delivered to the project sponsor (Pratt and Whitney, USA). The existing computational capability has been augmented to be able to perform 3D LES simulations. The existing compute cluster has been upgraded to 192 cores connected by high speed QDR infiniband to ensure efficient scaling of parallel jobs over large numbers of cores.

Several new rigs and diagnostic facilities have been operationalized in the new turbulent combustion and spray research laboratory as shown in Figure 2.



**Figure 2:** New facilities in the turbulent combustion and spray research laboratory

These include facilities for PIV in reacting and non-reacting flows, high speed combustion to support SCRAMJET related activities and a three cup swirl rig for Gas turbine combustion related studies. Research on the breakup of liquid jet/sheet 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, 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. An optical based spray drop size measurement system (SPRAYTEC from Malvern Instruments, UK) is installed in the laboratory (see Figure 3).



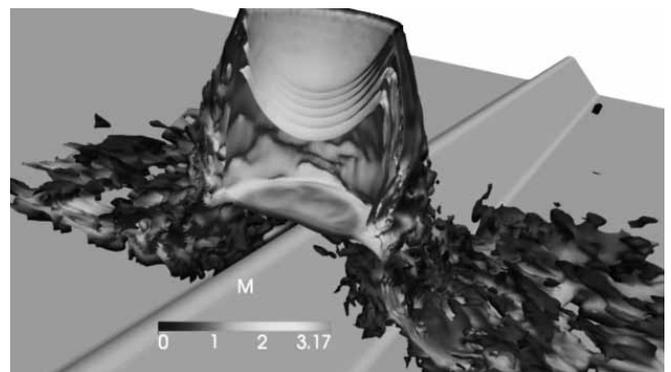
**Figure 3:** Spray drop size measurement system (Spraytec from Mavern Instruments, UK)

### C) AERODYNAMICS

A new hydrogen-oxygen combustion based fluid jet delivery method was developed, which will also be useful in bacterial transformation experiments. A new dual tube vertical shock tube facility has been installed, which is capable of simulating blast structure interactions within the laboratory. The feasibility of using alternate thermal protection systems including mass transfer cooling for re-entry vehicles were explored. A novel Carbon Nano Tube (CNT) sensor was developed to measure heat transfer rates over planetary entry-configurations.

A method for Large Eddy Simulation of evaporating dilute sprays with explicit filtering approach was developed. It was observed that droplet-laden round jets exhibit

a relaxation zone, with increased mixing, immediately downstream of the jet breakdown location before settling down to a self-preserving state (See Figure 4). Such a relaxation has not been observed before. The explicit filtering approach was extended to flows with shocks using a shock sensor and adaptation of the filter order in the vicinity of the shock. This method was found give qualitatively close predictions of the structure of impinging supersonic jets that are relevant to the configuration at lift-off of launch vehicles.



**Figure 4:** Supersonic round jet impinging on wedge from a Large Eddy Simulation. Density iso-surfaces coloured by Mach number

Aeroacoustics of shrouded supersonic jets were explored using reduced order models where it was found that such jets can have potential for significant sideline and upstream radiation from broadband incident acoustic perturbations. Such an analysis, for the first time, points to a possible mechanistic description of non-aft (upstream) radiation from supersonic jets.

The convective-absolute instability boundary of compressible, swirling pipe flows were investigated, which indicated a strong dependence on the nature of mean density profile.

Among the new facilities acquired are a Vertical Shock tube for blast testing applications, PLIF System(OH, NO, acetone), DiCam Pro- ICCD Camera, High Vacuum system and test section for hypersonic shock tunnel – HST2 , FPST for material testing applications.

### D) GUIDANCE AND CONTROL

Research activities were carried in the areas of guidance, control, estimation, and path planning of various autonomous vehicles/systems. Some of the

highlights include generalized state estimation and model predictive guidance for spiraling and ballistic targets, adaptive flight control design using neural network aided optimal nonlinear dynamic inversion, capturability analysis of a 3-d retro-pn guidance law for higher speed nonmaneuvering targets, and sliding mode control-based autopilots for leaderless consensus of unmanned aerial vehicles. Significant research contributions were made in the areas of curvature-constrained trajectory generation for waypoint following for miniature air vehicle, accurate time-to-go estimation for proportional navigation guidance, path planning using parametric curves and satellite image processing for land use and land cover mapping.

The group also leads in activities related to design and development of fixed wing nano air vehicle as part of India's National Program for Micro-Aerial Vehicles (NP-MICAV). See Figure 5 for some MAVs developed under this program.

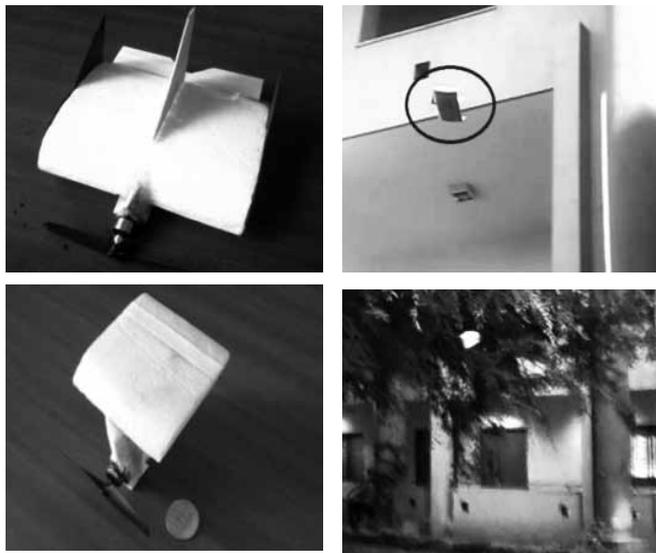


Figure 5: MAVs In Flight

**Space Technology Cell:** The ISRO-IISc Space Technology Cell (STC) was set up in 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 2014. 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, some were started, and a new set of proposals were evaluated and some among them were started, and a new set of proposals were evaluated and some among them were approved for funding from the next financial year.

About fifty projects were active in 2014. Theoretical studies were on flow modeling including aeroacoustics and atomization. Experiments were on materials and setups for characterization of nanowires, magnetic tunnel junctions, carbon nanotubes, investigations of nano-structured plasmonic crystals, and spray distribution in atomizers. Others included studies on urban development, forest degradation, vegetation dynamics, self-healing circuits, earthquakes, and heat pipes. Sensors for health monitoring, detection of gases, and telemedicine are being developed.

**Joint Advanced Technology Projects:** Seven new in-house projects were sanctioned by JATP during 2014. These projects involve dynamically adaptive moving mesh method for compressive flows, sublimation technique for gas turbine heat transfer, mixing and segregation of fuel particles in solid rocket propellants, spectral response of plasmonic metamaterials, carbon nanostructure based sensors, graphene based fire retardant shielding and nanostructures gas sensors.

## CIVIL ENGINEERING

**Staff: Academic: 21; Scientific: 4**  
**Students: PhD: 116; MSc (Engg): 3; ME/MTech: 54**  
**Degrees Awarded: PhD: 10; MSc (Engg): 3;**  
**Publications: 170**

The Department of Civil Engineering was established in the year 1950 and has grown manifold over the years to become one of the finest centers of advanced research and training in the field. The Department focuses on research and education in the broad areas of Geotechnical Engineering, Structural Engineering,



Transportation Engineering and Water Resources & Environmental Engineering.

The research portfolio spans across several synergetic areas like uncertainty and risk modeling, sustainable infrastructure, earthquake resistant design, innovative construction technologies and environmental hazard assessment and mitigation. The Department continues to expand its research to address topical issues. This year, our research focused on problems of global importance like seismic vulnerability and safety, low carbon building materials and technologies, climate change, floods, water supply, clean water, solid waste management, contaminant transport and sustainable transportation systems.

New perspectives to solve the challenging problems of energy, environment, health and safety of structures using interdisciplinary approaches are explored this year with great success. Advanced mathematical models that can simulate the non-isothermal multiphase flows and heat transport through fractured media are applied to geothermal reservoirs, which could be the clean and renewable source of energy in future. Psycho-physical attributes of drivers and travel behavior of commuters are analyzed and applied to solve traffic situations of real cities to develop guidelines for traffic law enforcement on road safety and mobility in India. Fatigue and crack propagation in concrete is modelled using concepts of thermodynamics. Principles of remote sensing and agricultural engineering are used to estimate soil hydraulic parameters and land surface temperature. Shock tube experiments and principles of aerodynamics are applied to develop eco-friendly mining and drilling practices.

A major strength of the Department is in the area of uncertainty, risk and reliability modeling for diverse applications like structural health monitoring, landfill engineering, rainfall prediction, climate change and flood analysis. As a part of ongoing studies on structural vibration control, a new vibration test procedure to estimate time variant reliability of randomly driven systems has been developed based on principle of Girsanov transformation to achieve sampling variance reduction. The efficacy of the

procedure has been demonstrated through shake table studies on bending-torsion coupled nonlinear building frames and frames with magneto-rheological damper based active isolation systems. Hygro-thermo-chemo-mechanical modelling of concrete is in progress so as to establish the time dependent loss of deformation in concrete. These deformations result in loss of prestress in post-tensioned concrete. Further loss of strength and stiffness to concrete on account of thermal damage is another issue that is being developed in the model. In geo-environmental engineering, reliability based techniques are successfully adopted for the assessment of spatial variation in geotechnical properties of municipal solid waste and also for estimating landfill settlements. Uncertainty analysis is conducted using instantaneous satellite orbital data products derived from the passive and active microwave sensors onboard TRMM (Tropical Rainfall Measuring Mission) satellite, namely TRMM Microwave Imager (TMI) and precipitation radar (PR) and a regional rainfall detection algorithm is developed based on scattering index methodology for the land regions of the study area. Performance evaluation of this algorithm, developed using low frequency channels are statistically tested for individual case study events during 2011 and 2012 Indian summer monsoonal months. Uncertainty modeling techniques are extended to non-stationary changes in hydroclimatic extremes. For extreme rainfall characteristics over India, significant physical drivers are identified through a fine-resolution analysis, within the statistical extreme value theory framework. In another study, a methodology was proposed for the detection of change in extreme drought levels under climate change. These analyses provide an improved understanding of such extremes and their robust projections which aid water resources planning and management. Assessment of hydrological impacts of land use and climate change has been carried out and the associated uncertainties are quantified. A new kernel based regionalization methodology is developed for regional frequency analysis of floods. Further, a wavelet based global fuzzy clustering approach is proposed for regionalization of hydrometeorological variables (rainfall, maximum and minimum temperatures) that can account for dynamic variability in the meteorological variables, besides nonstationarity.

The Department's sustained involvement and efforts towards seismic analysis and design for the past four decades continued this year. A new method to estimate maximum earthquake magnitude considering the regional rupture characters is proposed. Response spectra are developed for various shallow soil columns in Peninsular India based on seismic site classification studies. New dimensions are added to the insights into initiation of liquefaction in sands based on shaking table studies on saturated sand beds. New strategies are evolved for the earthquake resistant design of soil slopes, retaining walls and foundations through laboratory model tests and field studies supported by numerical modeling.

This year's research in the areas of sustainable construction saw the continuation of the Department's pursuit towards economical and innovative design practices consistent with green building technologies. Efficacy of cement stabilized rammed earth (CSRE) as a low carbon building material is investigated through extensive experimentation. Fracture behavior of CSRE in mode – I is investigated by testing geometrically similar notched three point bend test specimens. Correction factors to estimate the compressive strength of CSRE based on the specimen's slenderness is established. Energy in building materials, buildings and conservation of natural resources are the key issues for delivering sustainability in civil engineering construction and hence they remained the key focus areas for the current year. Embodied and operational energy in traditional and conventional residential buildings in India is examined in greater detail. A practical framework is developed for embodied energy assessment considering process analysis. The studies for the first time revealed that the operational energy and embodied energy can compete with each other in many cases of dwellings in different climatic zones of India.

The department's committed research towards the use of geosynthetics in various infrastructural projects like roads, retaining walls, embankments, slopes, landfills and foundations has gained momentum due to escalating need for optimum land usage, faster and economical construction. Various aspects of the 3D cellular confinement systems (geocells) subjected to static and cyclic loading are comprehensively studied

with the help of experimental and numerical studies. For the first time in the country, models of geocell retaining walls are constructed and tested to establish their optimum design configuration under static and seismic loading conditions. Savings in the aggregate layer thickness by adopting different geosynthetic layers in road construction is being investigated through laboratory model tests as well as field studies on real rural road sections in Karnataka. Research is initiated on the use of shredded tire chips mixed with sand as low-cost green alternative for naturally mined materials like gravel.

The Department is proactively adopting the transformative and cutting edge technologies into its gamut of research activities. Ultrasonic and laser based displacement measurements are replacing the conventional measuring instruments such as dial gauges in various laboratory element and model tests. Digital image based measurement techniques are being implemented in various experimental methods. Experimental investigations into the formation of fracture process zone and crack mouth opening displacement using various techniques such as digital image correlation, scanning electron microscopy, acoustic emission, indentation and spectroscopy are being carried out. Image based deformation measurements are being used to explore the mechanical behaviour of transitional geomaterials and granular materials. Digital image analysis and image segmentation techniques are applied to measure the shear band thickness in interface shear tests to understand the failure mechanisms in reinforced soil structures.

The Department continued its research on the fundamental and application aspects of environmental engineering, keeping in pace with growing global focus towards these issues. Considerable work has been carried out in the area of landfill engineering in terms of exploring the geotechnical properties of municipal solid waste (MSW) such as compressibility, shear strength, stiffness and their importance in design and construction of landfills. Settlement and gas production in the landfills have been studied at a laboratory scale. A new constitutive model is developed incorporating biodegradation and creep of MSW into the calculations and the applicability of the model



for landfills is verified. In another study, the role of gypsum on the physical and strength behaviour of fly ash-lime stabilized expansive soil is investigated. Another bigger level issue addressed is the estimation of rapidly changing environmental gradient in moisture and land surface temperature in tropical regions. A methodology is developed for retrieving leaf area index from active microwave remote sensing observations. The framework is validated with ground data sets using turmeric, maize, marigold, sunflower, and sorghum crops during Kharif season in the Berambadi experimental watershed ([www.ambhas.com](http://www.ambhas.com)). A method for estimating soil hydraulic parameters in multilayer soils using active microwave remote sensing and crop model inversion was tested and validated. A model of disaggregation of land surface temperature from remote sensing data was developed and was applied on different global sites pertaining to temperate and tropical regions as well as humid and semi-arid climatic regions. Role of vegetation cycling elements on the stream chemistry was investigated through studies in the tropical forested experimental watershed in the Kabini river basin.

Water supply and water quality are other major areas where the Department has contributed significantly. A model of water distribution system (WDS) is developed for a typical city like Bangalore, India and analyzed for several operating conditions. The calibrated model of Bangalore WDS is used to achieve equitable water supply quantity to different zones of Bangalore city using different controllers. Equitable water distribution to different reservoirs, when a part of the source fails to supply water is also studied. A methodology is developed to model the nodal, system and total reliability for water supply networks by considering the hydraulic and mechanical failure scenarios. Water quality is another concern in ground water systems, which is often governed by the transport of contaminants through soil layers. Laboratory studies have been conducted to understand the role of geological medium in controlling contaminant/moisture transport and retention in unsaturated soils. Experimental results brought out that the unsaturated permeability coefficient is unaffected by variations in void space for moisture flow and solely depends on matric suction. It has been demonstrated that besides controlling moisture and contaminant

transport, the geological medium also affects the mass of contaminant available for transport by facilitating redox reactions or sorption reactions. A process to treat heavy metal contaminated water is developed.

For the coming few years, Department will continue to pursue research in the areas of structural health monitoring, climate hydrology, energy efficient buildings, sustainable transportation modeling, earthquake resistant design and environmental hazard assessment. Some of the various new areas of research that the faculty of the Department is planning to explore include high-temperature testing of materials, thermal damage to structures, infrastructural design for challenges and threats, hydro-bio-mechanical modeling of municipal solid waste for the efficient design of landfills, large-strain plasticity and non-motorized transportation planning.

## CHEMICAL ENGINEERING

---

**Staff: Academic: 11; Scientific: 2**

**Students: PhD: 43; MSc (Engg): 6; ME: 23**

**Degrees Awarded: PhD: 4; MSc (Engg): 1; ME: 13**

**Publications: 31**

The Department of Chemical Engineering was started in 1943 as a wing of the Division of Pure 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 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.

## WATER AND ENVIRONMENTAL ENGINEERING

Our department is actively involved in research related to clean water and novel technologies related to the environment. Studies have been carried out to study the defluoridation of reject water from a reverse osmosis unit and synthetic water using adsorption. Column

experiments were conducted using activated alumina (AA) and a hybrid anion exchange resin embedded with nanoparticles of zirconium oxide (HAIX-Zr). With AA, about 185 bed volumes of reject water could be treated before the concentration of fluoride (F<sup>-</sup>) in the effluent exceeded the desirable limit of 1 mg/L. A much larger volume of water could be treated when the reject water was replaced by synthetic water containing only F<sup>-</sup>. Thus the uptake of F<sup>-</sup> is affected by the competitive adsorption of the other ions present in the reject water.

### **CATALYSIS AND NANOTECHNOLOGY**

A novel environmentally friendly in situ method has been developed to deposit silver nanowires on paper using a printing technique. This offers a route to flexible electronics and patterned conducting. Several catalysts have been tested for activity to a variety of reactions. In other studies new insights into electronic and geometric effects in the enhanced photoelectrooxidation of ethanol using ZnO nanorod/ultrathin Au nanowire hybrids have been studied. In efforts to investigate pathways for synthetic natural gas production, CO methanation over highly active Ni/TiO<sub>2</sub> catalysts have been studied.

### **THERMODYNAMICS AND STATISTICAL MECHANICS**

The Gibbs-Tolman model was used along with the van der Waals and the Lee and Kesler equations of state to develop a correlation for the variation of the surface tension with the temperature. Monte Carlo simulations have been used to study the effect of adsorbate loading on selectivity during adsorption of C<sub>2</sub>/C<sub>1</sub> and C<sub>3</sub>/C<sub>1</sub> n-alkane binary mixtures in silicalite.

### **ENERGY TECHNOLOGIES**

Investigations begun into large scale energy storage in flow batteries, so that energy derived from intermittent sources such as solar and wind can be used effectively, have yielded new insights into the mechanisms responsible for poor cycleability of soluble lead acid redox flow battery (SLRFB). First, we have found that a SLRFB induces natural convection, which is strong enough to obviate the need of any external convection to aid in ion transfer. Second, poor cycleability is on account of slow autocatalytic acid buildup caused by residue formation on electrodes and increase in charging voltage which sets in electrolysis of water.

Third, we show that intense agitation employed in the literature increases cycleability not by decreasing resistance to mass transfer, but instead by increasing recovery of residue from electrodes. The same can be achieved by engineering flow direction on electrodes and also by devising periodic cleaning of electrodes. Using molecular simulations a novel Gibbs-ensemble based technique has been developed for Monte Carlo simulations of Electric Double Layer Capacitors (EDLC) at constant voltage.

Natural gas is emerging as a cleaner alternate fuel to petrol and diesel. Studies to design an effective on-board natural gas storage system has been carried out to investigate phenomenon at different length scales. At the materials level, density functional theory and statistical mechanics methods have shown that specific functional groups and defects found on graphene based adsorbents can enhance the methane storage capacity. Packed bed models have been developed to assess critical non-equilibrium heat and mass transfer effects while developing an onboard storage device for automotive applications. We have critically reviewed the interpretation and basis for natural gas storage targets reported in the literature. Methane gas is stored naturally in clathrates. Using molecular simulations we have investigated the equilibrium phase diagram of several clathrate based systems which are difficult to achieve experimentally.

### **BIOENGINEERING AND BIOLOGICAL FLOWS**

We have developed a mathematical model that elucidates the origins of the failure of standard treatments for hepatitis C virus infection. The model also explains for the first time the synergy observed between anti-hepatitis C drugs suggesting a rationale for treatment optimization. The lytic action of pore forming toxins has been investigated using kinetic models and experiments. The results indicate that oligomerization of proteins on the membrane surface for the toxin Cytolysin A occurs via a non-sequential oligomerization pathway suggesting possible intervention strategies for several bacterial diseases implicated by pore forming toxins. In order to probe biophysical events at the single molecule level, novel high resolution microscopy techniques are being developed in the department.



layer-by-layer assembled thin films and microcapsules of nanocrystalline cellulose have been tested for hydrophobic drug delivery systems.

We have characterized the flow in a microchannel at Reynolds numbers as low as 200 after a flow instability due to the dynamical coupling with a soft wall, and shown that the flow exhibits all the features of turbulence at much higher Reynolds numbers, including the flatness of the velocity profile near the center, the log law at the wall, the large velocity fluctuations in the streamwise and cross-stream directions. It also exhibits several new characteristics not observed in turbulent flows, such as the non-zero Reynolds stress at the wall and an asymmetric profile for the velocity fluctuations which are much larger near the soft wall in comparison to the hard wall. These studies have implications in our understanding of blood flows in capillaries and arteries

### COMPLEX FLUIDS

In our previous experiments using a cylindrical Couette cell, we had made the seemingly puzzling observation of all components of the stress at the outer cylinder increasing roughly exponentially with distance from the free surface. Subsequently, using DEM simulations and careful imaging, we have shown this to be caused by a Taylor-Couette like vortex. However, unlike in fluids, the vortex is anti-centrifugal, and there is always a single vortex no matter what the Couette gap and height. Though counter-intuitive, this vortex explains qualitatively the exponential rise of the stress. However, an anti-centrifugal vortex is not explained by any existing constitutive theory for granular flows, and our current efforts are towards arriving at a suitable continuum mechanical explanation.

In an effort towards understanding the shape dynamics of individual particles and the macroscopic rheology of a suspension of soft, deformable particles, we have initiated a study of synthesizing microspheres using a T-junction microchannel having a flow focusing mechanism. We have successfully fabricated the microchannels and synthesized cross-linked PDMS particles in the size range of size 50-200  $\mu\text{m}$  of a range of elastic modulus. We are now engaged in determining the rheology and margination of a suspension of soft particles flowing through a channel.

A comprehensive study has been carried out on the shear alignment of lamellar mesophases and the structure-rheology relationship. All the important dimensionless parameters affecting the rheology have been identified, and the effect of variation in these parameters have been studied.

A novel 2D lamellar phase ripple structure has been observed in molecular dynamics studies of a binary surfactant-cosurfactant system commonly used in hair conditioner formulations.

## MATERIALS ENGINEERING

---

**Staff: Academic: 22; Scientific: 5; Technical: 1**  
**Students: PhD: 110; MSc (Engg) 1; ME: 35**  
**Degrees Awarded: PhD: 23; ME: 18**  
**Publications: 195**

The research activities of the department in the field of materials is wide ranging. Topics covered include tissue engineering, polymers, functional ceramics and alloys, nanoparticles and thin films, hard coatings, materials and mineral processing and computational modeling.

The biomaterial group has successfully synthesized lipid coated mesoporous silica nanoparticle (L-MSN) for oral delivery of ciprofloxacin for intracellular elimination of Salmonella pathogen. Ciprofloxacin, a fluoroquinolone antibiotic, loaded into the L-MSN particles showed enhanced antibacterial activity against free drug in in vitro assays. A mesoporous silica nanoparticle (MSN)-protamine (PRM) hybrid system (MSN-PRM) has been fabricated that selectively releases drugs in the presence of specific enzyme triggers present in the proximity of cancer cells. In the field of orthopedic bio-implant research stainless steel surface was successfully modified at the nanoscale to improve its mechanical and biological performance. The improved performance was found to be associated with changes in oxide layer at the biomaterial surface induced by nanocrystalline modification. In another study, post-consumer PET waste was processed to prepare biocompatible and biodegradable polymers for tissue regeneration. A polycationic gene carrier has been developed to biofunctionalize polymer

scaffold which augments bone tissue regeneration. The functional polymer group has developed a portfolio of materials exhibiting band gaps in the range 1.2 – 2.2 eV, many of them with enhanced photovoltaic properties. An electrochemical lead ion sensor has been developed using polypyrrole functionalized with iminodiacetic acid (IDA-PPy) by modification of carbon paste electrode, and the lower detection limit of Pb<sup>2+</sup> has been found to be 9.6 nanomolar concentration. Another interesting development is related to fabrication of nanoporous polymeric membranes by selective etching of amorphous PMMA in phase separated blends of PVDF and PMMA. In addition, research is going on in the area of developing lightweight, flexible and corrosion resistant EMI shielding materials using polymeric nanocomposites. A high reflection loss > 40 dB is observed in PVDF based composites involving ferroelectric and ferromagnetic phases. A collaborative activity has recently been initiated with Dayanand Sagar Medical college with the objective to use functionalized inorganic nanoparticle composites of graphene oxide-gadolinium oxide, graphene oxide – cobalt ferrite composites for the enhancement of image contrast in magnetic resonance imaging (MRI). The aim is to significantly enhance the proton relaxivity to shorten the data acquisition time along with the enhancement in the spatio-temporal resolution and reduced exposure of electromagnetic radiation on the patient. In the area of functional ceramics a six decade long puzzle with regard to the uncertain phase formation behavior of the multiferroic systems BiFeO<sub>3</sub>-PbTiO<sub>3</sub> has recently been solved. For the first time a correlation has been established between abnormal grain growth and its influence on the phase stability. There is ongoing research in the area of lead-free piezoceramics as well.

The department has strong groups in the field structural materials. A mathematical model has been developed to predict the densification during reactive hot pressing of ZrC from powders of Zr and C. A tribological combination of Mg-alloy reinforced with alumina fibres and a DLC coated steel is found to yield low friction and wear in conditions appropriate to IC engines; humidity effects on wear of TiN coatings have been identified at room temperature. Research in the area of light alloys has led to the development of wrought aluminium and magnesium alloys with excellent strength and ductility

properties. Autocatalytic duplex Ni-P/Ni-W-P coatings have been developed on AZ31B magnesium alloy, among which the duplex-heat treated-passivated (duplex –HTP) coatings showed improved corrosion resistance with lower corrosion current density and higher polarization resistance. Computational modelling has been carried out to describe the slag-metal emulsion behavior and how the droplets and bubbles travel through the slag phase to enhance the heat and mass transfer of the system. This model has been verified with experiments and against published data extensively. Granulation of iron ore along with sintering model is being verified at plant level with the help of Visakhapatnam Steel Plant. In the field of bio-mineralization DNA isolated from different *Bacillus* species has been confirmed as an environmentally benign bio-reagent for the selective flotation of sphalerite from galena. A noteworthy finding has been the higher biocollector capacity of single stranded DNA vis-à-vis the double stranded DNA, leading to better flotation selectivity.

The multidisciplinary character of the department has further strengthened with Dr. Vijay Anand Sethuraman joining the department as an Assistant Professor in 2014. His research emphasis is on electrochemically-active and functional materials for electrolysis, energy-storage and energy-conversion; electrochemical desalination and remediation of pollutants and electrochemical metallurgy of critical materials. With the financial support from the Institute, a state-of-the-art 9 kW rotating anode powder diffractometer with high and low temperature attachment facility has recently been installed in the department to cater to the needs of high quality diffraction studies of advanced functional materials.

## MECHANICAL ENGINEERING

---

**Staff: Academic: 18; Scientific: 5**  
**Students: PhD: 126; MSc (Engg): 21; ME: 48**  
**Degrees Awarded: PhD: 8; ME: 20**  
**Publications: 128**

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, Microsystems, Robotics, Acoustics, Vibration, Acoustics, Fatigue, Micro-Electro-Mechanical systems (MEMS) and Tribology. Important aspects pertaining to research activities carried out during the calendar year 2014 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.

## **I. SOLID MECHANICS**

### **(a) Fracture of brittle bulk metallic glasses (BMGs)**

Fracture experiments were conducted using embrittled BMG specimens and the fracture surface features were analyzed to reveal the underlying physical processes. For the first time, Wallner lines were observed on the dynamic fracture surface from which the crack speed was deduced as 800 m/s. Crack initiation occurred by cavity nucleation at the mid-thickness of the specimen. HRSEM and AFM images showed the occurrence of highly periodic nano-scale corrugations with spacing of about 79nm in the dynamic crack growth regime. Possible mechanisms of dynamic crack growth were explored from the experimental results.

The effect of the applied stress state on the cavitation behavior of a heterogeneous plastic solid with distributed weak zones was studied using 2D plane strain finite element simulations. Earlier work had demonstrated that this model mimics the cavitation response of brittle BMGs which show nanoscale fluctuations in atomic density and strength. A unit cell containing a weak zone and subjected to different (biaxiality) stress ratios was analyzed. The volume fraction and yield strength of the weak zone were varied over a wide range. The results showed that unlike in a homogeneous plastic solid, the cavitation stress of the heterogeneous aggregate does not reduce appreciably as the stress ratio decreases from unity when the yield strength of the weak zone is low. It was found that a non-dimensional parameter characterizing the stress state prevailing in the weak zone and its yield properties uniquely control the cavitation stress. The nature of cavitation bifurcation may change from unstable bifurcation to the left at sufficiently low stress ratio to one involving snap cavitation at high stress ratio.

### **(b) Ductility enhancement in Nanoglasses (NGs)**

The mechanistic origin of enhancement in ductility and suppression of dominant shear banding in nanoglasses (NGs) was analyzed using a thermodynamically consistent non-local plasticity model. It was found that the interaction stress between flow defects plays a central role in promoting global plasticity of NGs. Specifically, the intrinsic length associated with this stress provides a scaling for the shear band width and its coupling with grain size governs the level of enhancement in the deformation behavior of NGs. This may provide useful insights in developing highly ductile NGs for practical engineering applications.

### **(c) Fracture of Magnesium single crystals**

A combined experimental and finite element study of fracture in Mg single crystals under mode-I loading was performed. Three crystallographic orientations were considered with respect to the notch front and normal to the flat surfaces of the notch. The c-axis (0001) was along the normal to the notch surfaces in two orientations, while in the third it was aligned with the notch front. The single crystal specimens were loaded under three-point bending using a fixture mounted inside a SEM. In addition to in-situ EBSD imaging around the notch root at various stages to monitor the evolution of twinning, optical metallography, fractographic examination and surface profiling were also conducted after completion of the test. 3D finite element simulations were carried out using a crystal plasticity formulation with provision for plastic flow due to both slip and twinning. The results showed that extension twinning of the {10-12}-type is a dominant mode of deformation and plastic dissipation in all three crystal orientations. The width of the dominant twin near the notch root evolved rapidly with displacement initially but saturated at around 120 to 150 microns, but twins continued to nucleate further away. Crack initiation occurred just before attainment of the peak load and the crack grew stably along the twin-matrix interface. It was deflected at twin-twin intersections leading to a zigzag crack path. The predicted load-displacement curves, slip traces, extension twinning activity from finite element analysis were in good corroboration with the experimental observations. The numerical results were used to understand the 3D nature of the crack tip stress, plastic slip and twin volume fraction distributions near the notch root.

## II. FLUID MECHANICS

### (a) Water Entry

Experiments have been conducted on the vertical impact of axi-symmetric bodies with different fore body shapes that include among other shapes a concave nose. Previous studies have shown that bodies with a convex nose, like a sphere, produce a well-defined splash with a relatively large cavity behind the model. In contrast, we find that with a concave nose, there is hardly a splash and the cavity extent is greatly reduced. This may be explained by the fact that in the concave nosed case, the initial impact is between a confined air pocket and the free surface unlike in the convex nosed case. From measurements of the unsteady pressure in the concave nose portion, we show that in this case, the maximum pressures are significantly lower than the classically expected "water hammer" pressures and also lower than those generally measured on other geometries. Thus, the presence of an air pocket in the case of a concave nosed body adds an interesting dimension to the classical problem of impact of solid bodies on to a free surface. The significant reductions in the cavity length and peak impact pressures could prove to be beneficial in some applications like landing of sea planes on ocean surface, dip coating technologies and development of air dropped underwater systems.

### (b) Multiphase Flows

Interfacial phenomena in multiphase flows are inherently multiscale both in space and time domains and continue to be a subject of extensive numerical and experimental studies. We have been working towards developments of numerical methods for multiphase flows to gain deeper physical insight and explore a wider parameter space to find the required control parameters. In particular, we have developed state-of-the-art tools to simulate various multiphase flows spanning from fluid-fluid systems to fluid-solid systems involving both Newtonian and viscoelastic fluids. We have employed these tools to study (i) Atomization of a liquid jet in cross flow for gas turbine combustors (ii) Water entry of projectiles for marine hydrodynamics (iii) Drop and bubble dynamics in the presence of electric field for control on bubble sizes in bubble column reactors (iv) Viscoelastic drop deformation in a microchannel and (v) Multiscale simulations for resolving continuum singularities.

(c) Experimental studies have been undertaken, in order to understand the role of flexibility often found in wings and fins in Nature. Using a simple flapping motion of an airfoil with a flexible tail in still fluid, it was found a uniform jet and an associated thrust. This may be considered as a new type of hovering motion, much simpler than that found in birds and insects. A new non-dimensional stiffness parameter has been defined that is applicable to flexible wings and fins.

## III. MATERIALS

### (A) Research on solidification modelling/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:

(i) **Development of a Rheo Pressure Die Casting System (jointly with CSIR-CMERI Durgapur):** In this project rheo pressure die casting system, process as well as an automobile component called Steering knuckle have been developed. The system has been developed by manufacturing and integrating nine sub systems such as melting furnace for melting aluminium alloy ingots, cooling slope for generation of semi-solid slurry on demand, holding furnace for holding the semi-solid slurry isothermally, ladling unit to transfer metered quantity slurry from holding furnace to shot sleeve of pressure die casting machine, pressure die casting machine to cast the semi-solid slurry, control unit to run the furnaces as well as to control the quantity of slurry generation and movement of the furnaces, hydraulic and pneumatic power pack, sleeve temperature controller and mould temperature controller. The steering knuckle is redesigned for manufacturing it out of A356 aluminium alloy by replacing ductile iron. Accordingly, the mould is manufactured and the component is successfully produced. The experimental set up is created at CSIR-Central Mechanical Engineering Research Institute, Durgapur. Concept design, CFD simulation semisolid slurry production and process design have been performed at IISc's National facility for Semisolid Forming.

(ii) **Lab scale production of non-dendritic SS 340L specimens by cooling slope method and**



**microstructural characterization:** In order to demonstrate the amenability of thixo-casting for manufacturing of stainless steel in a production mode, cooling slope technique was chosen to obtain the required microstructures in the billet. In this method, the alloy in low superheat condition is poured over an inclined cooling plate made of ceramic material that is maintained at a relatively lower temperature than the melt. This method was successfully was fairly established for producing non-dendritic billets for non-ferrous alloys, but this is the first demonstration of the method for ferrous alloys. Using an in-house developed (at IISc) cooling slope, the thixo-casting of 304L SS was carried out. Melting of the steel for this process was carried out using the furnace at Defence Metallurgical Research Laboratory, Hyderabad and a thixo-cast ingot of 10 kg weight was produced. The thixo-casting process carried out is shown in the figure below. The project was funded by IGCAR, Kalpakkam.

## **(B) Nanomaterials**

A novel nanocomposite coating with ordered porous alumina as matrix embedded with aligned metal nano rods has been developed. Ordered porous alumina layer formed by a two-step anodisation process is uniformly filled with Copper by electrodeposition. This was achieved by optimally modifying the barrier layer without sacrificing the interfacial strength. Uniform nanocomposite coating has been achieved over an area of 10 mm x 10 mm. The properties of the porous alumina and the nanocomposite were measured by nanoindentation. Porous alumina deformed either by compaction or by forming circumferential and radial cracks. However, when copper is filled in the nano pores no circumferential cracks were found up to the load of 10 mN for a film thickness of about 1  $\mu\text{m}$  and the hardness increased by 50%. Coefficient of friction of the coating reciprocated against steel in dry condition is found to be around 0.4 with very minimal wear.

## **IV. THERMAL SCIENCE AND COMBUSTION**

### **(a) Design of Low Temperature Combustor**

Significant progress has been made towards realizing a novel two-stage, low temperature combustor design proposed as a hybrid heating source for a solar thermal power plant application. The motivation for this work is to achieve high energetic and exergetic efficiencies

with near-zero pollutant concentrations. Comprehensive in-situ measurements of fuel-air mixing and velocimetry in an optically-accessible trapped vortex combustor (TVC) were conducted. Results show that highly stable combustion can be achieved along with high efficiency and low emissions with fuels such as methane and syngas, with exhaust NO<sub>x</sub> emissions less than 5 ppm. Work towards developing compact gas turbine combustors using the TVC concept has progressed by successful demonstration of the combustor operation with liquid (Jet-A1) fuel.

### **(b) Dynamics of Droplets**

- Transitional structures and stability maps in swirling flows
- Analyses of boiling in burning droplets
- Novel pathways to suppress ebullition in burning droplets using acoustics
- Shape oscillations of droplets in vertical and oscillating flow fields
- Precision control of droplet drying and agglomeration using rhythmic oscillations
- Droplet shape oscillation mechanisms

### **(c) Development of a Two Stage Water + Silical gel Adsorption System**

The objective of this project is to perform fundamental studies, simulate and then build a laboratory model of a unit that generates cooling (at  $\sim 5^\circ\text{C}$ ) using flash evaporation of saline subsoil or sea water and then compresses the steam generated therein at  $\sim 1$  kPa to about 20 kPa using thermal compression means which is realized from a set of silica gel adsorption beds. The thermal energy needs are derived from either solar collectors or waste heat source. Detailed analysis and experiments are being carried out to obtain the interrelationship between thermal energy input, and the quantity of refrigeration and potable water output.

The 2-stage water + silica-gel adsorption chiller and desalination system comprising of 4-adsorber in each stage is first designed schematically. Simulation studies are performed in order to obtain best design parameters. Individual components such as adsorbers, evaporator, plenums, condenser, cold and hot water reservoirs are designed and fabricated. The instrumentation system involves controlling of large number of water valves,

steam valves and acquisition of data from flow sensors, pressure sensors and thermocouples. All the individual equipments are mounted and assembled on 90x90 section aluminum frames and angled brackets. The laboratory based experimental setup has been fully assembled in the Heat Transfer Laboratory, Mechanical Engineering Dept., IISc Bangalore.

## V. DESIGN AND BIOMECHANICS

### (a) Biomechanics and Microsystems

(i) A soil-moisture sensor is developed and is integrated with electronics for wireless-transmission. It is being tested in the field. Another version of a soil-moisture based on mechanical amplification of the expansion of a super-absorbent material is developed. This one does not use external power and hence is affordable by small to medium scale individual farmers.

(ii) Deformation and residual stress analysis of growing elastic bodies was investigated and applied to a practical application to study leaf-growth. Two algorithms are developed: one to simulate the growth for given growth-rate tensor and the initial configuration of a leaf, and the other determining the growth-rate for given initial and final shapes of a leaf. An experimental setup is also developed to measure the growth-rate of leaves of model plants in the laboratory conditions.

(iii) A perfusion culture system for biological cells is designed, made, and tested. This system comprises miniature peristaltic pumps and bioreactors; both designed and made in house, custom-designed electronics, and user-controls. The system has provision for live imaging at high magnification, ease of use just like multi-well plates, and parallel perfusion of medium at desired rates. The whole system can be put inside any standard CO<sub>2</sub> incubator.

### (b) Robotics and Design

An endoscopic simulator for upper gastrointestinal (GI) tract is developed. It has haptic feedback and visualization integrated to simulate the patient for use in training and haptic playback. The system has many novel features including an extra degree of freedom for simulating the insertion of the endoscope into the throat, proper haptic feedback throughout the upper GI tract,

and instrumented endoscope to track the profile of the tube. Novel behavior of a bimodal bistable mechanism is analyzed. This mechanism has two stable states that can be switched by using two different actuations wherein the paths of switching from one state to another are different. This nonlinear concept is used in designing a chair for the elderly to assist in rising from the chair.

## VI. TECHNICAL ACOUSTICS AND VIBRATIONS

Parametric expressions have been developed for differential length and end corrections for improved tuning of the extended concentric tube resonator for wide-band transmission loss which would help in design of automotive mufflers with minimal back pressure and aerodynamic noise generation.

## CENTRE FOR ATMOSPHERIC AND OCEANIC SCIENCES

---

**Staff: Academic: 9**

**Students: Ph D: 30; M Sc (Engg): 7; MTech: 12**

**Degrees Awarded: M Sc (Engg): 2; M Tech: 5**

**Publications: 35**

The students and faculty members at CAOS carry out research in the interdisciplinary field of physics-chemistry-biology of the atmosphere and ocean. Our research topics span from field observations and data analysis, to high resolution numerical model simulations and geoengineering of the climate. Following are the highlights of our research activity.

### FIELD OBSERVATIONS

The uncertainties in the estimation of speciated aerosol radiative forcing contribute significantly to the total climate forcing. The direct radiative forcing due to various aerosol species in an external mixture depends non-linearly on the optical properties of the neighbouring aerosol species. The contribution of multiple scattering due to neighbouring aerosols on the speciated aerosol radiative forcing and sensitivity of this non-linear effect to the aerosol composition and loading were investigated using a typical aerosol model measured during Integrated Campaign for Aerosol, gases and Radiation Budget (ICARB) and DISORT radiative transfer model.



The multiple scattering due to neighbouring aerosol species contribute significantly (140%) to the black carbon radiative forcing at the top of the atmosphere. Our studies show that the non-linear and heterogeneous effects of multiple scattering due to aerosols impose significantly large uncertainty in the radiative forcing due to BC at top of the atmosphere, especially over the oceans, and is a function of total columnar aerosol loading. The radiative forcing efficiency of BC aerosols also varied with neighbouring aerosol composition, loading and surface albedo. Spatial heterogeneity in the contribution of multiple scattering due to neighbouring aerosols to the black carbon radiative forcing at the top of the atmosphere demand the inclusion of these non-linear effects while estimating speciated aerosol radiative forcing.

### DATA ANALYSIS

In a step toward understanding the drought characteristics of Indian summer monsoon, study from CAOS shows that the droughts of the Indian summer monsoon can be broadly and robustly classified into two categories: those that are triggered by El Nino, and those that are not. Unlike the non El Nino droughts, the El Nino-related droughts showed large negative rain anomalies over the Asian continent extending up to the Pacific warm pool region. Thus, the non-El Nino droughts do not appear to be large-scale droughts and are confined only to Indian region. More importantly, the pattern representing the class of non-El Nino droughts showed a near-normal rainfall in the peak monsoon months of July and August. This finding questions the common, long-held notion that the character of monsoon droughts is controlled by the rainfall deficit in July and August.

Another study, using long-term river discharge of Ganga and Brahmaputra rivers, reports that there is no obvious evidence of the impact of climate change on their discharge. Having established weak second order stationarity, this study shows that there exists a power-law scaling between 2 days and 30 days for both rivers' discharge fluctuations. The utility of this type of scale-invariance for downscaling holds promise for temporally disaggregating satellite altimeter discharge observations (at 10- or 35-day timescales) and resolving finer-scale temporal variability.

### NUMERICAL MODELING

High resolution modeling of Indian summer monsoons was one of the focuses of this year's work. Simulations were conducted to understand the role of orography on Bay of Bengal cold pool rainfall. A cloud resolving model simulation was conducted to understand the nature of convection over Bay of Bengal (perhaps one of the highest resolution simulations for this region). Analysis of daily rainfall precipitation of coupled models showed that models had difficulty in simulating low rainfall and overestimated high rainfall over the Indian region.

In another study, impact of proximate and remote heating of the atmosphere by anthropogenic aerosols on Indian summer monsoon was investigated. It was found that aerosols over Indian region enhances monsoon over northwest India through increased advection of moisture carried by low level winds. More interestingly, aerosols over east Asia were also found to modulate monsoon rainfall over India through spatial shift in the phase of upper level Rossby wave, an prominent circulation characteristics of subtropics. This study implies that atmospheric heating perturbation can impact climatology of a remote location.

### GEOENGINEERING

Global anthropogenic carbon dioxide emissions from fossil fuel burning have been accelerating in recent decades and the efforts to mitigate these increasing emissions are proving to be challenging. This has led to an interest in geoengineering to counteract climate change. Geoengineering is defined as a large scale intentional manipulation of the climate system intended to reduce the undesired impacts of climate change. There are two main categories of geoengineering methods: Solar Radiation Management (SRM) and Carbon Dioxide Removal methods (CDR). While SRM would counteract the warming caused by greenhouse gases by reducing the incoming solar radiation or by increasing the planetary albedo, CDR methods propose to accelerate the removal of CO<sub>2</sub> from the atmosphere.

At CAOS, we use climate models to investigate the effectiveness and secondary impacts of SRM methods such as injecting aerosols into the stratosphere or reflectors in space. SRM methods have been shown to

lead to reduction in global mean rainfall when the global mean temperature change is offset exactly. However, a simple and clear understanding of the effects of systematically varying the north-south distribution of aerosols on rainfall and surface temperature was lacking. In a recent study, we performed a set of climate model (geoengineering) simulations to investigate the changes to global rainfall pattern for various latitudinal distribution of solar insolation reduction in SRM methods. The major finding of this modeling study is that the rainfall in the tropical regions such as India would be reduced significantly if stratospheric aerosol concentration is maximized in the tropical stratosphere. Therefore, if geoengineering in the tropics were ever used to counter climate change, it is likely to have detrimental effects on water resources and crop yields in India.

## CENTRE FOR EARTH SCIENCES

---

**Staff: Academic: 6**

**Students: PhD: 24; MSc (Engg): 1; ME/MTech: 8**

**Degrees Awarded: PhD: 1**

**Publications: 29**

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, present day carbon and hydrological cycle, ocean-atmosphere interaction, modern and paleoclimate studies, establishment of new proxies for 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 2014 are:

- In this year Dr. Josia Jacob together with Professor. Prosenjit Ghosh and other collaborators from other Institutes reported seasonal variability of anoxic condition along the costal environment of south

eastern Arabian Sea. In the paper published in Journal of Oceanography (2014) authors presented the observation and raised concern about the role of anoxia on fish production and health of costal ecosystem.

- A major milestone was achieved this year, when Dr. Tania Guha, research student along with Professor. Prosenjit Ghosh at the Centre reported the first observation documenting the role of Indian Monsoon controlling the effect of anthropogenic emission on the seasonal variation of air-CO<sub>2</sub> over Bangalore. In the paper published in Environmental Science and Pollution Research (DOI 10.1007/s11356-014-3530-3) the authors presented three years of observation capturing the time in a day and in a season while carbon dioxide concentration reaches maximum level. This was first such kind of documentation from any city over India about the level of anthropogenic emission and seasonal variability.
- Insights obtained on tectonic correlation of India and Madagascar; CO<sub>2</sub> migration during charnockites genesis modeled; evidence of crustal-scale subduction in Neo-Archean from high P-T granulites of Scotland and from chromite-silicate chemistry of the Sittampundi complex of southern India.
- Ages and sizes of pre-2004 tsunamis inferred from Andaman and Nicobar; high-resolution speleothem record reveals climatic variability in Central Himalayas in the last 1800 years.
- Stable isotopic compositions of the Hooghly river estuary has provided new insight on seasonality in the eastern part of the Indian sub-continent; Chromium recycling in the earth was explored using Cr stable isotopes in mantle-derived rocks and their weathering products. Geochemical signatures of middle and late Permian mass extinctions were studied.
- Numerical models of lithosphere and mantle convection; evaluating a best-fitting viscosity structure for the earth constrained by plate velocities and deformation rates, geoid and dynamic topography; understanding the origin of the Indian Ocean geoid low.



- The effect of the lower mantle on dynamo action in the earth is being explored.

## CENTRE FOR PRODUCT DESIGN AND MANUFACTURING

---

**Staff: Academic: 5; Scientific: 2**  
**Students: PhD: 36 ; MSc (Engg): 8; MDes: 32**  
**Degrees Awarded: PhD: 2; MDes: 20**  
**Publications: 31**

The research activities in the Centre spans a wide spectrum of areas from Design Theory to Sustainability of Products and Technologies. Faculty in the department are addressing research questions in design creativity, collaborative design, product informatics, knowledge acquisition and management, framework for design of sustainable products, digital human modelling, design for manufacturing, thermal comfort and tools for CAE.

A significant finding in the area of creativity was the discovery of a stable pattern in design ideation process across novice and experienced designers, where both seem to carry out search for and in twelve distinct search spaces. A significant finding in design for disassembly was the significantly higher ergonomic hazards associated with manual disassembly in informal sectors vis-à-vis those in formal sectors. In product informatics, two significant findings/approaches have been developed: a questioning based method and tool for automated acquisition of knowledge; and a model of how knowledge capture tools influence creativity in collaborative design.

A computer assisted procedure has been developed for accurate anatomical landmark identification from MRI axial slice data and X-ray images. This method can handle inter-subject variability as well as clinical anatomical differences in bone segmentation.

A framework has been developed to characterise manufacturing as a globally distributed network. The framework integrates multiple geographically referenced information layers pertaining to local impacts (and sustainability) attributed to various life-cycle phases

of a product, and its manufacturing phasetraceability. A Capability Approach based design framework is been developed and tested based on a multi-stakeholder model to define product success and the identification of factors that determine success. The contribution includes an updated design methodology that would increase the chances of product success for the BoP, with a few case studies, including the dissemination of fuel-efficient wood-burning stoves developed at IISc.

## CENTRE FOR SUSTAINABLE TECHNOLOGIES

---

**Staff: Academic: 4; Scientific: 1; Technical: 1**  
**Students: PhD: 26**  
**Degrees Awarded: PhD: 1; MSc (Engg): 2**  
**Publications: 54**

The Centre for Sustainable Technologies (formerly ASTRA – Application of Science and Technology for Rural Areas) is an interdisciplinary research centre pursuing cross-cutting collaborative research in areas of sustainability (forestry and human settlements), carbon sequestration mechanisms, climate change, clean energy technologies, low-energy buildings, climate-responsive architecture, safe water and sanitation, environmental remediation and solid waste management. Researches into clean energy technologies at the centre include bio-methanation and producer gas technologies, high-efficiency biomass stoves and driers, and Building Integrated Photovoltaics (BIPV). Research at CST has always merged sound scientific temper and applied research pertaining to society, environment, energy and natural resources.

The research highlights on diverse areas and contributions in 2014 are as follows:

### REUSE OF INDUSTRIAL MINE WASTE AS SAND SUBSTITUTE

The research explores the suitability of non-organic solid wastes for the production of construction materials. The investigations involved use of iron ore tailings (IOT) as fine aggregate in mortar and concrete, and manufacture of compressed soil blocks.

The R&D results proved that IOT can be used as partial replacement of natural fine aggregate. The concept has been demonstrated through a two storeyed building.

### **STRATEGIES FOR IMPROVING PEAK-TIME PERFORMANCE OF BIPV**

Building Integrated Photovoltaics (BIPV) are buildings were PV as part of the building envelope. Current PV cells exhibit high temperatures (60°C) resulting in lowered efficiency and output. The current research experimentally investigated a strategy of regulating (lowering) cell temperature during cleaning with a recovery of 3% efficiency. The daily influence of temperature on PV performance was found to be more dominant than the daily influence of dust.

### **THERMAL COMFORT IN BUILDINGS**

Based on thermal-comfort studies in IISc Ungra extension centre, the applicability of prevalent International standards (Fangers PMV model) was verified. Despite application of a correction factor, international standards estimated *warm* sensation responses in winter contrary to observed *slightly cool* thermal sensation responses. This concurs with the fact that Europeans are likely to feel warmer in tropical winter conditions as they are more acclimatized to extremely cold climatic conditions.

### **ESTIMATING TRENDS IN INDIAN FOREST COVER**

India has been reporting increase in forest area consistently for the last 15 years. However, our studies reveal that India has been potentially over reporting area under forests and under reporting forest loss. This study attracted public attention and was also discussed in the Parliament. A recent study in the Western Ghats showed that despite large community dependence on forests, there was no negative impact on the biodiversity, carbon stocks and flow of forest products to communities.

### **SAFE LANDFILL DESIGN**

Landfills are commonly adopted for disposal of Municipal Solid Waste (MSW) and hazardous waste. Liner systems prevent leakage of leachate into the subsurface soil and groundwater. The presented study adopts various computational models to evaluate and understand the behaviour of these barrier systems.

The study also includes laboratory investigations to design optimal thickness landfill liners. GIS and Remote Sensing based research also aided the identification of potential landfill sites and associated risks. Further, variations in geotechnical properties with biodegradation and associated settlement and gas production in landfills have been studied at a laboratory scale and appropriate models developed. Mechanical responses of MSW in undrained and drained conditions have been experimentally studied.

### **IN-SITU SOIL BASED NITRATE REMOVAL FROM DRINKING WATER**

Research investigates the process of in-situ denitrification utilizing indigenous soil microbes for nitrate removal from drinking water. The work has two potential strategic areas of implementation- microbial denitrification in sub-soils to mitigate nitrate leaching in vadose zone and on-site heterotrophic denitrification column reactor. The study was based on first order kinetics, where the denitrification rate was aided by increase in incubation temperature, degree of saturation of soil voids and C availability; the optimum C/N ratio for denitrification corresponded to 3. The results make an important contribution in nitrate removal for safe drinking water.

### **BIO-ENERGY RECOVERY FROM BIOMASS**

Anaerobic digesters, as bio-refineries, adopting various bio-resources are being investigated and underlying processes regulated to improve bio-energy recovery from soft biomass under various stressed situations. Attempts are being made to derive several value added by-products such as edible fungi and fiber. Further research includes cost effective removal of N and P (for value added products) and pathogenic bacteria based on Cascaded Algal Plug Flow Reactor (CAPFR).

### **ANAEROBIC WASTEWATER TREATMENT**

Anaerobic digestion as a method to treat low strength grey water under sub-optimal nutrition and frequent exposure to everyday antimicrobials in natural fiber anaerobic bio film reactors as a novel domestic grey water treatment option. Similarly the use of mixotrophic algal consortia under alternating anaerobic-aerobic conditions for wastewater treatment is being explored.



Affordable sanitation: Affordable sanitation technology packages, at a nominal cost of ₹ 11000 each, have been developed for both rural and urban areas based on rammed earth and twin-pit composting model. Nearly 50 of these units have been constructed in Ungra.

#### **MONITORING AND CONSERVING CORAL REEFS**

Coral reefs boast exceptional species diversity and primary productivity akin to rain forests. However, they are poorly protected, highly degraded, and exposed to multiple threats such as in the Gulf of Kutch, India. The remote sensing based study involves time-series data analysis of factors affecting coral reefs for ecosystem monitoring and management.

#### **MONITORING COASTAL WATER QUALITY**

Coastal zones are densely inhabited and subject to various anthropogenic pressures resulting in undesirable changes in coastal water quality. Estimation of chlorophyll-a concentration (as a proxy for phytoplankton) is an important indicator of coastal water quality. The study involves development of regionally tuned empirical algorithms to measure chlorophyll-a concentration using remote sensing techniques.

#### **THERMO-CHEMICAL CONVERSION PROCESS**

Research into biomass based clean fuel technologies includes hydrogen rich syngas production, FT process for liquid fuels, Solid oxide fuel cell evaluation, and Coal gasification. Studies also include modelling of processes for producer gas engines.

#### **ENERGY SECURITY AND EMPOWERMENT THROUGH EFFICIENT BIOMASS STOVES AND DRIERS**

Stoves and driers developed at CST (astra) have the highest field efficiencies around 50% based on an improved mould based construction. These moulds also empower local people to build their own stoves without depending on scarce labour. In addition to the 1.5 million of these stoves, nearly a thousand of these have been disseminated in Karnataka and Madhya Pradesh.

#### **DIVECHA CENTRE FOR CLIMATE CHANGE**

---

##### **Publications: 5**

Satellite observations were used to study the retreat of the glaciers in Bhutan. Multi-model projection of climate change were used to estimate the changes in glacial mass balance in the Himalayas. The bottom topography of the Gangotri glacier was inferred from satellite derived velocities and a simple glacier model. The bottom topography highlights the potential formation of glacial lakes when there is a retreat of the glacier on account of global warming.

The use flexible photovoltaic panels on the roof of railway compartments has been proposed. The use of this technique has been shown to be economically viable and will reduce the Diesel consumption by the Indian railways.



---

## 6.6 Division of Physical and Mathematical Sciences

(Chairperson: Rahul Pandit)

---

The Division consists of the following Departments/Centres:

- Instrumentation and Applied Physics
- Mathematics
- Physics
- Centre for Cryogenic Technology
- Centre for High Energy Physics

### INSTRUMENTATION AND APPLIED PHYSICS

---

**Staff: Academic: 10; Scientific: 6**

**Students: PhD: 81; MSc (Engg): 3; MTech: 7**

**Degrees Awarded: PhD: 9; MSc (Engg): 3; MTech: 8**

**Publications: 71**

Research was carried out on many aspects of instrumentation, materials science, and applied physics. The highlights of this research are given below.

#### RESEARCH HIGHLIGHTS

Highly dense and vertical Zinc oxide (ZnO) nanorods have been synthesized on Platinum (Pt) film coated Si substrates, without any ZnO seed layer, by the solution growth method (SGM). Also, Al doped ZnO nanosheets have been successfully synthesized by using the SGM. These nanorods and nanosheets have potential applications in piezoelectric sensors and energy-harvesting devices. A suitably modified version of a piezoelectric, thin-film-based impact sensor (developed earlier) has been used for detecting adulteration in milk; new, possible applications include the detection of adulteration in liquids like alcohol, petrol, fruit juices, and biomedical fluids. Silicon and stainless steel microneedle arrays for drug-delivery applications have been fabricated. A peristaltic micropump, developed in house, has been integrated, via necessary electronics, with the microneedle array for continuous insulin delivery and monitoring (in collaboration with DESE and CeNSE). Polymer microcantilevers, with embedded thin-film resistors for surface-stress sensing and thermal-actuation studies, have been designed and fabricated. The PVDF nasal-sensor dimensions have been optimized, based on theoretical and experimental results; it has been calibrated by using a MEMS-based

pressure sensor; and the procedure for this calibration has been standardized. The detailed performance of this system for clinical validation has been done in the M S Ramaiah Hospital. An experimental study has been made of the effects of process parameters of a CsI photocathode in the enhancement of the efficiency for a UV photon sensor.

Carbon nanotubes (CNTs) and graphene sheets have been synthesized and used for sensing and actuation-device applications. These include graphene-carbon-nanotube-based conductive networks for photo-detection, mechanical-energy absorption, and chemical and vapor sensors. In addition, work has been performed on the detection of flames by using carbon-nanotube sensors. Experimental studies have been carried out on nanoindentation of graphene and CNT foams; and studies of graphene-based hybrid electrodes for batteries have been initiated.

A highly sensitive humidity sensor, based on carbon nanotubes coated on the surface of an etched fiber Bragg grating (FBG) sensor, has been developed. By using the etched FBG sensor, the reversible and irreversible pH induced transitions in a weak polyelectrolyte system has been probed. A novel, in vivo, non-invasive technique has been employed to determine radial arterial compliance by using the radial arterial pressure pulse waveform acquired by using an FBG pulse recorder. A highly sensitive and accurate biochemical sensor has been developed by using etched FBGs coated with single-walled carbon nanotubes and graphene oxide. Furthermore, a novel FBG-sensor-based strain-sensing plate, for the measurement of planar strain distribution in the human foot, has been developed. In addition, a non-contact method of controlling and monitoring



photomechanical actuation in carbon nanotubes (CNT) has been accomplished by imparting a reversible photo-induced strain to CNT-coated FBGs.

Micro-Raman studies and Alternating Differential Scanning Calorimetric (ADSC) studies have been conducted on as-quenched and annealed  $\text{Ge}_{15}\text{Te}_{80-x}\text{In}_5\text{Ag}_x$  glasses to probe the structural network, its evolution with composition and signatures of the intermediate phase.

In the area of precision measurement and control, a measurement system has been developed to measure directly three-dimensional forces in atomic force microscopy. A strategy has been developed to design and fabricate atomic-force-microscope (AFM) probes with specified eigen-frequencies. This has been subsequently evaluated experimentally. Furthermore, the following have been designed and developed: (a) micromanipulators for multi-axis measurement and control of forces; (b) a pico-liter-volume liquid dispenser, based on electrohydrodynamic pulling; and (c) an opto-electronic profiling and ranging sensor, for the monitoring of perimeters for the detection of intruders in the case of agricultural lands, etc.

Graphene-Sn/SnO composite structures have been developed and studied as anode materials for Li-ion batteries. Titanium nitride and Titanium carbide coatings have also been shown to be good anode candidates for these batteries; and the reaction kinetics have been explained. Silicon nanowires have been grown and plasma treated and it has been shown that the hydrophobicity improves towards superhydrophobicity. Amorphous-silicon thin films have been deposited by different sputtering modes and the microstructure factor has been correlated to the process parameters. Work on 3D batteries and printed batteries has been initiated.

In the area of Nanobioimaging, work was focused on the development new microscopy systems, such as Multiple Light-Sheet Microscopy (MLSM) and Light-Sheet based Nanolithography (LSN) systems. In addition, a Light-Sheet based Imaging Cytometry (LSIC) system and a Real-Time Fluorescence Imaging (RTFI) system were also developed.

In the area of Optics and Microfluidics Instrumentation (OMI), automated, portable, open-platform-technology-based point-of-care (POC) testing devices and instruments have been developed. These novel devices have been used for the diagnosis of sickle-cell anemia, spherocytosis, and malaria. A common reader has been designed to diagnose all these diseases; a replaceable, microfluidic-lab-on-chip (MLOC) cartridge needs to be inserted into the instrument to perform the test.

In the area of semiconductor devices and integrated circuits, a comprehensive solution has been developed for the on-line self-healing of open-circuit faults on printed-circuit boards to improve their lifetime and reliability. In addition, an integrated circuit on flexible substrates has been developed for actuator-interface applications. Furthermore, a method to control a machine by using EEG signals, which is useful for people with disabilities, has also been developed. A novel, field-effect-based water filtration and desalination system has been developed; this system uses a non-uniform electric field and dipole interactions to filter the water efficiently. A notable feature of the compact prototype system that has been developed is that it is easily scalable for the purification of a large quantity of water.

Nonlocal interactions have been brought in to account for the fluctuations in mean-squared displacement obtained from ultrasound-assisted diffusing wave spectroscopy. The corresponding inverse problem has been shown to retrieve mechanical-property changes in malignant tissue, which can point to the growth of tumours, and improve the efficacy of chemotherapy.

A laboratory-model glucose sensor has been developed. Work has also been performed on the realization of solid-electrolyte-based gas sensors, which are suitable for the detection of exhaust gasses from automobiles. An experimental study on the growth and characterization of CIAS and CZTS solar cells has been initiated.

A microsecond-resolution pulse-heating technique has been developed for application in heat-diffusion and emissivity measurements in certain alloys. The method

is rapid (less than 125 microsecond) and can heat the alloy sample up to 2473 K. The system involving temperature measurement and control; has been automated and is available for experimental analysis of exothermic reactions involving phenolic resins and gas phase reactants.

Software packages for (a) a robot-linkage mechanism and (b) radiation-shape-factor calculations have been developed and made available for the public through the Matlab central library. The demand for these has exceeded 15,000 downloads.

## MATHEMATICS

---

**Staff: Academic: 20**

**Students: PhD: 24; Int PhD: 18**

**Degrees Awarded: PhD: 7**

**Publications: 45**

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 couple of years, and new research areas have been established in the Department. Highlights of research performed over the past year are as follows:

### RESEARCH HIGHLIGHTS

Risk-sensitive control of continuous-time Markov chains on a countable state space and compact action set has been studied. The existence of an optimal control has been established via the corresponding Poisson equation.

It is important to understand the effect of measurement noise on estimating causal relations between time series. The analytical dependence of Granger causality on various noise-dependent system parameters was obtained.

The chaotic behavior of the heat semi-group on weighted  $L^p$  spaces on  $\mathbf{R}^n$  has been studied; and the same has been investigated in the Dunkl set up. Mixed-norm estimates for Riesz transforms and Bochner-Riesz means for the Dunkl harmonic oscillator have been obtained. The boundedness of Hermite pseudo-multipliers has been studied.

The penalty method of Babuska has seen interesting applications recently in the context of optimal control problems with Dirichlet boundary control. Also the penalty method is useful in the approximation of nonhomogeneous, Dirichlet, boundary-value problems. Motivated by this, Babuska's penalty method has been revisited. Optimal rate a priori error estimates and geometric multigrid (W-cycle and V-cycle) algorithms have been derived. Since the penalty method exhibits high condition number, a diagonal pre-conditioner has been constructed in the analysis. A  $C^0$  interior penalty method for an optimal control problem, governed by a fourth order partial differential equation (PDE) and with control constraints, has been proposed and analyzed. Therein, both a priori and a posteriori error estimates have been derived under realistic regularity conditions.

A family of domains, each of which is a generalization of the tetra block to higher dimensions, was introduced. Various characterizations of these domains were derived. A full description of when a problem in mu-synthesis (mu-synthesis being the original motivation for introducing these domains) is ill-conditioned was established.

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. This was used to show that a concept of dominance introduced by Gromov is, when restricted to compact complex manifolds, a partial order.

The homogenization of an initial and boundary value problem, for a doubly-nonlinear system in the context of maximal monotone operators, has been studied; the inclusions have been formulated as null-minimization principles via the theory of Fitzpatrick. In the limiting case, a two-scale formulation has been obtained and a (single-scale) homogenized problem has then been retrieved. The method of unfolding has been used to study optimal control problem in a domain with an oscillating boundary. Neumann conditions on the oscillating part of the boundary have been considered and it has been shown that the result is more interesting than in the case of Dirichlet conditions. Here the limit problem consists of two parts, namely, the lower and



upper parts, with appropriate interface conditions. Two cost functionals, namely, the  $L^2$  and Dirichlet cost functionals have been considered; interior and boundary unfolding operators have been introduced in the process.

The following results have been obtained: (a) If a closed triangulated 3-manifold is tight neighbourly then it is locally stacked and tight with respect to all fields. (b) If a triangulated closed 3-manifold is tight with respect to some field of odd characteristic then it is stacked. (c) A connected triangulated manifold without boundary is stacked if and only if it can be obtained from a stacked sphere by a finite sequence of combinatorial handle additions. (d) For a field  $F$ , let  $M$  be an  $F$ -tight closed triangulated manifold of dimension  $d > 3$ . If  $\beta_i(M; F) = 0$  for  $1 < i < d - 1$ , then  $M$  is locally stacked.

In the broad area of Probability theory and, more specifically, in the zeros of random functions and eigenvalues of random matrices, a conjecture of Thomas Lam about the limiting direction of a random walk in the affine root system  $A^n$  has been proved. A far-reaching generalization of Warrington's juggling process has been introduced; and results about their stationary distribution, recurrence and mixing times have been proved. The random-to-random card-shuffling algorithm to linear extensions of an arbitrary poset have been generalized; and a conjecture has been presented for the spectral gap of the Markov chain.

A few problems of practical interest have been investigated. These include effects of melting on natural, convective, boundary-layer flow over a horizontal plate embedded in a porous medium saturated with a non-Newtonian nanofluid, transient natural convection flow in a rectangular cavity filled with a porous material, with localized heating from below and thermal stratification, natural convection heat and mass transfer from a sphere in non-Newtonian nanofluids, mixed convection with thermal radiation in a vertical pipe with partially heated or cooled wall, mixed convective boundary layer flow over a vertical wedge embedded in a porous medium saturated with a nanofluid, and steady mixed convection flow of Maxwell fluid over an exponentially stretching vertical surface with magnetic field and viscous dissipation.

Work is going on in the representation theory of matrix groups over local rings and of finite dimensional Artin algebras.

It is proposed to investigate the algebraic geometric properties of the Burnside algebra  $B(G)$  of a finite group  $G$ . A key ingredient of this investigation will be the construction of explicit efficient algorithms for computing Burnside rings and checking their properties, thereby enabling the computation of complicated examples and providing new insights.

## PHYSICS

---

**Staff: Academic: 29; Scientific: 6; Technical: 1**  
**Students: PhD: 159; Int PhD: 65**  
**Degrees Awarded: PhD: 26**  
**Publications: 135**

### RESEARCH HIGHLIGHTS

Faculty members in the Department of Physics continues to push the frontiers of state-of-the-art physics research in specific areas of experimental and theoretical condensed matter physics, astrophysics, atomic and optical physics, and biophysics.

In the area of soft matter physics, significant results have been achieved in the past year. Current interest in this field has been focused on the behaviour of large numbers of self-propelled objects, called active matter. The self-organized motion of vast numbers of creatures in a single direction is a spectacular example of emergent order. This phenomenon has been recreated by using actuated nonliving components. Millimeter-sized tapered rods, rendered motile by contact with an underlying vibrated surface and interacting through a medium of spherical beads, undergo a phase transition to a state of spontaneous alignment of velocities and orientations above a threshold bead-area fraction. Theory and experiment agree on the structure of the observed phase diagram in the plane of rod and bead concentrations and power-law spatial correlations occur near the phase boundary.

The physics of glassy materials is another challenging field. Recent research work, done in collaboration with

a group at JNCASR, has resulted in direct experimental signatures of a nonequilibrium phase transition associated with the yield point of a prototypical soft solid—a binary colloidal glass. By simultaneously quantifying single-particle dynamics and bulk mechanical response, the threshold for the onset of irreversibility has been identified with the yield strain and the relaxation time has been extracted from the transient behavior of the loss modulus; and it has been found that it diverges in the vicinity of the yield strain. In related work, it has been shown, by using video microscopy and holographic optical tweezers, that Dynamical Facilitation (DF) in a colloidal glass-forming liquid grows with density as well as the fraction of pinned particles. In addition, it has been observed that heterogeneous dynamics in the form of string-like cooperative motion emerges naturally within the framework of facilitation.

Especially when they are combined with other materials, polymers show fascinating properties that can be used in novel applications. Investigations have revealed that confinement enhances dispersion in nanoparticle-polymer blends films. While the grafted molecular weight of nanoparticle is much smaller than that of a matrix in a PNC film, a thicker film shows segregation of particles on the surface and film-substrate interface of the film. However, a reduction in film thickness (comparable to the radius of gyration of the matrix chains) leads to a clear homogenization of the particle density into the film; this has been quantified from the electron density profile, along the film thickness, extracted from the XR profile. If the ratio of the grafted polymer molecular weight and matrix polymer molecular weight, represented by  $f=M_g/M_m$ , increases, then the film (even one with high thickness) becomes almost homogeneously dispersed.

Computer simulations are a powerful tool for exploring the dynamics of nanosystems. By using molecular-dynamics simulations on multi-core cluster computers, the effective interaction between nanostructures has been investigated in order to come up with novel designs, which can control the interaction. As an example, a detailed potential of mean force (PMF) between PAMAM dendrimers has been carried out by using umbrella sampling to investigate the nature of effective interactions between dendrimers. This is very

important since PAMAM dendrimers are frequently used as self-assembly reagents. Next, PAMAM dendrimers have been used to control the interaction and distance between gold nanoparticles and to demonstrate how the effective interaction between the gold-nanoparticle-dendrimer nanocomposites can be tuned by changing the concentration and protonation level of the dendrimers. Subsequently, the applicability of ssDNAs to assemble the dendrimers has been explored. It has been shown that ssDNA can be used efficiently to control the inter-dendrimer distance in the self-assembled DNA-dendrimer structure.

Computer simulations have also been used effectively for *in silico* studies of the effects of (a) mechanical deformation of cardiac tissue and (b) early after depolarizations (EADs) on spiral-wave dynamics. These studies have been carried out by using state-of-the-art mathematical models for cardiac tissue and are of relevance to the development of low-amplitude defibrillation schemes for the control of life-threatening arrhythmias such as ventricular fibrillation. The statistical properties of two-dimensional superfluid turbulence have been studied extensively by carrying out direct numerical simulations of the Gross-Pitaevskii and Hall-Vinen-Bekharevich-Khalatnikov equations.

In the area of biocystallography and biophysics, significant advances have been made in understanding the structure and function of biologically relevant proteins. As an example, the nucleoid associated protein HU plays an important role in the maintenance of chromosomal architecture and in global regulation of DNA transactions in bacteria. Although HU is essential for growth in *Mycobacterium tuberculosis* (Mtb), there have been no reported attempts to perturb HU function with small molecules. The crystal structure of the N-terminal domain of HU from Mtb has been determined. A core region within the HU-DNA interface, which can be targeted using stilbene derivatives, has been identified. These small molecules specifically inhibit HU-DNA binding, disrupt nucleoid architecture, and reduce Mtb growth. The stilbene inhibitors induce gene-expression changes in Mtb that resemble those induced by HU deficiency. The results indicate that HU is a potential target for the development of therapies against tuberculosis.



The department continues its strong tradition of focused research in emerging areas of condensed matter theory. By using dynamical mean field theory (DMFT) studies of the ionic Hubbard model (IHM), it has been shown that doping of correlated band insulators provides a novel route to half metallicity. For the IHM a detailed phase diagram, showing the region of stability of the half-metallic phase, has been determined. A theory of the Feshbach resonance between atoms in a synthetic gauge field has been developed. The main points uncovered include a shift of the Feshbach field (this has been subsequently verified in an experiment at NIST), centre-of-mass-momentum-dependent interactions between atoms, and the need for a wide Feshbach resonance to realize the rashbon state. Studies have also been carried out on beating the entropy problem of lattice fermions in cold-atom system and a new scheme, based on a holographic optical lattice, has been proposed.

Experimental research in the low-temperature physics of matter continues to expand in the Department with the addition of new faculty members and several sophisticated cryogenic facilities. In the past, the investigation of two-dimensional electron systems (2DES) has revealed several interesting physical phenomena, such as Wigner crystallization, integral and fractional quantum Hall effects, and many more. This has been primarily achieved with two different model experimental systems, covering two distinct, non-overlapping regimes of the 2DES phase diagram, namely, the quantum-liquid phase obtained in semiconducting heterostructures, and the classical Wigner solid and fluid phases observed for electrons confined above the surface of liquid helium. To bridge this gap in the phase diagram of 2DES, as well as to study the properties of electrons on curved flexible surfaces, multielectron bubbles (MEBs) in liquid helium offer an exciting possibility, although this has been limited because all experimental studies have so far been transient in nature. In recent work, it has been possible to trap and manipulate MEBs in a conventional Paul trap for several hundreds of milliseconds, and thereby obtain reliable measurements of their physical properties. Interestingly, the surface charge density of a single MEB

can vary by a large amount during the course of one measurement, which in conjunction with the intrinsic curvature of the bubble surface can provide insights into previously unexplored aspects of 2D electron systems.

The development of new experimental tools and techniques, especially with an eye on novel applications, is also the focus of research in the Department. An instrument for carrying out direct three-dimensional image reconstruction of a model, based on diffuse optical tomography (DOT) and by using a single source and a single detector, has been developed. In this study, the discretized 3D diffusion equation has been solved by the finite-element method (FEM) with Robin boundary conditions. The model-based iterative-image-reconstruction method (MOBIIR) has been employed for reconstruction by using experimental data from multiple measurement planes. The conventional Gauss-Newton approach takes approximately 20 hours for a single iteration. A faster approach, based on the Broyden method, has been attempted and implementation for both 2-D and 3-D models has been effected. In order to speed up the algorithm, parallel-computing approaches, based on CUDA, are being probed.

The Department also has a strong research activity in specific areas of astrophysics. In the field of galactic dynamics, significant results have been achieved in the last year. The local stability of an astrophysical disk supported by rotation and pressure is given by the classic Toomre Q criterion. This criterion is shown to be modified for a typical galactic disk embedded in a dark-matter halo. The unperturbed rotational speed is higher on inclusion of the external halo potential, and this significantly increases disk stability. The halo is shown to be crucial in ensuring local stability of all galactic disks. This idea is then applied to the special case of low-surface-brightness galaxies, where the dark matter halo dominates at all radii starting from the inner regions. This is shown to explain naturally the suppression of star formation and spiral structure, which has been observed. In solar physics, the knowledge gained from dynamo models of the sunspot cycle has been used to probe various characteristics of the Sun and to understand solar cycles.

## CENTRE FOR CRYOGENIC TECHNOLOGY

---

**Staff: Academic: 1; Scientific: 2**

**Publications: 14**

Research was carried out on many aspects cryotechnology. The highlights of this research and the facility activities of this Centre are given below

### FACILITY ACTIVITIES

The Centre has dedicated its services mainly to produce and supply cryogens for all the low- temperature activities in the Institute. To support this objective, the Centre is equipped with two liquid-nitrogen and two liquid-helium plants. This year, approximately 4,25,000 liters of liquid nitrogen and about 55,000 liters of liquid helium have been supplied to users

### RESEARCH ACTIVITIES

Experimental studies of the pressure-wave generator, funded by the Space Technology Cell (STC), were completed. Optimisation studies, to increase the cooling power at 80 K, were carried out with a novel stacked regenerator with a thin wall thickness. The mass flow in the pulse-tube cooler was measured by using a calibrated hot-wire anemometer.

A pulse-tube cryocooler, for a small-scale helium-recondensation system, was designed and developed for the project funded by the Department of Science and Technology (DST). A no-load temperature of 40K was achieved.

The liquid-level-sensor calibration activities for ISRO are being continued to calibrate the level sensors of LH<sub>2</sub> and LOX. One level sensor has been successfully calibrated by using an eleven- point calibration system. A light-weight high-temperature-superconductor-based liquid-level sensor for LOX has been developed and calibrated, with the standard liquid-level sensor, to predict the linearity in various levels of LOX and LN<sub>2</sub>. A special four-wall cryostat has been fabricated for conducting LOX-based experiments successfully.

A temperature-sensor-calibration system, developed many years ago, has been dedicated for the use of the

Indian Space Research Organisation (ISRO). By using this facility, it is possible to calibrate the temperature sensors from room temperature down to 4.2K. This year nearly 90 sensors have been calibrated and delivered to LPSC, Mahendragiri.

An experimental set up has been developed for the measurement of thermal conductivity of various materials in the range of 300 – 4.5 K. The system consists of a Janis variable-temperature liquid-helium cryostat along with necessary instrumentation; and the data acquisition is done by using the LabVIEW software.

Under a BRNS-sponsored project, liquefaction and recondensation of helium gas at room temperature has been successfully carried out by using a two-stage GM cryocooler. The incoming helium gas is precooled in the first stage of the cryocooler by using a heat exchanger. Subsequently, it is cooled by a heat exchanger mounted on the second stage before condensing into the liquid-helium collection vessel. An approximate liquefaction rate of 3.5 litres/hour has been achieved.

A cryotribometer has been designed and developed to determine the tribological properties of polytetrafluoroethylene (PTFE) at cryogenic temperatures. This unit can be used to conduct experiments to study wear properties of any material both at room and cryogenic temperatures.

### NEW FUNDING AND PLANNED FUTURE RESEARCH AREAS OF THE DEPARTMENT

Since the beginning, the Centre has been upgrading its infrastructure to support its plant-related activities; at the same time it has focused equally on research. Experimental research studies will continue in the area of cryocoolers, vortex -tube studies, the determination of mechanical properties of materials at cryogenic temperatures, etc. The supply chain of liquid helium will be extended to new research laboratories that require liquid helium. Both the liquid-helium plants will be technically upgraded soon by incorporating external purifiers, recovery compressors, and purity monitors. These steps will enhance both the quality of production and the supply of liquid helium to users.



## CENTRE FOR HIGH ENERGY PHYSICS

---

**Staff: Academic: 10**

**Students: PhD: 11; Int PhD: 4**

**Degrees Awarded: PhD: 2**

**Publications: 48**

Research was carried out on many aspects of particle phenomenology, field theory, string theory, theoretical condensed-matter physics, and quantum computing and quantum information. The highlights of this research are given below.

### RESEARCH HIGHLIGHTS

A periodic driving of a system of hard-core bosons was shown to localize them for certain values of the system parameters. It was shown that a combination of magnetic fields and potentials can confine electrons on the surface of a topological insulator to certain regions, thus making it possible to design wave guides. The different phases of Heisenberg spin-1/2 and spin-1 chains, with alternating ferromagnetic and antiferromagnetic interactions, were found. It was shown that quantum systems with topological symmetries can exhibit topological blocking; this is a phenomenon in which the system, starting in the ground state at one time, is unable to remain in the instantaneous ground state when one of the parameters in the Hamiltonian is slowly changed in time. Periodic driving of some of the parameters of the Kitaev model (a spin-1/2 system on a honeycomb lattice with highly anisotropic couplings) was shown to generate Majorana modes on the edges of the system. States confined at the edges lying between two surfaces of a topological insulator were studied.

Research has focused on quantum mechanics, entanglement entropy in the context of gauge/gravity duality, the calculation of transport coefficients of a strongly coupled anisotropic plasma, and aspects of the conformal bootstrap. In the area of quantum mechanics, it has been shown that the usual application of the superposition principle to explain slit-based interference phenomena is not completely correct; and one can calculate an experimentally measurable quantity that is non-zero if non-classical paths contribute (paper

featured as a focus article in Physical Review Letters). One-, two- and three-point functions for a very general conformal field theory with a gravitational dual have been computed. Two other papers have focused on using the positivity of the relative entropy in quantum information, in the context of holography, to constrain nonlinear terms in the metric and hence try to see if the gravity equations lead to Einstein gravity or not.

Research was carried out in the areas of linear-collider physics, with emphasis on signals for new physics in di-boson production, and the effects of new physics in Yukawa-coupling measurements. The former was studied with the view of looking at spin-momentum correlations in the presence of either transverse or longitudinal polarization. Work was carried out in evaluating the two-pion contribution to the muon anomalous magnetic moment by using the method of unitarity bounds and also improving the omega-pi form factor

Research focused on cosmological-singularity resolution in string theory, in the tensionless limit, where the theory is expected to be in a symmetry-unbroken phase. Strong evidence was provided that, in this limit, string theory can resolve these singularities. In another line of work, it was demonstrated that the non-linear instability of gravity in AdS spaces can be modeled, to a surprising degree, by using a much simpler system, namely, a scalar field in AdS. Certain conserved quantities were identified for this simpler system; these were later identified also in the gravity case by others. A generalization of general relativity was constructed; this might be of phenomenological relevance in understanding dark-sector cosmology.

The implications of the discovery of the Higgs boson on various Physics-Beyond-Standard-Models were investigated by concentrating, in particular, on supersymmetric theories. It was found that two solutions exist to gauge-mediated supersymmetric theories, which have problems with the discovery of the Higgs mass at 125 GeV. A full phenomenological analysis of two Higgs-doublet models was presented; it was shown that only one particular class of these models survives after all the present data are taken in to consideration.

Optimisation of quantum-Hamiltonian evolution has been studied, with respect to the specified output precision. It has been shown that it is possible to make the computational complexity polylogarithmic in the output precision, by modifying the Lie-Trotter formula so that it is accurate even with large step size. The algorithm uses a projection-operator decomposition of the Hamiltonian, superposed evaluation of multiple contributions and elimination of residual error by error-correcting codes. The technique can be used to improve many importance-sampling methods.

A formalism has been developed to describe the evolution of a quantum state during individual weak-measurement events. This fills a gap in the conventional framework of quantum mechanics, which only predicts probabilities of various outcomes over many experimental runs. The proposed equation for the projective collapse of the quantum state preserves pure states and has eigenstates of the measurement interaction as its fixed points. Its predictions for the ensemble evolution are different from those of the Born rule, and it is an open question whether or not suitably designed experiments can observe this alternative evolution.

Research was carried out in the following topics related to the AdS/CFT duality: Finite-size corrections to the Renyi entropies of 2d-free-boson and free-fermion CFT on the torus were evaluated. These corrections were precisely shown to agree with those obtained in holography. It was shown that leading corrections to entanglement entropies, because of a spin-3 chemical potential, are universal. These corrections were again shown to agree with a proposal in holography.

Spinning-string solutions in AdS<sub>3</sub>, with NS flux, were studied and it was shown that they were related to minimal surfaces.

Studies were carried out of perturbative as well as non-perturbative properties of non-commutative quantum field theories. The role of quantum ambiguity in understanding the definition of entropy was examined. The effects of Lorentz violation in the non-perturbative structure of quantum electrodynamics were studied.

Studies of new-physics phenomenology were carried out. In particular, the search strategies in present and upcoming colliders were examined along with the associated jet rate, which can be used to improve the separation between quark/gluon initiated jets. The detection strategies for Higgs bosons in the supersymmetric (SUSY) model were also investigated.

In Higgs physics and SUSY, innovative and new methods, using jet-substructure techniques, were used to study CP violation in the HVV coupling via VH production at the LHC. Special methods were developed to obtain allowed regions in the parameter space of CP-violating supersymmetric models, in spite of the new, stringent constraints on the electric dipole moment of the electron. Implications of the data on Higgs rates were analysed for models with Vector-Like Fermions; improved bounds were also obtained on the MSSM parameter space, implied by considerations of color and charge-breaking minima and the data on Higgs rates. Simultaneous probes of top polarization and anomalous Wtb coupling at the LHC were developed. In quantum chromodynamics (QCD) predictions were obtained for the transverse-spin asymmetries expected in charmonium production, stable against theoretical QCD uncertainties, which can probe the Gluon Sivers function in the collisions of electrons with transversely polarized protons.

---

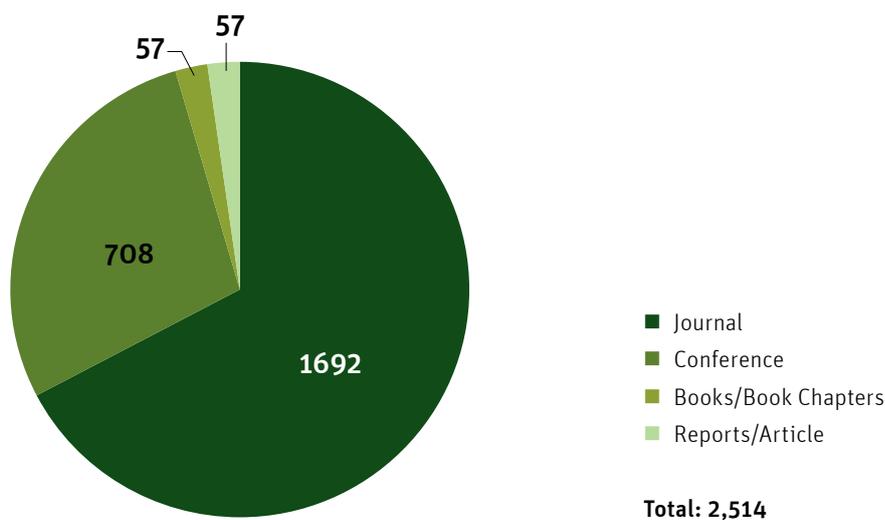
## 6.7 Research Publications

---

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 numbers of publications including research papers/conference proceedings/reviews/reports/books/book chapters are given below:

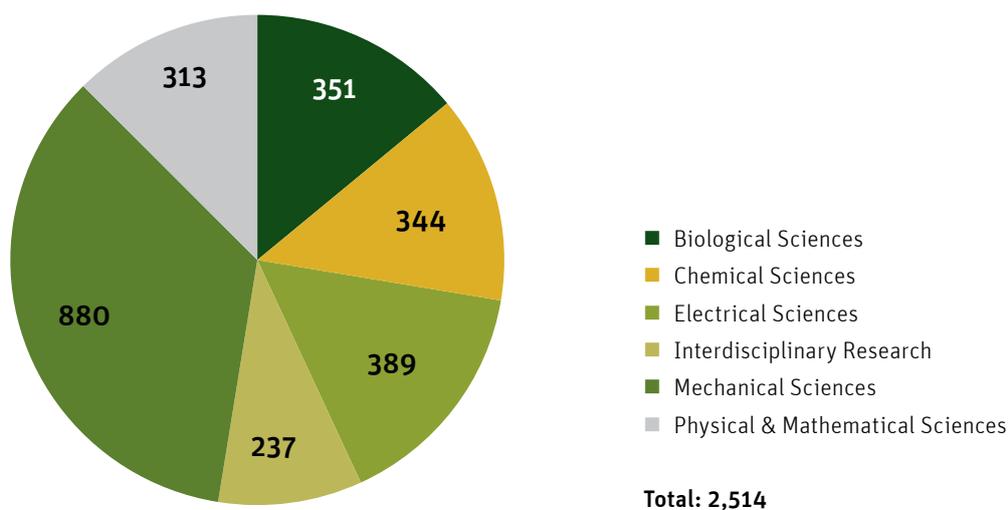
### RESEARCH PUBLICATIONS 2014-15

---



### RESEARCH PUBLICATIONS 2014-15 – DIVISIONAL BREAK-UP

---



## 6.8 Programmes and Courses

### RESEARCH

□ PhD   ♦ Int. PhD   ⊙ MSc (Engg)

#### Science

Biochemistry	□	♦
Ecological Sciences	□	♦
Microbiology and Cell Biology	□	♦
Molecular Biophysics	□	♦
Molecular Reproduction Development and Genetics	□	♦
Neurosciences	□	
Inorganic and Physical Chemistry	□	♦
Materials Research	□	♦
Organic Chemistry	□	♦
Solid State and Structural Chemistry	□	♦
Mathematics	□	♦
Physics	□	♦
Astronomy and Astrophysics	□	♦
High Energy Physics	□	♦
Earth Sciences	□	○
Interdisciplinary Programme	□	
Undergraduate Programme		+

### COURSES

● ME   ○ MTech   ∅ MDes   ❖ MMgt   + BSc (Research)

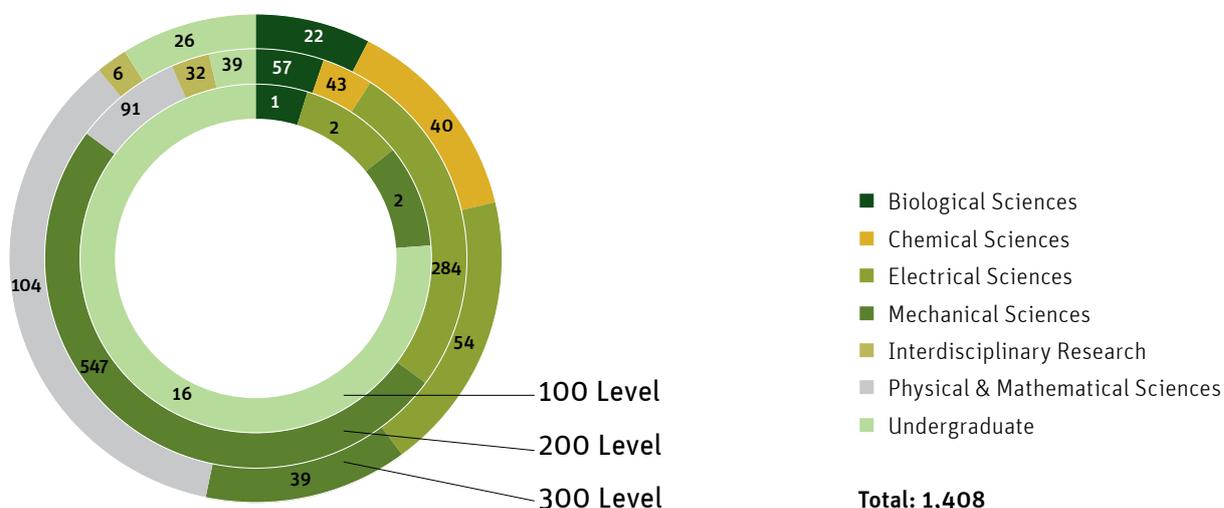
#### Engineering

Energy Research	□		
Computer Science and Automation	□	⊙	●
Electrical Engineering	□	⊙	●
Electrical Communication Engineering	□	⊙	●
Electronic Systems Engineering	□	⊙	● ○
Aerospace Engineering	□	⊙	●
Chemical Engineering	□	⊙	●
Mechanical Engineering	□	⊙	●
Materials Engineering	□	⊙	●
Product Design and Manufacturing	□	⊙	∅
Atmospheric and Oceanic Sciences	□	⊙	○
Civil Engineering	□	⊙	● ○
Management Studies	□	⊙	❖
Nano Science & Nano Technology	□		○
Instrumentation	□	⊙	○
Supercomputer Education and Research	□	⊙	○

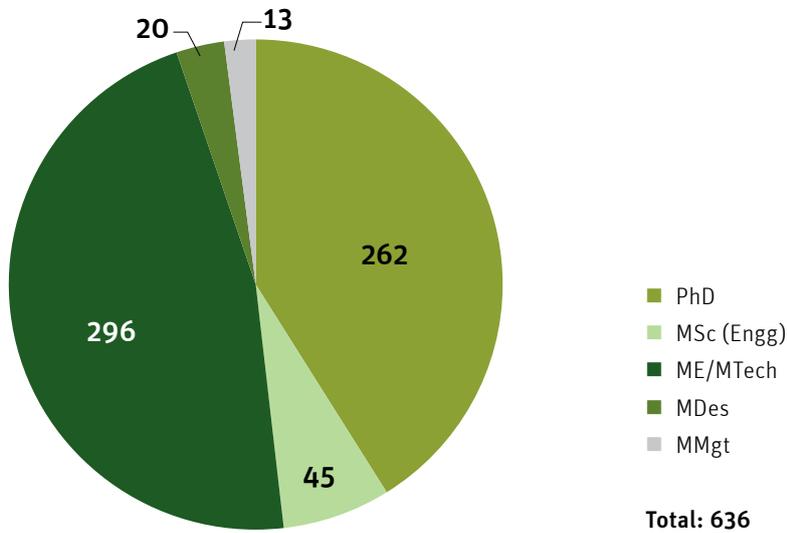
### COURSES

Teaching Courses are offered from 100 level to 300 level for undergraduate, postgraduate and advanced research topics.

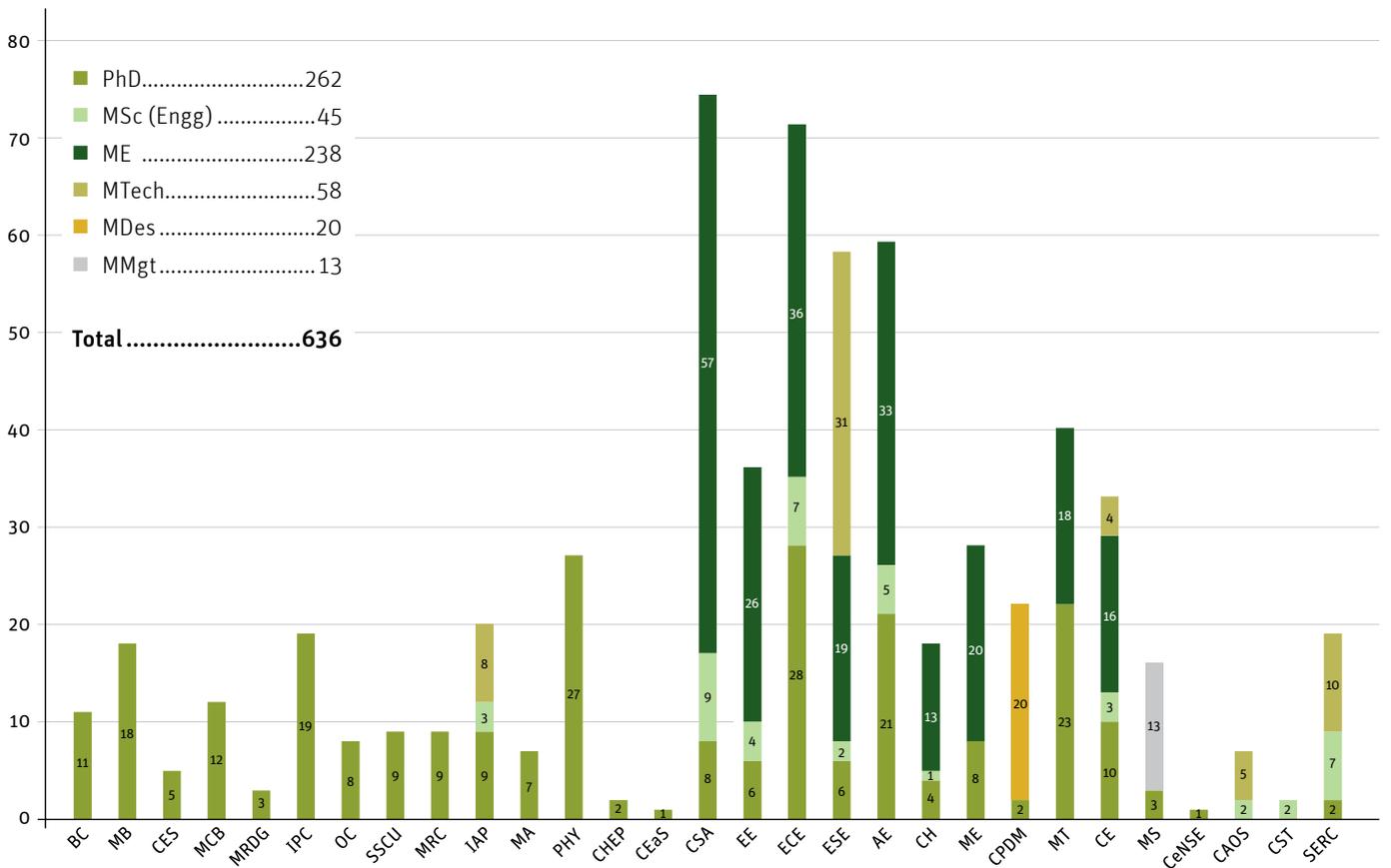
### COURSES OFFERED 2014-15



## 6.9 Degrees Awarded



## DEGREES AWARDED 2014-15



---

## 6.10 Research Conferments: PhD, MSc (Engg)

---

### Doctor of Philosophy (PhD)

#### BIOCHEMISTRY

---

1. **Mr Sujay Ramanathan:** Anti-proliferative and apoptosis-inducing activities in cancer cells by the secondary metabolites of endophytic fungi isolated from *Catharanthus roseus*
2. **Ms Josyula Nitya Kalyani:** Structure-function relationship of Diaminopropionate amonialyase (DAPAL) – a PLP dependent enzyme and its interaction with pyridoxal kinase
3. **Mr Shwetank:** Infection of human cell lines by Japanese Encephalitis Virus: Increased expression and release of HLA-E, a non-classical HLA molecule
4. **Ms Hima Rani S:** Implications of Soluble Diacylglycerol Acyltransferases in Triacylglycerol Biosynthesis of Yeast and Plants
5. **Mr Rishi Kumar N:** Insights Into the *Trans*-splicing Based Expression of Heat Shock Protein 90 in *Giardia lamblia*
6. **Mr Devanjan Sinha:** Unraveling the intricate architecture of human mitochondrial presequence translocase – Insights on its evolution and role in tumourigenesis
7. **Mr Bhagawat S Chandrasekar:** Studies on Novel Functional Responses of Mouse Peritoneal Macrophages to Interferon-gamma: Roles of Nitric Oxide Synthase 2
8. **Ms Mrinal Srivastava:** Identification of an Inhibitor of Nonhomologous DNA End Joining: Role in DNA Repair and Cancer Therapeutics
9. **Mr Manish Grover:** Understanding the Heat Shock Response pathway in Plasmodium falciparum and Identification of a novel exported Heat Shock Protein

10. **Ms P Divyaanka Iyer:** Role of Mitochondria in Cancer: G-quadruplex Structures at Fragile Regions of the Mitochondrial Genome and a Novel Mode of BCL2 Inhibition in Cancer Therapeutics
11. **Mr Gautam Pareek:** Understanding the dynamic organization of the presequence-translocase in translocation of preproteins across mitochondrial inner membrane

#### MICROBIOLOGY & CELL BIOLOGY

---

12. **Mr Rupesh Kumar:** DNA gyrase and topo NM from mycobacteria: Insights into mechanism & drug action
13. **Mr Vijay S:** Ultrastructural and Molecular Analyses of the Unique Features of Cell Division in Mycobacterium tuberculosis and Mycobacterium smegmatis
14. **Ms Deshpande Swati Martand:** Study of Rpb4, a Component of RNA Polymerase II as a Coordinator of Transcription Initiation and Elongation in *S. cerevisiae*
15. **Mr Imtiyaz Ahmad Khanday:** Target Genes and Pathways Regulated by *OsMADSI* during Rice Floret Specification and Development
16. **Mr Debjit Khan:** Interaction of Cellular Proteins with p53 IRES: Implications in Regulation of Translation of p53 mRNA
17. **Mr Anirban Mitra:** Insights into occurrence and divergence of Intrinsic Terminators and Studies on Rho-dependent termination in *Mycobacterium tuberculosis*
18. **Mr Jamma Trinath:** Mechanistic and functional insights into *Mycobacterium bovis* BCG triggered PRR signaling: Implications for immune subversion strategies



19. **Mr Sudhanshu Kumar Shukla:** Role of DNA methylation in glioblastoma development
20. **Ms Sangeeta Chakraborty:** Multi factorial Regulation of Virulence and Survival by a Novel Enzyme “Lactoylglutathione lyase” in *S. Thphimurium*
21. **Ms Priyanka Tare:** Transcription Initiation and its regulation in *Mycobacterium tuberculosis*
22. **Mr Divya Prakash G Aug:** From transformation to therapeutics: Diverse biological applications of shock waves
23. **Ms Iyer Namrata Ramchandran:** Racemases in *Salmonella*: Insights into the dexterity of the pathogen

## MOLECULAR REPRODUCTION, DEVELOPMENT AND GENETICS

---

24. **Mr Nishad Matange:** Moonlighting functions of the Rv0805 phosphodiesterase from *Mycobacterium tuberculosis*
25. **Mr Mohammed Iqbal Rather:** Transcriptional and posttranscriptional regulation of the tumor suppressor *CDC73* in oral squamous cell carcinoma: Implications for cancer therapeutics
26. **Mr Ankur Sharma:** Unfolding the Mechanism of Notch1 Receptor Activation: Implications in Cancer Stem Cell Targeting

## MOLECULAR BIOPHYSICS UNIT

---

27. **Ms Shveta Bisht:** Structural and functional studies on Pyridoxal 5' -phosphate dependent Lyases and Aminotransferases
28. **Ms Sreejata Chatterjee:** Effect of the stress hormone corticosterone on synaptic transmission and astrocytic release
29. **Mr Amit Kumar Verma:** Elucidating the role of MsRbpA in rifampicin tolerance and transcription regulation of *Mycobacterium smegmatis*
30. **Mr Rustam Ali:** Deciphering Structure-Function Relationships in a *two-subunit-type* GMP Synthetase by Solution NMR Spectroscopy
31. **Ms Neelanjana J:** Structural studies on thiolases and thiolase-like proteins
32. **Mr Senthil Kumar DK:** Structural and conformational features of RNA duplexes
33. **Mr Bhaskara Ramachandra Moorthy:** Structure, Stability and Evolution of Multi-domain proteins
34. **Mr Deivanayaga Barathy V:** Structural studies on mycobacterial aspartic proteinases and adenylyl cyclases
35. **Ms Piyali Saha:** Protein Engineering of HIV-1 Env and human CD4
36. **Ms Paramita Sarkar:** Resurrection of omega: the smallest subunit of bacterial RNA polymerase
37. **Mr Nirnath Sah:** GABA<sub>A</sub> receptor mediated phasic and tonic inhibition in subicular pyramidal neurons
38. **Mr Vikas Navratna:** Structural and biochemical characterization of proteins involved in peptidoglycan synthesis in gram-positive bacteria
39. **Ms Shukla Jinal Kaushikkumar:** Understanding the regulatory steps that govern the activation of *Mycobacterium tuberculosis*  $\sigma^k$
40. **Mr Sanchari Banerjee:** Structural studies on bacterial adenylosuccinate lyase and *Sesbania mosaic virus* protease
41. **Mr Anurag Pandey:** Spike- Timing- Dependent- plasticity at excitatory synapses on the rat subicular pyramidal neurons
42. **Ms Arti Tripathi:** Determinants of stability, structure and function of the bacterial toxin CcdB
43. **Mr Indra Mani Sharma:** Dissecting the C-DI-GMP Signaling Pathways: Tools and Tales
44. **Ms Rakshambikai R:** Structural and Evolutionary Analyses of Signalling Proteins With Special Reference to Protein Kinases

## CENTRE FOR ECOLOGICAL SCIENCES

---

45. **Mr Ishan Agarwal:** Biogeography and Systematics of bent-toed geckos (Squamata: Gekkonidae)
46. **Mr S P Vijayakumar:** Insights into an Evolutionary Radiation: Causes and Consequences of Diversification in the Western Ghats Bush Frogs
47. **Ms Joysree Chanam:** A Farewell to Arms: *Dynamics of interactions between the unique semi-myrmecophyte Humboldtia brunonis (Fabaceae) and its domatia inhabitants in the absence of a universal protection mutualism*
48. **Mr Hari Sridhar:** Causes and Consequences of Heterospecific Foraging Associations in Terrestrial Bird Communities
49. **Ms Nandita Mondal:** Fire Ecology of a Seasonally Dry Tropical Forest in Southern India

## INORGANIC AND PHYSICAL CHEMISTRY

---

50. **Mr Dipak Samanta:** Self-Assembled Coordination Cages for Catalysis and Proton Conduction
51. **Mr P Chinna Ayya Swamy:** Design and Syntheses of Triarylborane Decorated Luminescent Dyes; Intriguing Optical Properties and Anion Sensing Applications
52. **Ms Rekha Gautam:** Vibrational Microspectroscopic Studies of Biomedical Conditions using Model Systems
53. **Ms Deepika Janakiraman:** Path Integral Approach to Levy Flights and Hindered Rotations
54. **Mr Devendra Mani:** Microwave Spectroscopic and Atoms in Molecules Theoretical Investigations on Weakly Bound Complexes: From Hydrogen Bond to Carbon Bond
55. **Mr Bhabatosh Banik:** Photocytotoxic Oxovanadium (IV) Complexes of Terpyridine Ligands for Imaging and Therapy
56. **Ms M Umayal:** Biomimetic Studies on Tyrosine- and Phenolate-based Ligands and their Metal Complexes
57. **Mr Barun Bera:** Influence of ancillary ligands in the chemistry of transition metal  $\sigma$ -complexes
58. **Ms Sthitaprajna Dash:** Electrocatalytic Oxidation of Organic Molecules on Nanostructured Metals on PEDOT Surface
59. **Mr Saptarshi Chatterjee:** Hyperbranched Polyacetals and Polydithioacetals
60. **Ms Puja Prasad:** Studies on Near-IR Light Photocytotoxic Oxovanadium Complexes
61. **Mr Sandip Mukherjee:** Serendipitous Assembly of 3d Metal-ion Polyclusters: Structures, Magnetic Behavior and Theoretical Studies
62. **Mr P Arun Kumar:** Mechanistic Investigation of Metal Promoted Nucleophilic Additions
63. **Mr Patil Yogesh Prakash:** Syntheses and Structure Elucidations of Ternary Metal (Cu/Co) Complexes with Nucleic Acid Constituents
64. **Ms Neha Arora:** Rational Synthesis, Stabilization, and Functional Properties of Metal and Intermetallic Nanoparticles
65. **Mr Rajesh Chalasani:** Functionalized Nanostructures: Iron oxide Nanocrystals and Exfoliated Inorganic Nanosheets
66. **Mr Chakrapani Kalapu:** Synthesis, Physicochemical and Electrochemical Studies on Iridium, Osmium and Graphene Oxide – Based Nanostructures
67. **Mr Sattaiah Naidu Kola:** Chemistry of Ru(II) complexes bearing sigma bonded H-X (X = H, Si, C) species/fragments
68. **Mr Raja Mitra:** Targeted Delivery of Cytotoxic Metal Complexes into Cancer Cells with and without Macromolecular Vehicles

## ORGANIC CHEMISTRY

---

69. **Mr Venkateswarlu Cheerladinne:** Novel synthetic strategies towards acetylenic biscarbamates/biscarbonates and organochalcogen derivatives



70. **Mr Lingampally Venu:** Stereochemical and Synthetic Investigations
71. **Mr Prashant K Metri:**  $\beta$ -Keto phosphonates from tartaric acid in the total synthesis of (+)-4-epi-gabosine A, (+)-dihydrokawain-5-ol, (-)-bengamide E and Identification of MPK-09: A small molecule that restores the wild type function of mutant p53
72. **Mr Supriya Dey:** Synthesis, Conformation and Glycosidic Bond Stabilities of Septanoside Sugars
73. **Mr Shrinidhi A:** Organic Transformations in Water: Synthetic and Mechanistic Studies towards Green Methodologies
74. **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
75. **Mr Kishore Gade:** Synthesis of Glycosyl-amino-acids, Glyco-amino-acids, &  $\sigma$  – Amino  $\gamma$  – Lactams from Carbohydrate Derived Donor-Acceptor Cyclopropanes
76. **Mr Rokade Balaji Vasantrao:** Copper-Catalyzed Novel Oxidative Transformations: Construction of Carbon-Hetero Bonds

## SOLID STATE AND STRUCTURAL CHEMISTRY UNIT

---

77. **Mr Anjan Banerjee:** Design, Development and Applications R&D on Substrate-Integrated Lead-Carbon Hybrid Ultracapacitors
78. **Mr Ravula Thirupathi:** (NN), Design, Synthesis and Characterization of Novel Nanomaterials
79. **Mr Srinu Tothadi:** Crystal Engineering: Design Strategies for Binary and Ternary Cocrystals
80. **Mr Arijit Mukherjee:** Building Upon Supramolecular Synthons: Some Aspects of Crystal Engineering
81. **Mr Sachin Rama Chaudhari:** Exploring Diverse Facets of Small Molecules by NMR Spectroscopy
82. **Mr Sumanta Mukherjee:** Internal Structure and Self-assembly of Low Dimensional Materials
83. **Ms K Catherine Kanimozhi K:** Rational Design of Diketopyrrolopyrrole-Based Conjugated Polymers for Ambipolar Charge Transport
84. **Mr Rajib Biswas:** Dynamics of Water under Confinement and Studies of Structural Transformation in Complex Systems
85. **Mr Sajesh P Thomas:** Phase Behaviour in Crystalline Solids: Exploring the Structure Guiding Factors via Polymorphism, Phase Transitions and Charge Density Studies

## MATERIALS RESEARCH CENTRE

---

86. **Ms Tanushree H Choudhury:** Anodized Zirconia Nanostructures
87. **Mr Dhayalan Shakthivel:** Thermodynamics and Kinetics of Nucleation and Growth of Silicon Nanowires
88. **Mr Shinde Satish Laxman:** Thermal Oxidation Strategies for the Synthesis of Binary Oxides and their Applications
89. **Ms Swastibrata Bhattacharyya:** Tuning Electronic Properties of Low Dimensional Materials
90. **Mr Ranajit Sai:** Development of CMOS-compatible, microwave-assisted solution processing of nanostructured zinc ferrite films for gigahertz circuits
91. **Mr Sugavaneshwar R P:** Vapour Phase transport growth of one-dimensional ZnO nanostructures and their applications
92. **Mr Mohammad Ibrahim Dar:** (Nanoscience & Nanotechnology), Solution-Based Synthesis of Metal and Metal Oxide Nanostructures: Investigations in Magnetism, Luminescence, Spectroscopy (SERS), Energy Storage (LIB) and Generation (DSC)
93. **Mr Dudekula Althaf Basha:** (NN), Phase Transformation Behaviour of Embedded Bimetallic Nanoscaled Alloy Particles in Immiscible Matrices

94. **Mr Ankur Goswami:** Design and Development of Microsereolithography (MSL) System and its applications in microfabrication of Polymer and Ceramic Structures

107. **Mr Kallol Roy:** Quantum Algorithmic Engineering with Photonic Integrated Circuits

108. **Mr Tanumay Datta:** Low-Complexity Receiver Algorithms in Large-Scale Multiuser MIMO Systems and Generalized Spatial Modulation

109. **Mr Mohan Raghavan:** First-Spike-Latency codes: Significance, relation to neuronal network structure and application to physiological recordings

110. **Ms Rajini V Honnugar:** Design and Analysis of Integrated Optic Waveguide Delay Line Phase Shifters for Microwave Photonic Applications

111. **Mr Vineeth B S:** On the tradeoff of average delay, average service cost, and average utility for single server queues with monotone policies

112. **Mr Prashanth G R:** Substrate Independent Non-covalent Based Surface Functionalization using Polyelectrolyte Multilayers for Bio-applications

113. **Mr Rakshith M R:** Algorithms for Spatial Modulation Systems

114. **Mr G R Jithamithra:** Space-Time Block Codes with Low Sphere-Decoding Complexity

115. **Mr Kodigenahalli R Y Prasad:** Generation of Modulated Microwave Signals Using Optical Techniques for Onboard Spacecraft Applications

116. **Mr Srinivasan V:** Influence Dynamics on Social Networks

117. **Mr Abhinav G:** Precoding for Interference Management in Wireless and Wireline Networks

118. **Mr Vijayaradharaj T M:** Network Coding for Wireless Relaying and Wireline Networks

119. **Mr Renu Jose:** Joint Estimation of Impairments in MIMO-OFDM Systems

120. **Mr Srinidhi N:** Multi-antenna Communication Receivers using Metaheuristics and Machine Learning Algorithms

121. **Mr Rajath V:** Time-based All-Digital Technique for Analog Built-in Self Test

## COMPUTER SCIENCE AND AUTOMATION

---

95. **Ms Preeti Malakar:** Integrated Parallel Simulations & Visualization for Large-scale Weather Applications

96. **Mr Manikantan R:** Improving Last-Level Cache Performance in Single and Multi-Core Processors

97. **Abhijeet Khopkar:** Computational and combinatorial problems on some geometric proximity graphs

98. **Ms Pradeesha Ashok:** Hitting Geometric Range Spaces Using a Few Points

99. **Ms Jasine Babu:** Algorithmic and Combinatorial Questions on some Geometric Problems on Graphs

100. **Mr Raghavendra K R:** Model-checking infinite-state systems for information flow security properties

101. **Mr N N R Ranga Suri:** Outlier Detection with Applications in GraPhData Mining

102. **Mr Swaprava Nath:** Mechanism Design for Strategic Crowd sourcing

## ELECTRICAL COMMUNICATION ENGINEERING

---

103. **Mr T Ganesan:** Source and Channel Coding Techniques For The MIMO Reverse-Link Channel

104. **Ms Malathi S:** Design and Analysis of Integrated Optic Resonators for Biosensing Applications

105. **Mr K Vinodh:** Linear Codes for Source Compression over Rings, Distributed Function Computation and MIMO Communication

106. **Mr Prasad K:** On Network Coding and Network-Error Correction



122. **Ms Revathy P:** High-k Dielectrics for Metal-Insulator-Metal Capacitors
123. **Mr A Karthik:** Fast, scalable, contention-based algorithms for multi-node selection in OFDMA and cooperative wireless systems
124. **Mr Mustafa Khandwawala:** Belief Propagation Algorithms for Mean-Field Combinatorial Optimisations
125. **Ms Srishti Shukla:** Wireless Network-Coded Multi-Way Relaying Using Latin Hyper-Cubes for M-PSK Modulation
126. **Mr Nityanand Kumawat:** Self-Referencing Techniques in Optical Label-Free Bio-Molecular Sensing
127. **Mr Avijit Chakraborty:** Delay Differentiation by Balancing Weighted Queue Lengths
128. **Ms Sindhuja S:** Silicon heterojunctions for photovoltaics
129. **Mr Adityasankar Medury:** Modeling the Electrostatics of Symmetric Double-Gate MOSFETs
130. **Mr Salil Kashyap:** Role of Channel State Information in Adaptation in Current and Next Generation Wireless Systems

## ELECTRICAL ENGINEERING

---

131. **Mr Govind Ramrao Kunkolienker:** Lightning Threat to Cables on Tall Towers and the Question of Electrical Isolation
132. **Mr Anirban Ghoshal:** Operation of Three Phase Four Wire Grid Connected VSI Under Non-ideal Conditions
133. **Ms Rimjhim Agarwal:** Intelligent Techniques for Monitoring of Integrated Power Systems
134. **Ms Sunitha K:** Coupling of Electromagnetic Fields from Intentional High Power Electromagnetic Sources with a Buried Cable and an Airborne Vehicle in Flight

135. **Mr Sourav Pramanik:** Frequency and Time Domain Response Analysis of Transformer Winding for Indirect Measurement of Series Capacitance and Construction of Ladder Network Models
136. **Mr Deepak Kumar:** Methods for text segmentation from scene images

## ELECTRONIC SYSTEMS ENGINEERING

---

137. **Mr Sambuddha Khan:** Development of Micromachined and Meso-scale Multi-axis Accelerometers with Displacement-amplifying Compliant Mechanisms
138. **Mr Guganeswaran S:** Design and Optimization of Displacement Measurement Eddy Current Sensor for Mass Production
139. **Mr Jyotirmoy Karjee:** Spatially Correlated Data Accuracy Estimation Models in Wireless Sensor Networks
140. **Mr Roshan Kumar Pappu:** Studies on Single DC link fed Multilevel Inverter Topologies by Cascading Flying Capacitor and Floating Capacitor Fed H-Bridges
141. **Mr Najath Abdul Azeez:** Studies on Current Hysteresis Controllers and Low Order Harmonic Suppression Techniques for IM Drives with Dodecagonal Voltage Space Vectors
142. **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

## MANAGEMENT STUDIES

---

143. **Ms Santhi P:** An exploratory study of behavioral and demographic characteristics of academic patentees
144. **Ms Indumathi A:** Knowledge Intensive Jobs & Well-Being of Knowledge Professionals: Development and Validation of a Multi-Construct Framework in the Indian Context

145. **Ms Poornima K:** Poential for Opportunity Recognition of PRE-, EARLY- and LATE-STAGE Entrepreneurs

## CENTRE FOR NANO-SCIENCE AND NANO ENGINEERING

---

146. **Mr Mohana Sundaram SM:** Large Enhancement in Metal Film Piezoresistive Sensitivity with local Inhomogenization for Nanoelectromechanical Systems

## SUPERCOMPUTER EDUCATION AND RESEARCH CENTRE

---

147. **Ms Radhamanjari Samanta:** Timing-Driven Routing in ULSI Physical Design under Uncertainty

148. **Mr Jayaprakash:** Development of next generation image reconstruction algorithms for Diffuse Optical and Photoacoustic Tomography

## AEROSPACE ENGINEERING

---

149. **Mr Iyer Arvind Sundaram:** Understanding High Speed Mixing Layers with LES and Evolution of Urans Modeling

150. **Mr Pradeepa TK:** Shocks, Shock-Boundary Layer Interaction, and Transonic Flutter

151. **Mr Prashant Kumar Srivastava:** Molecular simulation of anisotropic stress and structure in polymers

152. **Mr Partha Mondal:** Wing in Ground Effect

153. **Mr S Rajagopal:** Multidisciplinary Design Optimization Approach to Unmanned Aerial Vehicle Design

154. **Mr Bhat Abhishek Roopkrishen:** Experimental and Computational studies on deflagration-to-detonation transition and its effect on the performance of PDE

155. **Mr Souren Misra:** Efficient Numerical Algorithms for Nonlinear Convection and Convection-Diffusion Equations of Fluid Dynamics

156. **Mr Chandrashekhar:** Structural Modeling and Damage Detection in a Non-deterministic Framework

157. **Mr Mysa Ravi Chaithanya:** Fluid-elastic interactions in flutter and flapping wing propulsion

158. **Mr G Subramanian:** Large EDDY Simulation of Free & Impinging Subsonic Jets and Their Sound Fields

159. **Ms Madhumita Pal:** Accurate and Efficient Algorithms for Star Sensor Based Micro-Satellite Attitude and Attitude Rate Estimation

160. **Mr Srisha Rao MV:** Experimental Investigations on Supersonic Ejectors

161. **Mr Umesh K:** On the Effect of Material Uncertainty and Matrix Cracks on Smart Composite Plate

162. **Mr Kaushik Das:** Multi-agent Positional Consensus under Various Information Paradigms

163. **Mr M Suresh:** UAV Group Autonomy in Network Centric Environment

164. **Mr R Sriram:** Shock Tunnel Investigations on Hypersonic Impinging Shock Wave Boundary Layer Interaction

165. **Mr Rakesh P:** A Study of the Characteristics of Gas-on-Liquid Impinging Injectors

166. **Mr Chintoo S Kumar:** Experimental Investigation of Aerodynamic Interference Heating due to Protuberances on Flat Plates and Cones Facing Hypersonic Flows

167. **Mr Senthilnath J:** Nature inspired optimization techniques for flood assessment and land cover mapping using satellite images

168. **Mr MVVS Murthy:** Wave transmission characteristics in honeycomb sandwich structures using the Spectral Finite Element Method

169. **Mr Keshava Kumar:** Delamination Modeling and Detection in Composite Structures



## CIVIL ENGINEERING

---

170. **Mr Mulampaka Shiva Naresh:** Theoretical Studies of the Mechanisms of the Entry of Virus into Cells
171. **Mr Pimprikar Neelesh Arvind:** New Variants of Stabilized Polynomial Reproducing Meshfree Approaches in Computational Mechanics
172. **Ms Suganya K:** Role of composition, Structure and Physico-chemical environment on stabilisation of Kuttanad soil
173. **Mr Naveen James:** Site Characterization and Assessment of Various Earthquake Hazards for Micro and Macro-level Seismic Zonations of Regions in the Peninsular India
174. **Ms Praseeda K I:** Studies into Embodied and Operational Energy in Traditional and Conventional Residential Buildings in India
175. **Mr Arjun Sil:** Seismic Hazard Assessment of Tripura and Mizoram States along with Microzonation of Agartala and Aizawl Cities
176. **Ms Raji M:** Endochronic Constitutive Model for Sands and its Application to Geotechnical Problems
177. **Mr D Santhosh:** Frequency Analysis of Floods- A Nonparametric Approach
178. **Mr VS Sundar:** Monte Carlo Simulations with Variance Reduction for Structural Reliability Modeling, Updating and Testing
179. **Mr Sreelash K:** Estimation of root zone soil hydraulic properties by inversion of a crop model using ground or microwave remote sensing observations

## CHEMICAL ENGINEERING

---

180. **Ms Ipshita Banerjee:** Formation of Porous Metallic Nanostructures- Electrocatalytic Studies on Self-assembled Au@Pt Nanoparticulate Films, and SERS Activity of Inkjet Printed Silver Substrates

181. **Mr S Sankar Kalidas:** Metal Nanoparticle Engineering: Development of a Process 'Toolkit' for Synthesis and Self-assembly into Functional Nanoscale Architectures
182. **Mr Girish M:** Monodisperse Gold Nanoparticles: Synthesis, Self-assembly and Fabrication of Floating Gate Memory Devices
183. **Mr Sahadev Pradhan:** Analytical and numerical modeling of rarefied gas flows

## MATERIALS ENGINEERING

---

184. **Mr Hindol Bandyopadhyay:** Effect of Processing and test variables on the deformation characteristics of tantalum
185. **Mr Soupitak Pal:** Microstructural Developments and Mechanical Properties of Electroless Ni-B Coating
186. **Ms Nagamani Jaya B:** Micro-scale fracture testing of graded (Pt, Ni) Al bond coats
187. **Mr Rajendra Kurapati:** Investigation of Graphene Oxide based Multilayered Capsules/Films for Drug Delivery and Antimicrobial Applications
188. **Ms Sudha J:** Effect of heat treatment and modification on flow and fracture behaviour of a newly developed Al-Si based cast alloy
189. **Mr Pradipta Ghosh:** Length scale effects in deformation of polycrystalline nickel
190. **Mr Soumitra Roy:** Interdiffusion Study In group IVB, VB and VIB refractory metal-silicon systems
191. **Mr Gaurav Singh:** Some Mechanical Properties of Ti-6Al-4V-B alloys
192. **Ms Krishna R:** Design & Fabrication of Bio-responsive Drug Carriers Based on Protamine & Chondroitin Sulphate Biopolymers
193. **Mr RK Sidharada Devarapalli:** Synthesis and Characterization of Intermetallic Coatings by Laser Cladding and Novel Ball Milling Approach

194. **Mr Shailesh Kumar Singh:** Experimental and Numerical Investigation on Friction Welding of Thixocast A356 Aluminium alloy
195. **Mr Tamoghna Chakrabarti:** Study on Reactive Hot Pressing of Zirconium Carbide
196. **Mr Kirtiman Deo Malviya:** Synthesis and study of microstructure evolution in nanoparticles of immiscible alloys by laser ablation under liquid medium
197. **Mr Praveena M:** Design, Fabrication and Application of In Situ Total Internal Reflection (TIR) Raman Tribometer For the Chemical Analysis of Tribological Systems
198. **Mr Ranjith K:** Design and Synthesis of Band GAP Engineered Conjugated Molecules for Organic Electronics
199. **Mr Govind:** Effect of Li Addition on the Plasticity of AZ31 Mg-alloy
200. **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
201. **Mr Satyajit Gupta:** Development of Hybrid Organic/Inorganic Composites as a Barrier Material for Organic Electronics
202. **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
203. **Mr Shyam Kanta Sinha:** Synthesis and Transformation of AuCu Intermetallic Nanoparticles
204. **Mr Alex Joseph:** Synthesis and Characterization of Functionalized Electroactive Polymers for Metal Ion Sensing
205. **Mr Madhavan R:** Materials Engineering, Role of stacking fault energy on texture evolution in micro and nano-crystalline Nickel-Cobalt alloys
206. **Chandra Sekhar Tiwary:** Study of Microstructural, Mechanical and Oxidation Behaviour of Ni-Al-Zr alloys

## MECHANICAL ENGINEERING

---

207. **Mr Santosh Bhargav DB:** Design and Development of Miniature Compliant Grippers for Bio-Micromanipulation and Characterization
208. **Mr Deepu P:** Dynamics of Droplets Under Support, Acoustic and/or Ambient Flow Excitation
209. **Mr Nepal Adhikary:** Geometric Reasoning with Mesh-based Shape Representation in Product Development
210. **Mr Samrat Rao:** Structure of the Tropical Easterly Jet in NCAR CAM-3.1 GCM
211. **Mr Pravin Kishor Verekar:** Experiments on rolling sphere submerged in an incompressible fluid
212. **Mr Santhosh D:** A Study of Mode Dependent Energy Dissipation in 2D MEMS Resonators
213. **Ms Charanjeetkaur Chanansingh Malhi:** Studies on the Design of Novel MEMS Microphones
214. **Mr Kali Charan Nayak:** Flow and Windage Heating in Labyrinth Seals

## CENTRE FOR EARTH SCIENCES

---

215. **Mr Ravi R:** High Resolution Reconstruction of Rainfall Using Stable Isotopes in Growth Bands of Terrestrial Gastropod

## CENTRE FOR PRODUCT DESIGN AND MANUFACTURING

---

216. **Mr S Subramanya:** Prediction of Physical behavior of rotating blades under tip-rub impact using numerical modeling
217. **Mr Vipin JS:** Natural Hand Based Interaction Simulation Using A Digital Hand

## INSTRUMENTATION AND APPLIED PHYSICS

---

218. **Mr Rajesh Thomas:** Investigations on Graphene/



- Sn/SnO<sub>2</sub> Based nanostructures as Anode for Li-ion batteries
219. **Ms Roopa Manjunatha:** Polyvinylidene Fluoride Nasal Sensor: Design, Development and Its Biomedical Applications
220. **Mr Shivananju BN:** Advanced Multifunctional Bulk Optical & Fiber Bragg Grating Sensing Techniques
221. **Mr Saurabh Gupta:** Development of Deterministic and Stochastic Algorithms for Inverse Problems of Optical Tomography
222. **Mr Tamilarasan Sabapathy:** Ultrafast Laser Inscribed Waveguides on Chalcogenide Glasses for Photonic Applications
223. **Ms Baishali Garai:** Development and Performance Study of Thick Gas Electron Multiplier (THGEM) based Radiation Detector
224. **Mr Rajaboina Rakesh Kumar:** Growth of Semiconductor and Semiconducting Oxide Nanowires by Vacuum Evaporation Methods
225. **Mr Sudeep Joshi:** Towards Flexible Sensors and Actuators: Application Aspect of Piezoelectric Thin Film
226. **Ms Sreevidya G:** Mechanical, Structural, Thermal and Electrical Studies on Indium and Silver Doped Ge-Te Glasses having possible PCM Applications

## MATHEMATICS

---

227. **Mr Jaikrishnan J:** On the structure of proper holomorphic mappings
228. **Ms Atreyee Bhattacharya:** On an ODE associated to the Ricci Flow
229. **Mr Santanu Sarkar:** Some Problems in Multivariable Operator Theory
230. **Ms Kamana Porwal:** A Posteriori Error Analysis of Discontinuous Galerkin Methods for Elliptic Variational Inequalities
231. **Mr Nitin Singh:** On Walkup's class of manifolds and tight triangulations

232. **Mr Divakaran D:** Compactness theorems for the spaces of distance measure spaces and Riemann surface laminations
233. **Mr Avijit Pal:** Contractivity, Complete Contractivity and Curvature Inequalities

## PHYSICS

---

234. **Ms Rupamanjari Majumder:** Spiral and Scroll-Wave Dynamics In Ionically and Anatomically Realistic Mathematical Models for Mammalian Ventricular Tissue
235. **Mr Thorat Kshitij Harischandra:** {JAAP}, The Cosmic Population of Extended Radio Sources: A Radio-Optical Study
236. **Ms Sapam Ranjita Chanu:** High-resolution spectroscopy in atoms using coherent control
237. **Mr Rupak Bhattacharya:** Structure and Dynamics of Interfacial Molecular Membranes
238. **Mr Anurag Misra:** Crystal Structures of Sortase A From *Streptococcus pneumoniae*: Insights Into Domain-Swapped Dimerization. Crystal Structures of Designed Peptides: Inhibitors of human Islet Amyloid Polypeptide (hIAPP) Fibrillization Implicated in Type 2 Diabetes and Those Forming Self-Assembled Nanotubes
239. **Mr Krishnayan Basuroy:** Structural studies on hybrid peptides: Crystallographic characterization of sequences containing backbone homologated monosubstituted unconstrained gamma amino acid residues
240. **Ms Indrani Banerjee:** Investigating Nucleosynthesis During Formation of Black Holes and Extracting their Properties
241. **Mr Pradeep Kumar:** Spectroscopic Studies of Iron-based Superconductors, Multi-ferroic Oxides and Double-perovskite: Phonons, Electronic and Spin Excitations
242. **Mr R Koushik:** Study of Phase Transitions in Two Dimensions using Electrical Noise

243. **Mr Rama Koteswara Rao:** Quantum Simulations by NMR: Applications to Small Spin Chains and Ising Spin Systems
244. **Mr Alok Kumar Singh:** Hyperfine structure-measurement in alkali-metal atoms and ytterbium atom
245. **Mr VS Manu:** Optimization of NMR Experiments using Genetic Algorithm: Applications in Quantum Information Processing, Design of Composite Operators and Quantitative Experiments
246. **Mr Subhamoy Ghatak:** Electrical Transport and Low frequency Noise in Graphene and Molybdenum disulphide
247. **Mr Hemant Kumar:** Structure, Dynamics and Thermodynamics of Confined Water Molecule
248. **Mr Jayanth Vyasanakere P:** Ultracold fermions in synthetic non-Abelian gauge fields
249. **Mr Alok Ranjan Nayak:** Spiral-wave Dynamics in Ionically Realistic Mathematical Models for Human Ventricular Tissue
250. **Mr Laxmi Narayan Tripathi:** Preparation and optical properties of hybrid assemblies of metallic gold nanoparticles and semi-conducting CdSe quantum dots
251. **Ms Geetanjali:** Magnetic Ordering in Bulk and Nanoparticles of Certain Bismuth Based Manganites  $\text{Bi}_{1-x}\text{A}_x\text{MnO}_3$  (A = Ca, Sr): Electron Paramagnetic Resonance and Magnetization Studies
252. **Mr Yogesh Maan:** Tomographic Studies of Pulsar Radio Emission Cones And Searches for Radio Counterparts of Gamma-ray Pulsars
253. **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.
254. **Mr Sivasurender C:** Structure and Dynamics of Binary Mixtures of Soft Nanocolloids and Polymers
255. **Mr Chanchal Sow:** Magnetic and magnetotransport studies in transition metal oxides: Role of competing interactions
256. **Mr Kaustuv Manna:** Evolution of the Magnetic Ground States with Lattice Distortion and Chemical Inhomogeneity in Doped Perovskite Oxides
257. **Ms Chandreyee Maitra:** (Astronomy and Astrophysics), High Magnetic Field Neutron Stars: Cyclotron Lines and Polarization
258. **Ms Mamta Gulati:** (Astronomy & Astrophysics) (JAP), A Study of Slow Modes in Keplerian Discs
259. **Mr R Anbalagan:** Thermoelectric Properties of Bi, Fe and Te Substituted  $\text{CoSb}_3$  Skutterudite Materials
260. **Mr Raghavendra Rao K:** Growth and Physical Properties of Biaxial Nonlinear Optical Crystals of Ascorbic Acid Family

## CENTRE FOR HIGH ENERGY PHYSICS

---

261. **Mr Kirtimaan Ajaykant Mohan:** The Higgs Boson as a Probe of Physics beyond the Standard Model at the Large Hadron Collider
262. **Mr Abhishek Muralidhar Iyer:** Randall-Sundrum Model as a Theory of Flavour

---

## Research Conferments: MSc (Engineering)

---

### COMPUTER SCIENCE & AUTOMATION

---

1. **Mr Vinayaka Prakasha Bandishti:** Tiling Stencil Computations to Maximize Parallelism
2. **Mr Roshan D:** Compiling for a Dataflow Runtime on Distributed-Memory Parallel Architectures
3. **Mr Ninad R:** Hitting and Piercing Geometric Objects Induced by a Point Set
4. **Ms Prachi Goyal:** Parameterized Complexity of Maximum Edge Coloring in Graphs
5. **Mr Aravind Acharya N:** Model-Checking in Presburger Counter Systems using Accelerations
6. **Ms Kamala R:** MIgrate the Storage too
7. **Mr Thejas CR:** Automatic Data Allocation, Buffer Management and Data Movement for Multi-GPU Machines
8. **Mr Chandan G:** Computer Science and Automation, Effective Automatic Computation Placement and Data Allocation for Parallelization of Regular Programs
9. **Mr Raghvendra Pratap Singh:** Simulation no Flexible Multibody Dynamics Systems using Hybrid FEM

### ELECTRICAL COMMUNICATION ENGINEERING

---

10. **Mr Mohd. Shabbir Ali:** Interference Modeling in Wireless Networks
11. **Mr Harsha SE:** Transmitter and Receiver Techniques for Multi-antenna Systems in Frequency-Selective Channels
12. **Ms Arthi S:** Timbre perception of time-varying signals
13. **Mr Santanu Mondal:** Packet Scheduling on the Wireless Channel

14. **Mr N Mukund Sriram:** Grassmannian Fusion Frames for Block Sparse Recovery and its application to Burst Error Correction
15. **Mr Pramod RT:** Computational Models of Perceptual Space: From Simple Features to Complex Shapes
16. **Mr Rahul R:** Delay Minimization of an M / M/1 point-to-point link model subject to throughput and powder constraints

### ELECTRICAL ENGINEERING

---

17. **Mr Haricharan A:** Demodulation of Narrowband Speech Spectrograms
18. **Mr Anil Prasad MN:** Segmentation Strategies For Scene Word Images
19. **Mr Abhiram B:** Characterization of the voice source by the DCT for speaker information
20. **Mr Gopalakrishnan KS:** Study on DC-Link Capacitor Current in a Three-Level Neutral-Point Clamped Inverter

### ELECTRONIC SYSTEMS ENGINEERING

---

21. **Mr Karthik A:** Alternate Self-powering Methods for Single-wire AC Switches
22. **Mr Srinivas NR:** Composite Current Space Vector Based Powerline Communication (PLC) Method for Grid Connected Inverters in AC Microgrids

### SUPERCOMPUTER EDUCATION AND RESEARCH CENTRE

---

23. **Mr Milind R:** Clustering for model reduction of circuits: Multi-level techniques
24. **Mr Durga Datta Kandel:** Ranking and Classification of Chemical Structures for Drug Discovery:

Development of New Fragment Descriptors and Interpolation Scheme

25. **Mr Bharath Venkatesh:** Fast Identification of Structured P2P Botnets using Community Detection Algorithms
26. **Mr Gaurav Kumar Singh:** Partitioning and Mapping of Computation Structure on a Coarse-Grained Reconfigurable Architecture
27. **Mr Mohit Dhingra:** Elasticity in Lass Cloud, preserving Performance SLAs
28. **Mr Prasanna Vasant Pandit:** Cooperative Execution of Open CL Programs on Multiple Heterogeneous Devices
29. **Ms Saradha R:** Malware Analysis using Profile Hidden Markov Models and Intrusion Detection in a stream learning setting

## AEROSPACE ENGINEERING

---

30. **Mr K Aatresh:** Microgravity Flow Transients in the Context of On-board Propellant Gauging
31. **Mr Ashutosh Sharma HA:** Three Dimensional Computational Fluid Dynamic Simulation and Analysis of a Turbocharger Compressor
32. **Ms Prachi Joshi:** Analysis and Detection of Ionospheric Depletions over the Indian Region in the Context of Satellite Navigation
33. **Mr Bijoy Kumar Malik:** Study Of Non-Equilibrium Flow Behind Normal Shock
34. **Mr Gopalakrishna N:** On Three Dimensional High Lift Flow Computations

## CIVIL ENGINEERING

---

35. **Ms Nimmy Mariam Abraham:** Studies on Propagating and Non-Propagating Cracks in Concrete under Fatigue Loading in the Short Crack Regime
36. **Ms Ila Chawla:** Hydrologic Response of Upper Ganga Basin to Changing Land Use and Climate

37. **Ms Teddy Kizza:** Modeling Salinity Impact on Ground Water Irrigated Turmeric Crop

## CHEMICAL ENGINEERING

---

38. **Mr Hari S Ganesh:** Computational study of long chain n-alkane binary mixture adsorption in silicalite under conditions of high loading

## CENTRE FOR ATMOSPHERIC AND OCEANIC SCIENCES

---

39. **Ms K Sirisha:** Modeling of solar Radiation Management: A comparison of simulations using reduced solar constant and stratospheric aerosols
40. **Mr Anirban Sinha:** Dynamics and Stability of Multiple Jets in Geophysical Flows

## CENTRE FOR SUSTAINABLE TECHNOLOGIES

---

41. **Ms Krupa D:** Autoflocculating Mixotrophic Algal Consortia Approach to Sustainable Wastewater Treatment
42. **Mr Ravi Kumar D:** Effect of Extractives and Crude Proteins On Kinetics of Hydrolysis in a Solid State Bio-Reactor

## INSTRUMENTATION AND APPLIED PHYSICS

---

43. **Mr Nyayapati Mahidhar Ramesh:** Poly-Vinylidene Fluoride Based Vibration Spectrum Sensors and Energy Harvestors
44. **Ms Mathangi Raghuraman:** Threshold Voltage Shift Compensating Circuits In Non-Crystalline Semiconductors for Large Area Sensor Actuator Interface
45. **Mr Raju Regmi:** Light Sheet Based Microfluidic Flow Cytometry Techniques for High-throughput Interrogation and High-resolution Imaging



## 6.11 External Registration

### Admissions in the current year

Department	Sponsors	No. Admitted
AE	NAL, DRDO, ISRO, ISC	5
CST	CSST&P, Tata Motors	2
CiE	ISRO	1
CSA	ISRO	1
ECE	ABB Corporate Research Center, NI Systems India Pvt Ltd, Robert Bosch Engineering and Business Solutions Ltd	3
IAP	Hemvati nandan bahuguna garhwal university, Honeywell Technology Solutions Pvt. Limited, ISRO	3
INTERDISCIPLINARY PROGRAM	CSTEP	1
MS	Schneider Electric India Pvt Ltd	1
MT	ADA, NAL	2
ME	ISRO, DRDO	3
<b>Total</b>		<b>22</b>

### Students on Roll under the External Registration Programme

Sl. No.	Sponsors	No. Admitted
1.	Aeronautical Development Agency, Bangalore	7
2.	Aeronautical Development Establishment, Bangalore	3
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	2
7.	BMS college	1
8.	Centre for Artificial & Intelligence Robotics, Bangalore	2
9.	Centre for Development of Advanced Computing, Bangalore	2
10.	Defence Research Development Lab, Hyderabad	7
11.	Defence Research Development Organization, Hyderabad	15
12.	Defence Metallurgical Research Laboratory, Hyderabad	4
13.	Gas Turbine Research Establishment, Bangalore	3
14.	Hindustan Aeronautics Ltd. Bangalore	2
15.	ISRO Satellite Centre, Bangalore	29
16.	Indira Gandhi Centre for Atomic Research, Kalpakkam	3

17. LRDE	1
18. National Aerospace Laboratory, B'lore	15
19. Vikram Sarabhai Space Centre, Trivandrum	5
20. Central Mining Research Institute, Nagpur	1
21. Nandan Hemavath Agarwal University	1

### PRIVATE ORGANIZATIONS

22. ABB Corporate Research Center, B'lore	2
23. Agere Systems India Pvt. Ltd., Bangalore	1
24. Analog Devices, Bangalore	2
25. APC-MGE	1
26. Crompton Greaves, Bangalore	1
27. CSTEP	1
28. FACT, Bangalore	1
29. Faurecia Emission Control Technologie	1
30. GE India Technology Centre Pvt. Ltd.	6
31. General Motors	4
32. Grindwell Norton, Bangalore	1
33. Hewett Packard, Bangalore	3
34. Honeywell Tech. Solutions Lab, Bangalore	4
35. International Business Machine, Bangalor	3
36. Indian Formers Fertilizer Cooperative Ltd., New Delhi	1
37. Indian Institute of Information Technology	1
38. IIMB	3
39. Intel Tech India Pvt Ltd. Bangalore	2
40. John Deere Tech Center, Pune	3

41. Laboratory for Electro Optics Systems	1
42. Motorola, Bangalore	1
43. MICO Bangalore	1
44. MSRIT	2
45. Microwave Tube Research and Development Centre	1
46. 3M India Limited	1
47. Philips, Bangalore	2
48. Pramati Tech., Hyderabad	1
49. Reliance Communications, Bangalore	1
50. Robert Bosch Engineering and Business Solutions Ltd	1
51. Saintgits College of Engg, Kerala	1
52. Samsung India	1
53. Siemens, Bangalore	1
54. Schneider Electric India, Bangalore	1
55. Symphony	1
56. Tata Motors, Pune	1
57. Tata Consultancy Services Limited	1
58. Tata Research, Design and Development Centre, Pune	1
59. Technology Informatics Design Endeavour, Bangalore	1
60. Texas Instruments, Bangalore	10
61. Tech Park	2
62. Thermal System	3
63. TVS, Chennai	3
64. WIPRO, Bangalore	3
<b>Total</b>	<b>190</b>

## 6.12 Undergraduate Program

The first batch of students from IISc's four-year undergraduate (UG) programme, started in 2011, graduated in July 2015. The programme was started under the leadership of the then Director of IISc, Prof. P Balaram, based on the recommendations of a report jointly prepared by the Indian Academy of Sciences, the Indian National Science Academy and

the National Academy of Sciences. There had been a strongly-held view among members of the academic community that undergraduate education had to be more effective to help students learn better and also make more informed choices about their careers. The Institute also believed that a good UG programme would help research in the Institute flourish.

In 2010, Prof. Chandan Dasgupta from the Department of Physics was appointed as the first Dean of the UG programme. It commenced in 2011, exactly a century after the Institute admitted its first batch of postgraduate students. Prof. Dasgupta has just completed his term, and he has been succeeded by Prof. Umesh Varshney from the Department of Microbiology and Cell Biology. As the programme has grown, it now also has two Associate Deans – Prof. P S Anil Kumar from the Physics Department and Prof. Balaji Jagirdar from the Department of Inorganic and Physical Chemistry. Administrative issues related to the UG programme will be looked after by Mr. Veeranna Kammar, who will serve as the new Assistant Registrar (Academic section).

The UG programme at IISc is highly selective. Only 120 students are chosen to be part of it every year from amongst more than 10,000 applicants received. Applicants need to have cleared at least one of the following to be eligible for admission: the Kishore Vaigyanik Protsahan Yojana (KVPY), the Joint Entrance Examination (JEE) or the All India Pre-medical Test (AIPMT). All the students who are admitted have been receiving a fellowship besides accommodation on campus.

Each UG student is assigned a faculty advisor who mentors her/him throughout their programme of study. Students major in any one of the following subjects: physics, chemistry, biology, mathematics, environmental science, and materials science. But until their third semester, students take compulsory foundational courses in all these subjects besides engineering and humanities courses. Students can also opt for additional engineering courses as electives in the following semesters for a total of 19 credits. Humanities courses, which are an integral component of this programme, are compulsory for the first six semesters and are conducted by the Centre for Contemporary Studies.

Once the students have completed their foundational course requirements, they choose their major and minor subjects. The seventh and eighth semesters are devoted entirely to research projects which they do with one of

the faculty members. This gives them valuable exposure to contemporary research. Over the four years of study, students are required to earn 131 credits, of which the core courses constitute 65 credits. The major subject counts towards 35 credits, the minor towards 15 credits, and the project towards 16 credits.

All classes are taught by faculty members of the Institute who are among the best researchers in their own fields. The curriculum emphasizes active learning in labs that are equipped with world class facilities. Many of the experiments that these students perform led to crucial scientific discoveries and even won Nobel Prizes.

In 2014, the administration made some minor changes to the UG programme based on recommendations made by the University Grants Commission (UGC). Graduating students now have the opportunity to receive a Master's degree if they continued their research for another year. The undergraduate degree they receive is now called Bachelor of Science (Research).

More than half of the students who graduated this year have decided to continue with their Master's in IISc itself. Twenty seven students have joined PhD programmes at premier universities abroad and two have taken up jobs in reputed organizations. However, one of these has now gone on to do his graduate studies. Without exception, they report that they have learned much over the last four years and that they have had a memorable time. They have excelled in academics as well as in numerous extracurricular activities. They have been selected by reputed national and international organizations and universities for their summer and final projects. At least 20% of them have secured CGPA (Cumulative Grade Point Average) of 7 or more out of 8. They have also been doing extremely well in student festivals in other universities and colleges, such as the inter-college quiz competition at *Mimamsa*, the student festival organized by IISER Pune, where IISc students have received the first place in each of the last four editions. Beginning 2014, the UG students have also been organizing *Pravega*, an annual science-tech-cultural fest. They also bring out an annual magazine called *Quarks* that showcases their multifaceted talents.

---

## 6.13 Centre for Continuing Education (Chairperson: 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 18 National Programmes; 20 Industry Oriented Programmes.

### NATIONAL PROGRAMMES

---

**QIP (Quality Improvement Programme) – Leading to the Award of Degrees:** During the current year, under this programme, 6 teachers were admitted for PhD and 12 for ME/MTech. 6 persons were given advance admission for Ph.D for 2014-2015.

The following table gives the Institute contribution to the QIP Programme:

During the Year	At IISc	
	PhD	ME/MTech
Students Admitted	6	12
Degrees Awarded	2	5
On Roll	20	14

**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.

### INDUSTRY PROGRAMMES

---

**PROFICIENCE:** Under the PROFICIENCE programme 2 semester-long, 27 evening courses were conducted

and 683 participants attended. 424 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.

### 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.

### 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 PhD 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.

### SERVICES RENDERED TO OTHER GOVERNMENT/PRIVATE ORGANISATIONS

- To improve the quality of education in the country, a note was sent to the Prime Minister's Office.
- Incorporation of Pedagogy in Engineering Education.

### 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, 197 faculty members from other universities/research laboratories/colleges, who visited the Institute, stayed in the guest house and **374** participants for Short Term Courses and Workshops/Seminars stayed at the guest house.

## 6.14 J R D Tata Memorial Library (Librarian-in-charge: N C Shivaprakash)

**Staff: Librarian-in-charge: 1; Deputy Librarian: 1; Asst. Librarian: 1; Scientific: 1; Technical: 4**

J R D TATA Memorial Library, at the Indian Institute of Science, is one of the oldest yet modern 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 of the 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 2014, the Library added 4740 documents including 1208 books, 3080 bound volumes and 452 Gift books. eBook cataloguing service has been introduced. The total holdings of the Library is now increased to about 5,07,172 physical documents which includes other

materials like Technical Reports, Standards, Theses & Dissertation. Library continues to primarily subscribe e-only journals and over 765 e-journals are being subscribed spending nearly ₹ 15 crores. The 'Electronic Theses Repository' contains about 2375 theses.

The Circulation section has registered 673 new members. Total number of 30,152 transactions were carried out by the Circulation section during 2014. Work such as reshelving, shelf rectification, shifting etc. are being carried out in the library regularly.

The Library continued to maintain pre-eminence in providing access to a large number of e-resources. Some of 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 subjects 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 Authorities and 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 INDEST-AICTE Consortium of MHRD, access is provided to over 6000 electronic journals, several databases and major e-resources including:

- Association of Computing Machinery Journals
- IEEE / IEE Journals
- Elsevier Science Direct
- Springer Link Journals
- ASTM Journals and Standards
- ASCE Journals
- ASME Journals
- Emerald full-text

Web of Science which was subscribed by INDEST-AICTE Consortium is now subscribed by the Institute.

Similarly, 27 Nature Group Journals were continued to be subscribed by the Library. These were earlier subscribed by the INDEST-AICTE Consortium.

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 issued out. Presently, the OPAC database has about 1,93,821 books and 2,05,087 records of bound volumes of periodicals. Content page access for books through Web OPAC is provided to all users of the library. Article indexing service for articles published by the Institute faculty has been initiated.

#### **HARDWARE-SOFTWARE RELATED**

Currently Library is using LibSys-4 for its housekeeping operations. Since the software support for the current version is likely to discontinue, library has planned for LibSys 7 a webcentric Library Information Management Software, for which funds have been sanctioned by the authorities.

For the optimum use of e-resources subscribed, 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 the places like user area, computer section and operational units are being augmented.

The Library had been providing photocopies of documents available in the Library within the copyright laws to Scientists/academicians/ students. UGC has identified the Library as 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 like, new additions of books and journals, Interactive services like reminders, reservations and overdue intimation and e-mail based reference service. 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 order on vendors who offer substantial discount while providing prompt supply. This has resulted in a discount ranging from 25% to 34% across various publishers.

The Library is recognized as the Resource Center for Mathematics for the South Region by the National Board of Higher Mathematics, Dept. of Atomic Energy, Government of India., and is receiving financial assistance for developing this collection on Mathematics.

### **NEW INITIATIVES**

- The Libsys-7 a webcentric Library Management Software is being implemented and the Library has procured associated hardware required for the purpose.
- In user areas and some of the operations units, new computer systems have been provided.
- Libaray painting after a gap of almost 15 years is done and new sign boards were provided in various locations in the Library
- Fire fighting and safety equipments were installed at various locations in the library
- A new service has been introduced viz., 'Virtual display of new documents'which compromises the earlier service 'Weekly display of new books
- Libaray hours has been extended till 2:00AM on all working days including on Saturdays to facilitate reading by the user community.





LIBRARY

JRD TATA MEMORIAL LI



BRARY

J. A. TILLYARD LIBRARY

# 7

# INTERACTIONS AND OUTREACH

---

## 7.1 Institute Lectures

---

The Institute has organized the following Centenary, Memorial, Endowment, Institute lectures during the year:

### CENTENARY LECTURES

---

Reflections on the Discovery of the Pulsars, Prof Jocelyn Bell Burnell, University of Oxford & Mansfield College, UK, 9<sup>th</sup> Jan. 2014.

**Radical Mechnostereochemistry**, Sir Fraser Stoddart Board of Trustees Professor of Chemistry, Northwestern University, Dept. of Chemistry, USA, 15<sup>th</sup> Jan. 2014.

**New Directions in Cancer Research** by Dr. Harold Varmus, Director, National Cancer Institute, USA, 21<sup>st</sup> Jan. 2014.

**Detecting Reaction Intermediates in Solution and Guiding Cancer Surgery using Mass Spectrometry** by Prof Richard N Zare, The Marguerite Blake Wilbur Professor of Natural Science, Dept. of Chemistry, Stanford University, USA, 5<sup>th</sup> Feb 2014.

### GOLDEN JUBILEE LECTURES

---

**Study of Human Diseases at the Intersections of Engineering, Science and Medicine**, Prof Subra Suresh, President, Carnegie Mellon University, USA, 12<sup>th</sup> March 2014.

### CNR RAO ENDOWMENT LECTURE

---

**Racetrack Memory: Highly Efficient Current Induced Domain Wall Motion in Synthetic Antiferromagnetic Racetracks**, Dr. Stuart Parkin, Department of Applied Physics, Stanford University, USA, 4<sup>th</sup> Dec 2014.

### SRI VITHAL N CHANDAVARKAR MEMORIAL LECTURE

---

**Democracy, Inclusion and Prosperity**, Dr. Raghuram Rajan, Governor, Reserve Bank of India, 27<sup>th</sup> Feb 2015.

### SPECIAL LECTURES

---

**Mapping the Universe and its History**, Prof George F Smoot, Nobel Laureate in Physics 2006, Prof. of Physics, University of California, Berkeley, 3<sup>rd</sup> Nov 2014.

**The Quest for Resilient Mechanism Design**, Prof. Silvio Micali, Turing Laureate 2012 and Ford Professor of Engineering, Massachusetts Institute of Technology, Prof. I G Sarma Memorial Lecture, Jan 6, 2015.

---

## 7.2 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

---

- India-UK Scientific Seminar Scheme: PIs: Sharon Peacock (Cambridge) and A. Vyakarnam (KCL- IISc)  
Title: Development of a research collaboration on

- infection and immunity between the University of Cambridge, King's College London and the Indian Institute of Science. Three day closed research workshop between 3 University of Cambridge scientists, 2 KCL scientists and 15 Indian academics, 29-30 January 2014 (Cambridge, King's College and CIDR, IISc)
- Marine turtle conservation and Management, Andaman Islands, 6 Feb 2014 (CES)
  - Training workshop on Western Ghats Biodiversity using Free and Open Source Geospatial (FOSS4G) tools, Organised jointly with Karnataka State Council for Science and Technology, OSGEO-India, Venue: Conference Room, Ground Floor, New Bioscience Building, IISc Campus, 24-27 Feb 2014 (CES, CISTUP and CST)
  - One day workshop on conservation of lakes in Malenadu, Organised jointly with Vrikshalaksha andolan, Sirsi, Venue: Sri Svarnavalli Mahasamsthatana, Sonda, Sirsi, 15 Mar 2014 (CES)
  - 17<sup>th</sup> Transcription Assembly Meeting, March 17-18, 2014 (MCB/MBU)
  - Recent advances in Chemical Biology, held at Manipur University, Imphal, 24-26<sup>th</sup> March, 2014 (MRDG)
  - UGC-NRC-Workshop in Biological Sciences and recombinant DNA techniques, May 5-31, 2014 (MCB)
  - One day Workshop on Environment Education for Science Teachers, 10<sup>th</sup> July 2014, Choksi Hall, Organised Jointly with Bangalore South District High School Headmasters Association, 10 Jul 2014 (CES and CST)
  - Indo-UK Math-Bio meeting, organized by Prof. Carmen Molina-Paris, University of Leeds and Prof. D. Nandi, CIDR, IISc, 10-12 July 2014 (CIDR)
  - Internet based Course – Environment Management, Aug-Dec 2014 (CES/CCE)
  - Workshop on Documentation of My Village Water Resources and its Surrounding Biodiversity – Interactive Session with School Students & Teachers, 04<sup>th</sup> August 2014, 10 am to 1.45 pm, Venue – Shalmala Sabhabavan, Govt. High School, Jaddigadde, Sirsi, Organised by EWRG, CES with Sanjeevini Eco Club, Govt. High School, Jaddigadde, Sirsi, 04 Aug 2014 (CES)
  - Workshop on Documentation of My Village Water Resources and its Surrounding Biodiversity – Interactive Session with School Students & Teachers, 04<sup>th</sup> August 2014, 2.15 pm to 5.30 pm, Venue – GSS Hall Gajanan Madyamika School, Vanalli, Sirsi, Organised by EWRG, CES with GSS, Eco Club, Gajanan Madyamika School, Vanalli, Sirsi, 4 Aug 2014 (CES)
  - Workshop on Documentation of My Village Water Resources and its Surrounding Biodiversity – Interactive Session with School Students & Teachers, 16<sup>th</sup> August 2014, 9.30 am to 1.00 pm, Venue – Lion School Conference Hall, Sirsi, Organised by EWRG, CES with Lion School, Sirsi Town, Sirsi, Jagadamba High School, Sarkuli, 16 Aug 2014 (CES)
  - Workshop on Documentation of My Village Water Resources and its Surrounding Biodiversity – Interactive Session with School Students & Teachers, 16<sup>th</sup> August 2014, 2.15 pm to 5.00 pm, Venue – Vidyodaya PU College Science Hall, Yedahalli, Sirsi, Organised by EWRG, CES with Vidyodaya P.U. College and Commerce College, Yedahalli, Sirsi, 16 Aug 2014 (CES)
  - Workshop on Documentation of My Village Water Resources & its Surrounding Biodiversity – Interactive Session with School Students & Teachers, 21<sup>st</sup> August 2014, 9.30 am to 1.00 pm, Venue – New English School, Honavar, Organised by EWRG, CES with Organised by EWRG, CES with Shree Maruthi Res. School, Bangarmakki, Gersoppa, Honavar, 21 Aug 2014 (CES)
  - Workshop on Documentation of My Village Water Resources and its Surrounding Biodiversity – Interactive Session with School Students & Teachers, 21<sup>st</sup> August 2014, 1.45 pm to 4.30 pm, Venue – Seminar Hall, Shree Maruthi Res. School, Bangarmakki, Gersoppa, Honavar, Organised by EWRG, CES with Shree Maruthi Res. School, Bangarmakki, Gersoppa, Honavar, 21 Aug 2014 (CES)
  - Workshop on Environment Education, Part of Vagdevi Parisara Utsav, Organised by Vagdevi Vilas school, Munnekolalu, Marathalli, 21 Aug 2014 (CES)

- Orientation programme on “Care and handling of laboratory animals” for graduate students. Prof. Kumaravel S, Prof. K.N. Balaji and Dr. Amit Singh from Dept. of MCB delivered lectures, 25-08-2014 to 01-09-2014 (CAF)
- Alexander von Humboldt Kolleg on ‘Interdisciplinary Science: A catalyst for sustainable progress’, 4-6<sup>th</sup> Sept 2014 (MBU)
- Workshop on Environment Education, Vidyaniketan Public School, Ullal Upnagar, Bangalore, Organised by EWRG, CES with Vidyaniketan Public School, Ullal, 10 Sep 2014 (CES)
- The UK Science and Innovation Network (SIN) of the Foreign and Commonwealth Office (FCO) organized calls for joint UK-India funding in the Infectious Disease area; 5 UK universities (KCL, Cambridge, Dundee, Sheffield, Edinburgh) participated. This led to an application for a MRC Newton-DBT Joint Centre Grant, 11-12<sup>th</sup> September 2014 (UK Science and Innovation Network (SIN) of the Foreign and Commonwealth Office (FCO) and CIDR, IISc)
- Student Conference on Conservation Science, 25-28 Sep 2014 (CES)
- Getting the measure of diversity: a macro-ecological perspective (at SCCS), 28 Sep 2014 (CES)
- Asian sea turtle researchers meeting, 25 Sep 2014 (CES)
- UGC Workshop in Bioinformatics, October 2014, IISc (BC)
- Workshop on Conservation of Malnadu lakes, Organised by Vrikshalaksha Andolan, Sagar, Sri Niketan School, Isloor with EWRG, CES Field Station, Kumta, 2 Oct 2014 (CES)
- Workshop on Environment Education – Orientation Programme for School Students, Venue – Rustum Choksi Hall (near IISc Main Gate), IISc, Bangalore, Organised by EWRG, CES and Bangalore South district Headmasters Association, 4 Oct 2014 (CES/CST)
- Lake2014 – Conservation and sustainable management of wetlands in western Ghats, 13-16 Nov 2014 (CES/CST and CISTUP)
- Teaching and Learning with Drosophila: Mendel to Genomics, 29<sup>th</sup> December, 2014 – 10<sup>th</sup> January, 2015 (MRDG)
- UGC-NRC-Workshop on Teaching and Learning genetics with Drosophila, Dec. 29, 2014- Jan.10, 2015 (MCB)
- Metabolomics 2015, 12<sup>th</sup> and 13<sup>th</sup> January 2015, IISc Bangalore (BC)

## DIVISION OF CHEMICAL SCIENCES

---

- IUMRS-ICA, Jan. 3-7, 2014 (MRC)
- 27<sup>th</sup> International Carbohydrate, 12<sup>th</sup> – 17<sup>th</sup> Jan. 2014 (OC)
- IYCR – Stamp Releasing Function, Jan. 30, 2014 (SSCU)
- MRSI AGM, Feb 9-12, 2014 (MRC)
- Human body as the complex systems, August 12, 2014 (SSCU)
- Indo-German Conference on Bioinspired Chemistry (IGCBIC-2014), 10-12 September 2014 (IPC)
- Designer Molecular Crystals: Mechanical and Functional Properties, November 14, 2014 (SSCU)
- 13<sup>th</sup> Eurasia Conference, 14<sup>th</sup> to 18<sup>th</sup> December, 2014 (OC)
- 3<sup>rd</sup> China –India-Singapore meeting on Crystal Engineering (CIS-3), December 7-9, 2014 (SSCU)
- National Workshop on NMR and TEM, 11-12 Dec 2014 (NMR)
- IUSSTF Workshop on “The Physics & Chemistry of graphene and other including MoS<sub>2</sub> and phosphorene”, December 22-24, 2014 (SSCU)

## DIVISION OF ELECTRICAL SCIENCES

---

- IFCAM Workshop on Social Networks, Jan. 2014 (ECE)
- CEFIPRA Workshop on New Avenues for Network Models, Jan. 2014 (ECE)



- IEEE International Conference on Electronics, Computing and Communication Technologies (CONECCT), Jan. 2014 (ECE)
- Sixth International Conference on Communication Systems and Networks, COMSNETS 2014, Jan. 2014 (ECE)
- Prof. I.G. Sarma Memorial Lecture, Jan. 2014 (CSA)
- Indo-US Lectures Week in Machine Learning, Game Theory and Optimization, Jan. 2014 (CSA)
- Workshop on Geometry and Graph Theory, Oct. 2014 (CSA)
- INUP Introductory Workshop on “Nanofabrication Technologies”, Mar. 2014 (ECE)
- IEEE Workshop on Game Theory and Applications, Oct. 2014 (CSA/ECE)
- INUP Hands-on Training on “Nanofabrication Technologies”, Oct. 2014 (ECE)
- INUP Familiarization Workshop on “Nanofabrication Technologies”, May 2014 (ECE)
- IISc-Microsoft Research India Summer School on Networking, Jun. 2014 (ECE)
- International Conference on Signal Processing and Communications (SPCOM 2014), Jun. 2014 (ECE)
- INUP Hands-on Training on “Nanofabrication Technologies”, Jun. 2014 (ECE)
- Green communications and networks track, IEEE Vehicular Technology (ECE)
- International Conference on Signal Processing and Communications SPCOM 2014, 22-25, July 2014 (EE)
- 2014 International Conference on Signal Processing and Communications (SPCOM 2014), July 2014 (ECE)
- INUP Hands-on Training on “Nanofabrication Technologies”, Aug. 2014 (ECE)
- Big Data Public Lecture Series – 2014 (CSA)
- The IEEE Electrical Design of Advanced Packaging and Systems (EDAPS), Dec. 2014 (ECE)

- IEEE Global Conference on Signal and Information Processing (GlobalSIP), Dec. 2014 (ECE)
- INUP Hands-on Training on “Nanofabrication Technologies”, Dec. 2014 (ECE)
- 2<sup>nd</sup> IEEE International Conference on Emerging Electronics “Materials to Devices”, Dec. 2014 (ECE)
- XI Indian Conference on Vision, Graphics and Image Processing (ICVGIP 2014), 14-17, Dec 2014 (EE)

## DIVISION OF INTERDISCIPLINARY RESEARCH

---

- Workshop on Business Analytics, 8<sup>th</sup> February 2014 (MS / Information Excellence Group (IEG) Bangalore)
- RBCCPS-IEE Japan Workshop on Technologies for Smart Cities, February 19, 2014 (RBC)
- INUP Introductory Workshop on “Nanofabrication Technologies, 4 – 7 March 2014 (CeNSE)
- Oxford– RBCCPS Workshop on Imaging for Medical Applications, March 13, 2014 (RBC)
- One day workshop on Computational Science, 21 Mar 2014 (SERC)
- Research Directions in Solar Energy (RDSE – 2014), April 1-2, 2014 (ICER)
- CeNSE – DRDO Workshop, 16 April 2014 (CeNSE)
- INUP Familiarization Workshop on “Nanofabrication Technologies”, 21 – 23 May 2014 (CeNSE)
- One day Workshop on How to Promote Start-ups?, 13<sup>th</sup> June 2014 (MS / Department of Technology Management / Defense Institute of Advanced Technology, Pune)
- Indian Symposium on Computer Systems (IndoSys) (2014), Jun 28-29, 2014 (SERC)
- INUP Hands-on Training on “Nanofabrication Technologies, 24 June – 3 July 2014 (CeNSE)
- Seventh International Conference on Smart Materials, Structures and Systems (ISSS-2014), 08-11 July 2014 (CeNSE)

- IISc – University of Melbourne Workshop, 21-22 July 2014 (CeNSE)
- INUP Hands-on Training on “Nanofabrication Technologies, 19 – 28 August 2014 (CeNSE)
- Humboldt Kolleg on Interdisciplinary Science: Catalyst for Sustainable Progress, 4-6, Sep, 2014 (SERC)
- NPDE-TCA advanced workshop on Finite element methods for Navier-Stokes equations, 8 – 12, Sep 2014 (SERC)
- INUP Hands-on Training on “Nanofabrication Technologies, 7 – 16 October 2014 (CeNSE)
- Workshop on Water for Cities and Agriculture from Confrontation-Competition to Cooperation, October 31-November 1, 2014 (RBC)
- India Academia-Industry Training Camp, November 10-14, 2014 (RBC)
- The 14<sup>th</sup> Consortium of Students in Management Research-COSMAR 2014 Conference, 21<sup>st</sup> – 22<sup>nd</sup> November 2014 (MS)
- Fourth Management Research Students’ Symposium, 27<sup>th</sup> November 2014 (MS)
- 2ndIEEE International Conference on Emerging Electronics “Materials to Devices, 3 – 6 December 2014 (CeNSE)
- ICEE-2014, International Conference on Emerging Electronics, 3-6 Dec 2014 (CeNSE)
- INUP Hands-on Training on “Nanofabrication Technologies”, 9 – 18 December 2014 (CeNSE)
- Resource Recovery and Safe Reuse Stakeholder Workshop, 10<sup>th</sup> December 2014 (MS / WHO / International Water Management Institute [IWMI], Colombo)
- Automated Knowledge Base Construction (AKBC) 2014, Dec 13, 2014 (SERC / NIPS 2014, Montreal, Canada)
- International Conference on Business Analytics and Intelligence (ICBAI), 18-20, Dec. 2014 (MS)

- Indo-US Workshop on Virtual Institutes for Computational Science & Data Engineering (CSDE), December 20, 2014 (SERC)

## DIVISION OF MECHANICAL SCIENCES

---

- International Workshop on Models and Theories of Design (IWMT’13), 4-5 Jan. 2013 (CPDM)
- 27<sup>th</sup> Annual Students’ Symposium, 16-17 Jan. 2014 (MT)
- Golden Reunion BE 1963-64 batch, 18 Jan. 2014 (MT)
- “Training Program on Climate Science” for 45 students selected across the country, 20-31 Jan. 2014, (CAOS)
- Training Program on Climate Science, 20<sup>th</sup> Jan. to 31<sup>st</sup> Jan. 2014 (DCCC)
- Workshop on “Impact of aerosols and benefits of mitigation for South Asia”, 3rd-4<sup>th</sup> Feb. 2014 (DCCC)
- Training workshop on Western Ghats Biodiversity using Free and Open Source Geospatial (FOSS4G) tools, 24-27 Feb. 2014 (CES / CISTUP / CST)
- 7<sup>th</sup> workshop on “Low carbon materials and building systems”, 17 – 22 Mach 2014 (CST / CiE / KSCST)
- Near real time forecasting of soil moisture for water resources management, 24 -26 March 2014 (CiE)
- Panel Discussion with Fulbright-Nehru Scholars on Climate Change, Environment and adaptation, 26<sup>th</sup> March 2014 (DCCC)
- Research Directions in Solar Energy, 1-2 April 2014, (MT / ICER)
- The Latest IPCC WG-II 2014 Report- “New Findings on Climate Change Impacts, Vulnerability and Adaption”, 3<sup>rd</sup> April 2014 (DCCC)
- International Global Atmospheric Chemistry (IGAC) brain storming meeting on “Formation of an IGAC India Working Group, 06 April 2014 (DCCC / CAOS)
- International Geosphere Biosphere Programme (IGBP) Symposium, 07 April 2014 (CAOS)
- International Geosphere Biosphere Programme (IGBP), 7<sup>th</sup> -11<sup>th</sup> April 2014 (DCCC)



- International Geosphere Biosphere Programme (IGBP) Science Committee meeting, 8<sup>th</sup>-10<sup>th</sup> April 2014 (CAOS)
- Sixth Jeremy Grantham Lecture on Climate Change- Prof. Lonnie G. Thompson, 9<sup>th</sup> April 2014 (DCCC)
- Meeting on “Development of Ice-core program for Himalayan Glaciers”, 11<sup>th</sup>-12<sup>th</sup> April 2014 (DCCC)
- Seminar on Discussion Meeting on The Latest IPCC WG-III 2014 Report- “What is New in the Latest IPCC Report on Mitigation of Climate Change”, 15<sup>th</sup> April 2014 (DCCC)
- NRC-M Symposium on Magnesium alloys: Processing, properties and applications, 5<sup>th</sup>-7<sup>th</sup> May 2014 (MT)
- NRC-M Symposium and Discussion meeting on Severe Plastic Deformation and bulk nano-structured materials, 12<sup>th</sup>- 14<sup>th</sup> May 2014 (MT)
- Seminar on Tropical Forests and Climate Change –Prof. Y. Malhi, 19<sup>th</sup> May 2014 (DCCC)
- NRC-M Workshop on Biomaterials, 23<sup>rd</sup>-25<sup>th</sup> May 2014 (MT)
- Training program on Glacier, Climate Change and Remote Sensing, 26<sup>th</sup> May – 6<sup>th</sup> June 2014 (DCCC)
- NRC-M Workshop on Phase-field Modeling, 8<sup>th</sup>-12<sup>th</sup> June 2014 (MT)
- 8<sup>th</sup> workshop on “Low carbon materials and building systems”, 12<sup>th</sup>-14<sup>th</sup> June 2014 (CST / CPDM)
- NRC-M Workshop on Molecular Dynamics & Monte Carlo Methods, 22<sup>nd</sup>-27<sup>th</sup> June 2014 (MT)
- NRC-M Workshop on Polymers: Properties, Characterizations & Applications, 1<sup>st</sup>-4<sup>th</sup> July 2014 (MT)
- Teaching Workshop on “Upper Ocean Physics”, 9<sup>th</sup>-21<sup>st</sup> July 2014 (CAOS)
- One day Workshop on Environment Education for Science Teachers, 10<sup>th</sup> July 2014 (CES / CST)
- SERB School on Noise and Vibration Control, One-week in July 2014 (ME)
- Structural Optimization, July 14-19, 2014 (ME)
- Monsoon School on Urban Floods, 04 – 09 Aug. 2014 (CiE)
- Internet based Course – Environment Management, August-Dec 2014 (CES / CCE / CST)
- International Conference on Friction Based Processes, Sept 03-05, 2014 (ME)
- International Conference on Friction based Processes-2014, Indian Institute of Science Bengaluru, 3-5 Sept 2014 (MT)
- Climate Change quiz, 23<sup>rd</sup> September 2014 (DCCC)
- Seminar on From Soil Aggregates to Landscapes: Insights for Sustainable Management of the Environment – Prof. Mark J Bailey, 01<sup>st</sup> October 2014 (DCCC)
- Workshop on Environment Education – Orientation Programme for School Students, IISc, Bangalore, 4<sup>th</sup> October 2014 (CES)
- 3<sup>rd</sup> Workshop of Adaptation of Irrigated agriculture to climate change, 6 -10 October 2014 (CiE)/ CST)
- Geo-Innovations 2014, 30-31 October 2014 (CiE / IGS Bangalore Chapter)
- Meeting on “Estimation of Glacier Stored Water in the Himalaya”, 11<sup>th</sup> – 12<sup>th</sup> November 2014 (DCCC)
- Lake 2014 – Conservation and sustainable management of wetlands in western Ghats, 13<sup>th</sup>-16<sup>th</sup> Nov 2014 (CES / CST / CISTUP)
- 2<sup>nd</sup> ANCST Workshop on “Atmosphere-Ocean Interactions in the Indo-Pacific Basin and Asian Climate”, 23<sup>rd</sup>-24<sup>th</sup> November 2014 (DCCC)
- ANCST Workshop on “Atmosphere-ocean interactions in the Indo-Pacific basin and their impact on Asian climate, 23<sup>rd</sup>-24<sup>th</sup> November 2014 (CAOS)
- International Workshop on Iron and Steel making (IWIS-2014), 3<sup>rd</sup>-5<sup>th</sup> Dec 2014 (MT)
- Indo-Dutch International Conference on Design for Sustainable Wellbeing and Empowerment, 7<sup>th</sup>-14<sup>th</sup> Dec 2014 (CST)

- International Multi-cultural Design Studio Workshop (CST)
- Science Discussion Meeting on “Bay of Bengal”, organised at Chennai, 16-18 December 2014 (CAOS)
- NRC-M Workshop on Advances in Corrosion Engineering, 22<sup>nd</sup>- 24<sup>th</sup> Dec 2014 (MT)
- Seminar-Cum-Meeting of SIG-G6 & H3 of WCTRS on “Transportation in Developing Countries & Disaster Resilience, 14<sup>th</sup>-16<sup>th</sup> Dec. 2014 (CiE / TRG / WCTRS)
- 37<sup>th</sup> International Conference on High Energy Physics, Valencia, July 2-9 2014 (CHEP)
- Workshop on “Galaxies and Cosmology”, July 7-18, 2014 held at NCRA,TIFR, Pune (PHY)
- Parallel Session on SUSY phenomenology, SUSY2014: The 22<sup>nd</sup> International Conference on Supersymmetry and Unification of Fundamental Interaction, Manchester University, July 21-26 2014 (CHEP/ Manchester)

## DIVISION OF PHYSICAL AND MATHEMATICAL SCIENCES

---

- Workshop on Geometry of Mechanics and Control Theory, Jan. 02-10, 2014 (NMI/Math)
- School and Conference on Strongly Correlated Systems: From Models to Materials, Jan. 6-17, 2014 (PHY)
- Women in Science (WiS) Program of the Indian Academy of Sciences, January 11, 2014 (CHEP)
- Indian Statistical Physics Community Meeting 2014 – organised with A. Dhar, K. Jain, S.S. Ray, and S. Sabhapandit, 1-3 February 2014 (PHY)
- Organised the International Workshop on Mathematical Structure in Quantum Physics and Applications from 3-14 February 2014, at IISc, Bangalore. (CHEP)
- Workshop on Nonlinear Integrable Systems and their Applications, Feb. 24 – Mar. 01, 2014 (Math)
- Career in Science, Program of the WiS Panel of the Indian Academy of Sciences, S.R.N. Adarsh College Bangalore, March 10-11 2014 (CHEP)
- Workshop on Discrete Integrable Systems, June 09 -14, 2014 (Math)
- Conference on Symmetries and Integrability in Difference Equations (SIDE 2014), June 16-21, 2014 (Math)
- Taylor series based map approach outperforms existing image reconstruction techniques, Focus on Microscopy 2014, Sydney, Australia (IAP)
- In-depth 3D image reconstruction for fluorescence microscopy, Focus on Microscopy 2014, Sydney, Australia (IAP)
- Sage Days 60, Aug. 14 – 17, 2014 (Math)
- Career in Science, Program of the WiS Panel of the Indian Academy of Sciences, CMR College Bangalore, August 22-23 2014 (CHEP)
- Conference on Stochastic Systems and Applications, Sept. 08-11, 2014 (Math)
- Group Co-ordinator, BSM physics, ICHEP Conference (CHEP)
- Session on Women in Science at the 50<sup>th</sup> Anniversary of the Abdus Salam International Centre for Theoretical Physics, October 4-8 2014 (CHEP/ Abdus Salam)
- Discussion Meeting on Quantum Measurements, 22-24 October 2014. (International) (CHEP)
- Asia Europe Pacific School on High Energy Physics, Puri, November 4-17, 2014 (CHEP)
- A One-Day Symposium on Galaxies, 29<sup>th</sup> November, 2014 (PHY)
- Computational Partial Differential Equations: Finite Element Meet, Dec. 18 – 20, 2014 (Math)

---

## 7.3 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 508 speakers from other

organizations and 285 speakers from within the Institute (Faculty and Students). The subjects generated a great deal of academic and scientific interest.

---

## 7.4 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 829 visits (419 abroad and 410 India) were made to various departments.

---

## 7.5 Faculty: Other Professional Services

---

Members of the Faculty visited other institutions/ organizations on topics of current interest. In all, 755 visits (264 abroad and 491 India) were made and 860 lectures were delivered during these visits. While 601 faculty members participated in conferences, symposia etc. organized within India, 259 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, Valuers and Members of Expert Panels, Selection Committees & Advisory Committees. In all, **426** participations were reported during the year (379 – thesis referees, 47 – question paper setting, etc. & 425 as Chairperson/Members in Advisory/Selection/Evaluation Committees etc.).

Scientific and Technical Journals play an important role in publishing research work and also for reference work. 335 members of the faculty served on Editorial Boards of various prestigious journals published in India and abroad.

---

## 7.6 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.

---

## 7.7 Office of International Relations

(Chairperson: Usha Vijayaraghavan)

---

The IRC oversees and coordinates all international programmes of the Institute. In particular, it is responsible for the following:

- Admissions of International students to PhD and MSc (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 Israel: H.E. Alon Ushpiz, Ambassador, on 13<sup>th</sup> May, 2014.
- Delegation from Texas, USA: Dr. Mark Hussey, President, A&M University, on 21<sup>st</sup> May, 2014.
- Delegation from UK: 12 members led by Dr. Stephen Flint, Associate Dean, (Internationalisation), University of Manchester, on 8<sup>th</sup> September, 2014.
- Delegation from Japan: 6 members, with Vice President of Mie University, on 10<sup>th</sup> September, 2014.
- Delegation from Embassy of The Islamic Republic of Iran: Dr. Ali Azam Khosravi, Research Counselor

(Science Research & Technology India & Subcontinent) on 29<sup>th</sup> September, 2014.

- Delegation from UK: Center for Ecology and Hydrology, Prof. Alan Jenkins, British High Commission, Delhi, on 1<sup>st</sup> October, 2014.
- Delegation from Germany: University of Juelich, Prof. Herzog, German embassy representative and Prof. N Bansal, on 7<sup>th</sup> October, 2014.
- Delegation from UK: Prof. Brian Kinsella, Deputy Director, Applied Corrosion Research and Testing, Curtin University and Prof. Robert Burford, CRC Polymers, on 13<sup>th</sup> October, 2014.
- Delegation from USA: Mr. Samuel Kotis, (US Embassy Counselor for Economics, Environment, Science and Technology) on 16<sup>th</sup> October, 2014.
- Delegation from France: Scientists, industry team leaders and engineering delegation (CNRS, Thales and others) led by Dr. Jenifer Clark on 28<sup>th</sup> October, 2014.
- Delegation from the Czech Republic: 15 member delegation, Embassy of the Czech Republic, on 29<sup>th</sup> October, 2014.
- Delegation from El Salvador: H.E. Ambassador of El Salvador, Mr. Guillermo Rubio Funes, on 29<sup>th</sup> October, 2014.
- Delegation from Denmark: Technical University of Denmark (DTU), led by Mr. Morten Overgaard, Head of International Affairs, on 5<sup>th</sup> November, 2014.
- Delegation from Germany: Prof. Dr. Juergen Kreft, Vice-President International Relations, on 27<sup>th</sup> November, 2014.
- Ambassador of Italy, Daniele Mancini on 2<sup>nd</sup> December, 2014.
- Delegation from Durham University UK, led by Prof. Patrick Hussey, Vice Chancellor (Science) on 5<sup>th</sup> December, 2014.



- Delegation from France: University Pierre et Marie Curie, Prof. Danielle Seilhean and Prof. Jean Chambaz, on 12<sup>th</sup> December, 2014.
- Delegation from Australia: The University of Melbourne, Australia, Prof. Saman K. Halgamuge, on 19<sup>th</sup> December, 2014.
- Delegation from USA: Rutgers, The State University of New Jersey, on 8<sup>th</sup> January, 2015.
- Delegation from JAIST Japan Advanced Institute of Science Technology, on 13<sup>th</sup> January, 2015.
- Delegation from France: Dr. Armel de la Bourdonnaye, Director Ecole des Ponts Paris Tech, France, led by Dr Thibaut Skrzypek, on 22<sup>nd</sup> January, 2015.
- Mr. Phillip Min, Consul-General, Chennai Consulate of USA on 29<sup>th</sup> January, 2015.
- Mr. Jörn Rohde, Consul-General, Germany on 30<sup>th</sup> January, 2015.
- Delegation from France: Prof. Catherine Jessus (Director, CNRS) on 3<sup>rd</sup> February, 2015.
- Delegation from Brunei: University of Brunei, Darussalam, Dr. Zulkarmain Hanafi, (Vice Chancellor & President), on 6<sup>th</sup> February, 2015
- Delegation from UK: University of Birmingham Dr Peter Lund on 9<sup>th</sup> February, 2015.

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:-

- Agreement of Cooperation with Alma Mater Studiorum University of Bologna, signed on 17<sup>th</sup> September, 2014.
- Indian and Egyptian Petroleum Research Institute (EPRI), Cairo, Egypt, signed on 26<sup>th</sup> September, 2014.
- The Natural Environments Research Council (NERC) Centre for Ecology & Hydrology, signed on 1<sup>st</sup> October, 2014.
- The Julius-Maximilians-Universität, Würzburg, signed on 27<sup>th</sup> November, 2014.
- Extension of MOU with Tohoku University, signed on 1<sup>st</sup> December, 2014
- National TsingHua University, Hsinchu, signed on 1<sup>st</sup> December, 2014.
- Adama Science and Technology University, signed on 18<sup>th</sup> December, 2014.
- Japan Advanced Institute of Science and Technology (JAIST) signed on 13<sup>th</sup> January, 2015.
- Center for Sensorimotor Neural Engineering, Seattle, Washington, USA, signed on 3<sup>rd</sup> February, 2015.
- Extension of MOU with University of Birmingham, signed on 9<sup>th</sup> February, 2015.

A detailed list of MOUs is available at the IRC website <http://irc.iisc.ernet.in/>



## 8

# SPONSORED RESEARCH AND EXTERNAL INTERACTIONS

## 8.1 Centre for Sponsored Schemes & Projects

(Advisor: R Mohan Das)

Most of the research contributions from the Institute come from research and development sponsored by over a hundred agencies with a total of **887** projects with an outlay of ₹ **1031.50 crores** and an annual cash flow of ₹ **207 crores**. The primary sponsors are the Department of Science and Technology, Aeronautical Research and Development Board, Dept of Biotechnology, Indian Space Research Organisation, Space Technology Cell, Council of Scientific and Industrial Research, Department 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 Welcome Trust, IBM, Asian Office of Aerospace Research and Development, Indo-French Centre for Promotion of Advanced Research, Korea Institute of Science and Technology, European Union, The Swiss Agency for Development Agency and UK-India Education and Research Initiative.

The Science departments received a total of **459** projects with a total outlay of ₹ **465.41 crores**. The Engineering departments received **428** projects with a total outlay of ₹ **566.09 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	240	188.28
Division of Chemical Sciences	117	157.90
Division of Electrical Sciences	82	98.56
Division of Interdisciplinary Research	59	77.83
Division of Mechanical Sciences	287	389.70
Division of Physical and Mathematical Sciences	102	119.23
<b>Grand Total</b>	<b>887</b>	<b>1031.50</b>

### BIOCHEMISTRY

**Projects: 52**

**Total: 3,669.88 Lakhs.**

- 'Feasibility of using Glycodelin in the Management of Graft Rejection' Anjali A Karande, DBTO, 9/22/2011 to 8/21/2015, 47.87 Lakhs.
- 'Development of Insect Based Bio Sensor Model for 2 Detection of Common Explosives' Anjali A Karande, DRDO, 12/5/2012 to 6/3/2014, 39.90 Lakhs.
- 'Characterization of Antibodies and Large Scale Screening of Herbal Compounds for the Development of 3 HCV Entry Inhibitors – Sub-Project 2.2' Anjali A Karande, DBTO, 9/3/2013 to 9/2/2018, 44.71 Lakhs.

4. 'Establishment of human ectopic liver tissue in mice' Anjali A Karande, DBTO, 9/18/2013 to 9/17/2016, 17.36 Lakhs.
5. 'Isolation & Structural Characterization of Tropane Alkaloids & Thrombin Inhibitors from Endophytic Fungi 5 Isolated from Catharanthus Roseus & Datura Metel' C Jayabhaskaran, DBTO, 9/29/2011 to 9/28/2014, 71.39Lakhs.
6. '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, 43.70 Lakhs.
7. '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, 37.50 Lakhs.
8. J C Bose Fellowship to D Narasimha Rao, DSTO, 9/1/2008 to 8/31/2018, 114.90Lakhs.
9. 'The Role of DNA Processing Protein (DprA): Studies With A Conserved Bacterial Protein Involved in Natural Transformation' D Narasimha Rao, DAEO, 4/15/2011 to 3/31/2014, 23.97 Lakhs.
10. 'Characterization of MutS Homolog Protein MutS2 from Helicobacter pylori' D Narasimha Rao, CSIR, 1/1/2012 to 3/31/2015, 27.35 Lakhs.
11. 'DNA Mismatch Repair in Prokaryotes: Beyond The E.Coli Paradigm' D Narasimha Rao, DBTO 7/2/2012 to 7/1/2015 34.47 Lakhs.
12. 'Understanding mRNA fate decisions: Role of arginine- methylation in functional transitions of RNA-protein complexes(mRNPs)' Purusharth Rajyaguru, WELT, 11/1/2013 to 0/31/2018, 351.73 Lakhs.
13. 'Mechanism of BCR-ABL translocation in chronic myelogenous Leukemia' Elizabeth Thomas, DSTO, 9/26/2012 to 9/25/2015, 24.60 Lakhs.
14. '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, 30.20 Lakhs.
15. 'The role of FANCO/RAD51C in DNA damage signaling' Ganesh Nagaraju, DSTO, 3/25/2013 to 3/24/2016, 54.70 Lakhs.
16. 'Malarial Parasite Biology: An avenue to discover new drug targets' G Padnababhan, DBTO, 8/19/2010 to 8/18/2015, 136.24 Lakhs.
17. J C Bose Fellowship to H S Savithri, DSTO, 9/1/2008 to 8/31/2018, 70.50 Lakhs.
18. 'Exploration of Marine Actinomycetes for Bioactive Compounds' H S Savithri, DSTO, 4/26/2011 to 4/25/2014, 24.10 Lakhs.
19. '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.
20. 'Genomic and proteomic profiling of preoptic area(POA) of the female rat following neonatal administration of estradiol-17  $\beta$ ' A Jagannadha Rao, DSTO, 7/1/2013 to 6/30/2016, 55.00 Lakhs.
21. J C Bose Fellowship to K Muniyappa, DSTO, 6/1/2006 to 5/31/2016, 115.55 Lakhs.
22. 'Processing of Dna Double – Strand Breaks By Yeast Mre11-Rad50-Xrs2 Complex' K Muniyappa, CSIR, 4/1/2011 to 3/31/2014, 27.79 Lakhs.
23. '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.
24. 'Research Associateship in Biotechnology and Life Sciences Programme for North East States' K Muniyappa, DBTO, 8/1/2013 to 7/31/2015, 174.40 Lakhs.
25. 'DBT Research Associateship Programme' K Muniyappa, DBTO, 8/1/2013 to 7/31/2015, 686.35 Lakhs.
26. 'Establishment of National Database on Tuberculosis (TB) – Phase II' Nagasuma Chandra, DBTO, 6/10/2011 to 6/9/2014, 55.96 Lakhs.

27. 'Mapping of Ligand Binding Sites to Protein Function Through Structural Analysis' Nagasuma Chandra, DSTO, 8/11/2011 to 8/10/2014, 17.40 Lakhs.
28. '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.
29. Add-on R&D Project II: 'Modelling and Simulation of Cytokine Networks' Nagasuma Chandra, DBTO, 1/21/2013 to 1/20/2016, 40.77 Lakhs.
30. 'Uncovering The Central Role of Human Frataxin Gene in Cellular Iron Homeostasis' Patrick D' Silva, CSIR, 4/1/2012 to 3/31/2015, 31.05 Lakhs.
31. '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.
32. 'Uncovering multifunctional roles of mitochondrial heat shock proteins in neurodegenerative disorders and cancer progression' Swarna Jayanti Fellowship Patrick D' Silva, DSTO, 8/26/2013 to 8/25/2018, 230.30 Lakhs.
33. '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 Lakhs.
34. 'Transcriptional Regulation by Mxr1p in Pichia Pastoris' P N Rangarajan, DBTO, 7/3/2013 to 7/2/2016, 71.01 Lakhs.
35. 'A Study on the Production of Bioactive Compounds from Endophytic Fungi. Fermentation (WOS-A)' Padmini Priya Chandrika, DSTO, 4/17/2012 to 4/16/2015, 17.80 Lakhs.
36. 'Infection with Japanese encephalitis virus (jev) role of soluble classical and nonclassical MHC-1 molecules' R Manjunath, CSIR, 9/1/2011 to 8/31/2014, 22.49 Lakhs.
37. 'The Mechanism of Hoxii Chromosomal Translocation in T-Cell Leukemia' Sathees C Raghavan, CSIR, 4/1/2010 to 3/31/2014, 29.40 Lakhs.
38. 'Mechanism of Bcl6 Translocation in Diffuse Large B-Cell Lymphoma' Sathees C Raghavan, DBTO, 7/1/2011 to 1/31/2015, 69.40 Lakhs.
39. '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.
40. '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.
41. '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, 39.87 Lakhs.
42. 'Mechanism of Dna Breakage and Repair in Mitochondria' Sathees C Raghavan, CSIR, 4/1/2013 to 3/31/2016, 23.28 Lakhs.
43. 'Mechanism of Chromosomal Translocations in Leukemia and Lymphoma' Sathees C Raghavan, DBTO, 8/27/2013 to 8/26/2016, 9.00 Lakhs.
44. 'Molecular Analysis of The Role of Mms21 Mediated Sumoylation in Maintenance of Chromosome Stability in Saccharomyces Cerevisiae' Shikha Laloraya, DBTO, 6/29/2011 to 8/28/2015, 54.16 Lakhs.
45. 'An Approach to Block Hepatitis C Virus Entry By Monoclonal Antibodies' Soma Das, DBTO, 9/11/2013 to 9/10/2016, 33.64 Lakhs.
46. '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.



47. 'Mining Markers of Pregnancy in Cell Free Body Fluids of Buffaloes (Bubalus Bubalis)' Utpal S Tatu, DBTO, 2/13/2012 to 2/12/2015, 17.86 Lakhs.
48. '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.
49. '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, 56.00 Lakhs.
50. '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.
51. '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, 69.23 Lakhs.
52. 'Effect of bacterial infections on Th1/Th2/Th17 balance during pregnancy' Vidya Devi, DSTO, 5/7/2013 to 5/6/2016, 25.60 Lakhs.
56. 'Alternate Approaches to Antitubercular Drug Discovery' Debnath Pal, DBTO, 10/24/2013 to 10/23/2016, 40.57 Lakhs.
57. 'Algorithms Software and Database to Analyze Nuclei Acid Sequence and Protein Structure' K Sekar, MITO, 3/19/2012 to 3/18/2015, 37.28 Lakhs.
58. '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.

## MICROBIOLOGY AND CELL BIOLOGY

**Projects: 59** **Total: 5,333.70 Lakhs.**

59. 'Elucidation of HIV/CD4T Cell Interaction Pathways for Novel Therapeutic and Biomarker Discovery' Annapurna Vyakarnam, DBTO, 1/9/2012 to 1/8/2017, 26.00 Lakhs.
60. 'Innate Predictors of Adaptive BCG and HBV Vaccine-Induce Responses in Bangalore Adolescents' Annapurna Vyakarnam, DBTO, 10/22/2013 to 10/21/2015, 102.98 Lakhs.
61. 'Programme Support for Research in Hiv-Tb Co-Infection' – Biomarker Discovery and Validation of Blood Immune Responses Following Hiv-Tb Co-Infection – Annapurna Vyakarnam, DBTO, 10/28/2013 to 10/27/2016, 184.15 Lakhs.
62. 'Organization of India-UK seminar at IISc from Jan 29-31st of 2014' Annapurna Vyakarnam, DSTO, 1/10/2014 to 1/9/2015, 4.10 Lakhs.
63. 'Functional characterisation of Novel Genes of Mycobacterium Tuberculosis & their role in Immunomodulation of host immune responses' Balla Venkata Kranthi, DSTO, 5/28/2012 to 5/27/2015, 24.17 Lakhs.
64. 'Establishment of Networking Resources Centre in Science Departments' C Durga Rao, UGCO, 5/8/2009 to 5/31/2015, 499.07 Lakhs.

## BIOINFORMATICS CENTRE

**Projects: 6** **Total: 139.87 Lakhs.**

53. '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.
54. 'Sub. Project. 5 – Analysis of Hemoglobin Variants (Core Project Dbt324)' Debnath Pal, DBTO, 9/29/2011 to 9/28/2016, 13.42 Lakhs.
55. 'A genome scale metabolic reconstruction and flux balance analysis of bifidobacterium animalis strain longum BBMN68' Debnath Pal, DSTO, 10/20/2012 to 10/19/2015, 21.65 Lakhs.

65. '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.
66. '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.
67. 'National Bioscience Award for Career Development 2010' Dipshikha Chakravorty, DBTO, 4/26/2011 to 3/20/2015, 8.74 Lakhs.
68. 'Biology of Gene-Deleted 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.
69. '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.
70. 'Molecular mechanisms of immune evasion by m. Tuberculosis' K N Balaji, IFCP, 10/1/2012 to 10/31/2016, 32.58 Lakhs.
71. '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, 73.14 Lakhs.
72. 'Sub Project of DSTO-809' Kumaravel Somasundaram, DSTO, 7/8/2008 to 3/31/2014, 55.34 Lakhs.
73. 'Dissecting Deregulated Micrnas Network in Glioblastoma' – Team Leader's Project 2 Kumaravel Somasundaram, DBTO, 9/9/2010 to 9/8/2015, 60.70 Lakhs.
74. '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.
75. 'Multi-Institutional Network Programme On Molecular Neuro-Oncology' – Core Project Kumaravel Somasundaram, DBTO, 9/9/2010 to 9/8/2015, 348.90 Lakhs.
76. 'Glioma Serum Biomarker Discovery Through Proteomic Approaches' Kumaravel Somasundaram, DBTO, 3/28/2011 to 3/31/2015, 83.10 Lakhs.
77. J C Bose Fellowship to Kumaravel Somasundaram, DSTO, 8/16/2012 to 8/15/2017, 68.00 Lakhs.
78. 'Genome Wide Screening to Dissect Glioma Sensitivity to Temozolomide' – Core Grant of DBT356 Kumaravel Somasundaram, DBTO, 9/20/2012 to 9/19/2015, 48.43 Lakhs.
79. 'Unraveling Glioma Development and Progression Through Whole-Exome Sequencing' Kumaravel Somasundaram, DBTO, 5/6/2013 to 5/5/2016, 99.72 Lakhs.
80. '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, 22.80 Lakhs.
81. '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, 39.32 Lakhs.
82. '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.
83. 'MicroRNA turnover complexes – 'miRNasomes': the potential core constituents of the microRNA turnover pathway in Caenorhabditis elegans' Saibal Chatterjee, WELT, 1/2/2013 to 1/1/2018, 391.42 Lakhs.
84. 'Approaches to Develop An Effective HCV Vaccine' Saumitra Das, DBTO, 7/7/2010 to 1/5/2015, 105.52 Lakhs.
85. 'Role of Host-Virus Interaction in Coxsackievirus B3 Infection' Saumitra Das, DBTO, 3/14/2012 to 9/13/2015, 62.22 Lakhs.
86. 'Studies on Translational Control of p53 Isoforms'



- Saumitra Das, DBTO, 9/7/2012 to 9/6/2015, 74.51 Lakhs.
87. '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.
  88. '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.
  89. '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.
  90. 'Centre of Excellence for Research On Hepatitis C Virus – Phase II' Saumitra Das, DBTO, 9/3/2013 to 9/2/2018, 163.50 Lakhs.
  91. 'To Study The Role of Hcv Proteins in Immunoregulation and Hepatocarcinogenesis' Saumitra Das, DBTO, 9/17/2013 to 9/16/2016, 55.42 Lakhs.
  92. '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.
  93. 'Role of Hermansky-Pudlak Syndrome Associated Protein Complexes in Organelle Biogenesis' Subbarao Gangisetty, WELT, 10/1/2010 to 9/30/2015, 350.96 Lakhs.
  94. '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.
  95. '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.
  96. Project No.4903-1 – 'Control of Melanosome Biogenesis by small Gtpases' Subbarao Gangisetty, IFCP, 3/1/2013 to 2/29/2016, 66.65 Lakhs.
  97. 'Imaging and Biochemical Analysis of Subversion of Innate Immune Cells by Glycoprotein's of Pathogenic Mycobacteria' S Vijaya, DBTO, 9/28/2012 to 9/27/2015, 70.23 Lakhs.
  98. '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.
  99. '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.
  100. 'Characterization of Tarani, A Locus Involved in Controlling Biological Surface Curvature' Utpal Nath, DBTO, 8/31/2010 to 8/30/2014, 50.47 Lakhs.
  101. 'Screening of Medicinal Plants for Antiviral Properties against Hepatitis-C Virus' Uma Reddy, DSTO, 5/18/2012 to 5/17/2015, 24.20 Lakhs.
  102. 'Functional Analysis of Gene Regulatory Networks during Flower and Seed Development in Rice' Usha Vijayaraghavan, DBTO, 9/18/2009 to 12/31/2014, 107.013 Lakhs.
  103. J C Bose Fellowship to Usha Vijayaraghavan DSTO 8/4/2010 to 8/3/2015 68.00 Lakhs.
  104. J C Bose Fellowship to Umesh Varshney DSTO 9/1/2008 to 8/31/2018 124.90 Lakhs.
  105. 'Biology of Gene-Deteted M.Tuberculosis Strains – Immunological Marker Profiling – Sub-Project of DBTO 253' Umesh Varshney, DBTO, 9/17/2009 to 9/30/2014, 33.10 Lakhs.
  106. 'Mechanisms of Protein Synthesis and Ribosome Targeting Antibiotic Drugs in Mycobacteria' Umesh Varshney, DBTO, 9/22/2009 to 6/21/2014, 94.43 Lakhs.
  107. '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, 21.83 Lakhs.
  108. '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, 76.42 Lakhs.

109. '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.
110. J C Bose Fellowship to V Nagaraj, DSTO, 9/1/2008 to 8/31/2018, 124.90 Lakhs.
111. 'Catalytic Antibodies in Immune-Mediated Disorders' V Nagaraja, IFCP, 8/1/2009 to 4/30/2014, 42.40 Lakhs.
112. 'Biology of Gene-Detected M.Tuberculosis Strains-Immunological Marker Profiling' V Nagaraja, DBTO, 9/17/2009 to 9/30/2014, 209.18 Lakhs.
113. 'More Medicines for Tuberculosis (Mm4tb)' V Nagaraja, EUCO, 2/1/2011 to 1/31/2016, 104.43 Lakhs.
114. 'Sys TB: A Network Program for Resolving The Intracellular Dynamics of Host Pathogen Pathogen Interaction in TB Infectio' V Nagaraja, DBTO, 1/9/2012 to 1/8/2017, 156.13 Lakhs.
115. '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.
116. 'Understanding the gene regulatory network of Mycobacterium tuberculosis' V Nagaraja, DSTO, 8/8/2013 to 8/7/2015, 6.77Lakhs.
117. 'Role of gas6 protein in inflammatory respiratory disease' William Rasican Surin, DSTO, 5/17/2012 to 5/16/2015, 13.90 Lakhs.

**CENTRE FOR INFECTIOUS DISEASE RESEARCH, MICROBIOLOGY AND CELL BIOLOGY**

**Projects: 3 Total: 107.58 Lakhs.**

118. Ramanujan Fellowship to Viswanathan Arun

Nagaraj, DSTO, 11/1/2010 to 10/31/2015, 62.40 Lakhs.

119. '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, 23.98 Lakhs.
120. 'Deciphering the Functional Significance of Rab-Mediated Vesicular Trafficking Processes in Malaria Parasite' Viswanathan Arun Nagaraj, DSTO, 7/23/2012 to 7/22/2015, 21.20Lakhs.

**MOLECULAR REPRODUCTION, DEVELOPMENT AND GENETICS**

**Project: 25 Total: 2,013.70 Lakh**

121. 'Study the Anti-Cancer Effects of Indigenous Medicinal Plants Bearing Sesquiterpene Lactones in Human Epithelial Cancer Stem Cells' Annapoorni Rangarajan, DBTO, 11/22/2010 to 11/21/2014, 34.58 Lakhs.
122. '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, 508.77 Lakhs.
123. '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.
124. '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.
125. '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.
126. 'Regulation of Map Kinase Transactivation By G Protein By Complex Translocation' Deepak Kumar Saini, DSTO, 52.2 Lakhs.

127. 'Sys TB: A Network Program for Resolving The Intracellular Dynamics of Host Pathogen Interaction in TB Infection' Deepak Kumar Saini, DBTO, 133.91 Lakhs.
128. 'Generation of Biosensors for Studying Activation and Subcellular Localization of two Component Signal Transduction System in Living Cells' Deepak Kumar Saini, DBTO, 81.95 Lakhs.
129. 'Identification of Genes Involved in Regulating Dna Damage Response, Cellular Senescence and Senescence Mediated Carcinogenesis' – Core Grant of Dbt356 – Deepak Kumar Saini, DBTO, 48.40 Lakhs.
130. 'Regulation of innate immune responses and longevity by the nervous system in Caenorhabditis elegans' Varsha Singh, WELT, 10/1/2013 to 9/30/2018, 338.43 Lakhs.
131. 'Studies on Cellular and Molecular Principles Regulating Zonolysis during Mammalian Blastocyst Hatching' P B Seshagiri, DSTO, 3/2/2012 to 3/1/2015, 42.44 Lakhs.
132. 'N Potential of Plourpotent 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.
133. 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.
134. '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.
135. 'Comparison of gene expression profiles of Oral squamous cell carcinoma with sub mucous fibrosis' Paturu Kondaiah, DSTO, 6/26/2013 to 6/25/2016, 53.31 Lakhs.
136. '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.
137. '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, 53.37 Lakhs.
138. 'Production and Characterization of Recombinant Bovine and Bubaline Gonadotropins' Rajan R Dighe, DBTO, 3/6/2012 to 9/5/2015, 46.67 Lakhs.
139. 'Immunological Approach to investigate the structure-function relationship of notch receptors and ligands' Rajan R Dighe, DSTO, 7/12/2012 to 7/11/2015, 57.61 Lakhs.
140. '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.
141. '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, 81.30 Lakhs.
142. 'Cyclic Nucleotide Mediated Cell Signalling in Mycobacteria: Structure and Function' Sandhya S Visweswariah, DSTO, 5/9/2011 to 5/8/2014, 7.61 Lakhs.
143. 'Novel Approaches to Tackling Tuberculosis' Sandhya S Visweswariah, UKIE, 5/9/2012 to 1/31/2015, 8.21 Lakhs.
144. '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.
145. '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.

## MOLECULAR BIOPHYSICS UNIT

---

**Projects: 42**

**Total: 3,288.31 Lakhs.**

146. J C Bose Fellowship to A Surolia, DSTO, 1/2/2012 to 11/30/2015, 61.2 Lakhs.
147. 'Characterization of Cytotoxic Intermediates and Deciphering The Underlying Mechanism of Cell Toxicity in Transthyretin Related Amloidosis' A Surolia, DBTO, 4/1/2012 to 11/22/2014, 4.30 Lakhs.
148. '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, 90.51 Lakhs.
149. '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.
150. '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.
151. 'Exploration of Ampylation, A Novel Post-Translational Signaling Mechanism, in Mycobacterium Tuberculosis' A Surolia, DBTO, 6/28/2013 to 6/27/2016, 120.95 Lakhs.
152. 'Potassium and Glutaminergic Channel Modulation to Relieve Neuropathic Pain and Obsessive Compulsive Disorder' A Surolia, CSIR, 8/1/2013 to 7/31/2018, 104.21 Lakhs.
153. 'National Bioscience Award for Career Development 2010' B Gopal, DBTO, 4/26/2011 to 3/31/2015, 9.00 Lakhs.
154. 'Understanding The Mechanism of Inter-Cell Communication in Staphylococcus Aureus' B Gopal, DSTO, 7/31/2012 to 7/30/2015, 43.53 Lakhs.
155. J C Bose Fellowship to Dipankar Chatterji, DSTO, 8/1/2007 to 7/31/2017, 121.25 Lakhs.
156. 'Development of an Inhibitor for Stingent Response: Control of Bacterial Growth in Stationary Phase' Dipankar Chatterji, DBTO, 9/17/2009 to 9/16/2014, 251.34 Lakhs.
157. 'Development of an Inhibitor for Stringent Response: Control of Bacterial Growth in Stationary Phase' Dipankar Chatterji, DBTO, 9/17/2009 to 9/15/2015, 261.75 Lakhs.
158. INSPIRE Faculty Award (IFA-11LSBM-03) to Konkallu Hanumae Gowd, DSTO, 4/1/2012 to 3/31/2017, 21.20 Lakhs.
159. 'Molecular dynamic simulation study on human guanosine monophosphate synthetase(GMPS) enzyme and their hydrated complex: A theoretical approach towards the design of anticancer agent' Hridoy Ranjan Bairagya, DSTO, 9/23/2013 to 9/22/2016, 18.00 Lakhs.
160. '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, 44.23 Lakhs.
161. 'Structural and Functional Characterization of small Heat Shock Proteins' K Suguna, DSTO, 3/3/2014 to 3/2/2017, 43.32 Lakhs.
162. J C Bose Fellowship to Manju Bansal, DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs.
163. J C Bose Fellowship to M R N Murthy, DSTO, 6/1/2006 to 5/31/2016, 115.55 Lakhs.
164. '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.
165. '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.
166. 'Biophysical and electrochemical characterization of G-quadruplex and small molecules binding' Niki Sweta Jha, DSTO, 11/1/2013 to 10/31/2016, 20.10 Lakhs.



167. 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.
168. '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.
169. 'Development of behavioural & 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 12/31/2014, 39.37 Lakhs.
170. 'Deep Sequencing of Venom Duct cDNAs From Indian Cone Snails' P Balaram, DBTO, 8/20/2010 to 2/19/2015, 47.94 Lakhs.
171. 'Mining cancer genome sequencing data to study mutations in cancer' Prathima Iengar, DSTO, 6/1/2013 to 5/31/2016, 17.28 Lakhs.
172. 'Calcium Store-Induced Intrinsic Plasticity in The Hippocampus' Rishikesh Narayanan, DBTO, 5/28/2012 to 5/27/2015, 50.86 Lakhs.
173. '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.
174. 'Development of anticancer compounds from ascidians' R P Rajesh, DSTO, 7/1/2013 to 6/30/2016, 22.75 Lakhs.
175. 'Collaborative Study Agreement Raghavan Vardarajan, MERK, 8/6/2003 to 9/30/2016, 52.79 Lakhs.
176. Collaborative Study Agreement Raghavan Vardarajan, MERK, 8/28/2006 to 8/23/2015, 67.79 Lakhs.
177. J C Bose Fellowship to Raghavan Vardarajan, DSTO, 8/1/2007 to 7/31/2017, 121.25 Lakhs.
178. 'Comparative Immunogenicity of Novel and South African Hiv-1 Subtype C Env Peptide and Recombinant Protein Constructs' Raghavan Vardarajan, DSTO, 4/21/2011 to 3/31/2015, 69.52 Lakhs.
179. 'Strategies for Preventing Protein Aggregation' Raghavan Vardarajan, DBTO, 2/22/2012 to 2/21/2016, 14.67 Lakhs.
180. 'Design of Peptide Analogs of Secondary structural Elements and The B12 Binding Site of Hiv-1 Gp120' Raghavan Vardarajan, DBTO, 3/27/2012 to 9/26/2015, 280.73 Lakhs.
181. '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.
182. '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.
183. 'Isolation & characterization of bioactive peptides from marine fungi and cone snails' Soorej M Basheer, DSTO, 6/26/2013 to 6/25/2016, 24.60 Lakhs.
184. 'Structural Studies of iLvM, The Regulatory Domain of E.coli AHAS II & 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.
185. 'Programme Support for Study of Molecular Structure and Intermolecular Interactions by NMR Spectroscopy' Siddhartha P Sarma, DBTO, 3/22/2012 to 3/21/2017, 276.29 Lakhs.
186. DBT's Twinning Programme for the Ne: 'In-Silico Design and Evaluation of Sequences for yD Crystallin Protein' Saraswathi Vishveshwara, DBTO, 1/4/2013 to 1/3/2016, 15.28 Lakhs.
187. '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.





## CENTRE FOR ECOLOGICAL SCIENCES

---

**Project: 35**

**Total: 1,496.99 Lakhs.**

188. 'Envis Centre on Western Ghats Ecology – Phase II' Chairman – BES, DEOO, 4/1/2007 to 3/31/2016, 47.01 Lakhs.
189. 'Studying conversation potential of *Syzygium travancoricum* Gamble, through ecological niche modelling & population genetic structure' Rajasri Ray, DSTO, 5/17/2012 to 5/16/2015, 24.58 Lakhs.
190. 'Altitudinal gradient in vector-mediated blood parasites across Western Himalayan birds' Farah Ishtiaq, WELT, 9/1/2013 to 8/31/2018, 356.84 Lakhs.
191. Molecular Phylogeographic Studies on Ranid Frogs of Western Ghats. K P Dinesh DSTO 5/24/2012 to 5/23/2015 25.20 Lakhs.
192. Addressing the 'Walleaceabn Shortfall' for Small Vertebrates in the Western Ghats across Space and Time, Kartik Shanker, CEPF, 10/1/2009 to 6/30/2014, 53.49 Lakhs.
193. '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, 28.24Lakhs.
194. 'Avian Frugivores-Understanding Patterns of Range and Richeness in The Western Ghats' Kartik Shanker, DSTO, 7/31/2012 to 7/30/2015, 16.46. Lakhs.
195. '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.
196. 'Impacts of Climate Change Induced Bleaching On Coral Reefs of The Andaman: Do Populaion Demography & Marine Protected Areas Enhance Recovery of Coral Reefs' Naveen Namboothri, DSTO, 5/17/2012 to 5/16/2015, 22.95 Lakhs.
197. 'Ecology & Mechanics of Acoustic Communication in Tree Crickets' Rohini Balakrishnan, UKIE, 2/15/2008 to 3/31/2015, 40.01 Lakhs.
198. '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.
199. 'Investigating the structure & function of vocal mimicry in the greater racket-tailed drongo (*dicrurus paradiseus*)' Rohini Balakrishnan, CSIR, 12/15/2010 to 6/30/2014, 34.11 Lakhs.
200. J C Bose Fellowship to Raghavendra Gadagkar, DSTO, 6/1/2006 to 5/31/2016, 115.55 Lakhs.
201. 'Queen Succession in The Primitively Eusocial Wasp *Ropalidia Marginata*' Raghavendra Gadagkar, CSIR, 11/1/2012 to 10/31/2015, 14.05 Lakhs.
202. 'Developement 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 Lakh
203. 'Centre for Ecological Science Scheme II -PHASE II' Renee M Borges, DEOO, 4/1/2007 to 3/31/2016, 34.50 Lakhs.
204. 'Fungus-Farming By Termites' Renee M Borges, CSIR, 11/1/2012 to 10/31/2015, 13.71 Lakhs.
205. '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.
206. 'Wildlife-Human Interactions: From Conflict to Co-Existence in Sustainable Landscapes' R Sukumar, NINA, 10/1/2007 to 6/30/2014, 121.80 Lakhs.
207. J C Bose Fellowship to Raman Sukumar, DSTO, 8/3/2010 to 8/2/2015, 64.40 Lakhs.
208. '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, 57.41 Lakhs.
209. 'Study of biodiversity in the Castlerock-Kulem





232. '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.
233. 'The Role of Constraints in the Design of the Nervous System' Biswa Sengupta, WELT, 12/1/2011 to 11/30/2015, 131.62 Lakhs.
234. '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.
235. 'Computational mechanisms of visual object segmentation and recognition' Harish Katti, DSTO, 9/25/2012 to 9/24/2014, 12.48 Lakhs.
236. INSPIRE Faculty Award to Naren P Rao (IFA-LSBM-36) Naren Rao, DSTO, 1/1/2013 to 12/31/2017, 35.92 Lakhs.
237. ;Interdisciplinary Centre on Neuroscience at IISc, (This is a Sub-Project of DSTO-943)' Shyamala Mani, DSTO, 3/30/2010 to 9/29/2015, 2.50 Lakhs.
238. '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.
239. '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.
240. '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.
241. J C Bose Fellowship to Vijayalakshmi Ravindranath, DSTO, 4/1/2009 to 3/31/2017, 103.05 Lakhs.
242. 'Brain Cytochromes P-450' Vijayalakshmi Ravindranath, NBRC, 7/20/2009 to 7/19/2019, 88.10 Lakhs.
243. 'Interdisciplinary Centre in Neuroscience at IISc' Vijayalakshmi Ravindranath, DSTO, 3/30/2010 to 9/29/2015, 1,341.90 Lakhs.

244. '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.

## CENTRAL ANIMAL FACILITY

---

**Projects: 2**

**Total: 118.38 Lakhs.**

245. 'Understanding the Mechanisms of Viral Induced Axonal Loss & Demyelination in an Experimental Animal Model' S G Ramachandra, DBTO, 9/1/2011 to 3/31/2015, 17.75 Lakhs.
246. 'Development of Diagnostic Kits for Health Monitoring of Experimental Animals' S G Ramachandra, DBTO, 11/18/2011 to 3/31/2015, 100.63 Lakhs.

## INORGANIC AND PHYSICAL CHEMISTRY

---

**Projects: 34**

**Total: 3,888.65 Lakhs.**

247. 'Metal complexes as structures 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.
248. 'Sub Project of DSTO 809' A R Chakravarthy, DSTO, 7/8/2008 to 3/31/2014, 22.00 Lakhs.
249. J C Bose Fellowship to A R Chakravarthy, DSTO, 9/1/2008 to 8/31/2018, 124.90 Lakhs.
250. 'Ferrocene-Conjugated Complexes as Photo Chemotherapeutic Agents' A R Chakravarthy, CSIR, 4/1/2012 to 3/31/2015, 12.47 Lakhs.
251. INSPIRE Faculty Award (IFA-11CH-11) to Bhalamurugan Sivaraman, DSTO, 3/14/2012 to 3/13/2017, 21.20 Lakhs.
252. '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, 11.32 Lakhs.



253. 'Laboratory Low Temperature Astrochemistry' B Sivaram, ISTC, 4/1/2013 to 3/31/2014, 16.68 Lakhs.
254. 'Synthesis of Luminescent supramolecular metal-organic frameworks for sensing of nitroaromatic explosives' Nidhi Goel, DSTO, 11/20/2013 to 11/19/2016, 25.00 Lakhs.
255. 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, 26.44 Lakhs.
256. J C Bose Fellowship to E D Jemmis, DSTO, 7/1/2013 to 6/30/2016, 42.20 Lakhs.
257. 'Development of Selenazole Drugs As A Novel Class of Anti-Cancer Agents Targeting The Immune Regulator Enzyme Indoleamine 2,3-Dioxygenase' G Mugesh, DBTO, 6/10/2011 to 12/9/2014, 105.66 Lakhs.
258. Astrazeneca excellence in chemistry award for the year 2011 to G. Mugesh, AZIP, 3/1/2012 to 12/31/2014, 25.05 Lakhs.
259. 'Peptide aggregation in Neurodegenerative Diseases: Metal Mediated Tyrosine and Histidine Modifications in Amyloid B-Peptides' G Mugesh, DSTO, 3/8/2012 to 8/31/2015, 53.67 Lakhs.
260. J C Bose Fellowship to K L Sebastian, DSTO, 9/1/2008 to 8/31/2018, 124.90 Lakhs.
261. 'Rate Capability Behaviour of Li<sub>1.2</sub>Ni<sub>0.13</sub>Mn<sub>0.54</sub>Fe<sub>0.13</sub>O<sub>2</sub>' Munichandraiah, RNTB, 2/13/2013 to 12/31/2014, 10.72 Lakhs.
262. 'Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors' Munichandraiah, DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs.
263. 'Electrochemical investigations on graphene and lithium phthalocyanine as catalysts for reversible oxygen reduction reaction in Li-O<sub>2</sub> Cells' Munichandraiah, AOAD, 4/25/2013 to 7/31/2016, 27.82 Lakhs.
264. 'Biocompatible metal carbonyl complexes as probes for cell imaging by IR and Raman microspectroscopy' M Velayudham, DSTO, 3/18/2013 to 3/17/2016, 19.70 Lakhs.
265. 'Organic and Metal-organic Hybrid Assemblies for sensing' Partha Sarathi Mukherjee, ISTC, 4/1/2012 to 3/31/2015, 13.23 Lakhs.
266. '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.
267. J C Bose Fellowship to S Ramakrishnan, DSTO, 10/10/2011 to 10/9/2016, 68.00 Lakhs.
268. 'Conformational control in macromolecules' S Ramakrishnan, DSTO, 2/7/2013 to 2/6/2016, 54.56 Lakhs.
269. 'Precision Chemical Engineering' – S Sampath, BCOO, 4/10/2007 to 12/31/2015, 1.30 Lakhs.
270. 'Ultracapacitor for Electric & Hybrid Electric Vehicles' S Sampath, TIFA, 7/15/2008 to 10/31/2014, 117.53 Lakhs.
271. '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.
272. '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 7/31/2015, 161.22 Lakhs.
273. 'Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors' S Sampath, DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs.
274. 'Organic materials as Electrodes for Li-ion Batteries' S Sampath, AOAD, 8/1/2013 to 7/31/2015, 53.25 Lakhs.
275. 'Exploitation of carbon nanostructure-organic supramolecular electrodes for lithium-ion

- batteries' S Sampath, DSTO, 1/1/2014 to 12/31/2015, 13.64 Lakhs.
276. J C Bose Fellowship to S Umapathy, DSTO, 8/4/2010 to 8/3/2015, 68.00 Lakhs.
277. 'Programme Support for Research in Biophotonics & Biomedical Instrumentation' S Umapathy, DBTO, 9/17/2010 to 9/16/2015, 668.22 Lakhs.
278. 'Development of Novel Raman Spectroscopic Techniques Like Sers & Sors for Detection of Explosives' S Umapathy, ARBO, 1/24/2011 to 7/31/2015, 297.27 Lakhs.
279. 'Novel Diboracycle as a Chemosensor for Anions' P Thilagar, CSIR, 5/1/2011 to 3/31/2014, 18.25 Lakhs.
280. '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.
286. 'Advanced Drug Delivery System' Santhanu Bhattacharya, CSIR, 1/31/2014 to 1/30/2017, 28.72 Lakhs.
287. 'Development of Catalytic Enantioselective Transformations Based On Chiral Counteranion Directed Asymmetric Induction' Santanu Mukherjee, CSIR, 5/1/2011 to 3/31/2014, 26.55 Lakhs.
288. J C Bose Fellowship to Tushar Kanti Chakraborty, DSTO, 1/2/2014 to 1/1/2018, 53.30 Lakhs.
289. J C Bose Fellowship to Uday Maitra, DSTO, 9/1/2008 to 8/31/2018, 122.50 Lakhs.
290. 'Biomimetic self-assembly of functional materials via the gel route.' Uday Maitra, DSTO, 7/12/2012 to 7/11/2015, 83.00 Lakhs.
291. 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.

## ORGANIC CHEMISTRY

**Projects: 11**

**Total: 571.28 Lakhs.**

281. 'Synthesis and Applications of Mesoporous Materials' – Divya Jyothi, DSTO, 9/7/2011 to 9/6/2014, 22.40 Lakhs.
282. 'Transition Metal Catalyzed Reactions (Chiral & Achiral): Design, Synthesis & Applications in Organic Synthesis' Prabhu K R, CSIR, 10/1/2010 to 3/31/2014, 25.23 Lakhs.
283. J C Bose Fellowship to Santanu Bhattacharya, DSTO, 9/1/2008 to 8/31/2018, 71.33 Lakhs.
284. '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.
285. '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.

## SOLID STATE AND

## STRUCTURAL CHEMISTRY UNIT

**Projects: 47**

**Total: 7,222.62 Lakhs.**

292. '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.
293. '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.
294. '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.
295. 'Development of advanced Multifunctional materials for Electrochemical Energy Devices'

- Aninda Jiban Bhattacharyya, DSTO, 7/10/2013 to 7/9/2016, 9.21 Lakhs.
296. 'Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors' A K Shukla, DSTO, 3/28/2012 to 3/27/2015, 620.06 Lakhs.
297. 'Development of a robust, high performance and field ready rural lighting solution using Rapidly Rechargeable Hybrid Ultra Capacitors (RRHUC)' A K Shukla, DSTO, 11/1/2013 to 1/13/2016, 78.98 Lakhs.
298. 'Synthesis and electro-optical studies of core/shell semiconductor nanocrystals for energy applications' Anshu Pandey, ISTC, 4/1/2013 to 3/31/2016, 12.37 Lakhs.
299. 'Computational study of interaction of metalloporphyrins of Au and Ag with amino acids and DNA bases' Y Anusooya Pati, DSTO, 6/28/2013 to 6/27/2016, 18.90 Lakhs.
300. J C Bose Fellowship to Biman Bagchi, DSTO, 6/1/2006 to 5/31/2016, 115.55 Lakhs.
301. 'Study of Nucleation and Growth during Phase Transformation in Condensed Matter' Biman Bagchi, DSTO, 7/5/2012 to 7/4/2015, 54.96 Lakhs.
302. 'Facile synthesis and physical properties study of ZnO nanostructures and their graphene nanocomposites for solar cell application.' Bharati Panigrahy, DSTO, 8/9/2012 to 8/8/2015, 6.50 Lakhs.
303. INSPIRE Faculty Award (IFA-ENG-20) to Bharati Panigrahy, DSTO, 3/1/2013 to 2/28/2018, 40.37 Lakhs.
304. 'Molecular simulation studies of adsorption and diffusion of hydrocarbons in zeolites and metal organic framework' Chitra Rajappa, DSTO, 6/28/2013 to 6/27/2016, 18.90 Lakhs.
305. INSPIRE Faculty Award to Chilukoti Srilakshmi, DSTO, 2/1/2013 to 1/31/2018, 35.92 Lakhs.
306. J C Bose Fellowship to D D Sarma, DSTO, 12/1/2008 to 5/3/2016, 89.72 Lakhs.
307. 'Local structure, function and the exotic properties of transition metal perovskites' D D Sarma, DSTO, 3/31/2009 to 9/30/2014, 17.67 Lakhs.
308. Stint Workshop D D Sarma, UU00, 1/20/2010 to 7/19/2014, 29.20 Lakhs.
309. 'Dynamics of correlated electron systems' D D Sarma, VTSK, 6/1/2010 to 12/31/2016, 4.05 Lakhs.
310. 'Indo-Italian Beamline at Elettra Synchrotron Radiation Source Trieste, Italy' D D Sarma, DSTO, 10/1/2010 to 9/30/2015, 2525.08 Lakhs.
311. Stint – 2 D D Sarma, UU00, 10/14/2011 to 12/31/2015, 12.45 Lakhs.
312. 'Electronic Origin of Cr Poisoning in Ceramic Fuel Cell Cathodes' D D Sarma' DSTO' 4/30/2012 to 4/29/2015' 18.24 Lakhs.
313. '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.
314. 'Rational Control of Functional Oxides' D D Sarma, IUSF, 8/23/2012 to 8/31/2015, 18.91 Lakhs.
315. 'Thematic Unit of Excellence on 'Computational Material Science' D D Sarma, DSTO, 9/14/2012 to 9/13/2017, 1207.26 Lakhs.
316. 'Low temperature, spatio-temporal spectroscopy of nanocrystals and multifunctional nanoassemblies' D D Sarma, DSTO, 3/10/2014 to 3/9/2019, 1,226.81 Lakhs.
317. Ramanujan Fellowship to Karthik Venkataraman, DSTO, 8/12/2013 to 8/11/2018, 73.00 Lakhs.
318. 'Weak intermolecular interactions: Consequences in crystal packing, polymorphism and properties of organic small molecules and APIs' Sumy Joseph, DSTO, 10/1/2013 to 9/30/2016, 25.00 Lakhs.
319. J C Bose Fellowship to Desiraju, DSTO, 5/15/2009 to 5/14/2016, 92.66 Lakhs.

320. 'International Year of Crystallography – IYCr2014' G R Desiraju, IUCR, 7/30/2012 to 7/29/2017, 2.97 Lakhs.
321. 'Project on 'India's contribution to the International Year of Crystallography' G R Desiraju, DSTO, 1/1/2014 to 12/31/2017, 63.82 Lakhs.
322. 'Crystal engineering studies on supramolecular synthon hierarchy in cocrystals: Halogen bond vs Halogen. Halogen interaction' Rajput Lalit Kumar, DSTO, 1/21/2013 to 1/20/2016, 21.73 Lakhs.
323. INSPIRE Faculty Award (PH-40) to Suman Mandal, DSTO, 5/16/2013 to 5/15/2018, 35.92 Lakhs.
324. New Materials for Energy Applications Srinivasan Natarajan, DSTO, 8/10/2010 to 7/7/2014, 36.39 Lakhs.
325. 'Synthesis, Structure & Properties of Inorganic-Organic Hybrid Compounds' Srinivasan Natarajan, CSIR, 7/14/2011 to 3/31/2014, 9.14 Lakhs.
326. J C Bose Fellowship to Srinivas Natarajan, DSTO, 6/11/2013 to 6/10/2018, 68.00 Lakhs.
327. 'Synthesis, Structure, Magnetic & Catalytic Behaviour of New Framework Compounds' Srinivasan Natarajan, DSTO, 6/18/2013 to 6/17/2016, 57.47 Lakhs.
328. J C Bose Fellowship to S Ramasesha, DSTO, 7/1/2006 to 6/30/2016, 118.60 Lakhs.
329. 'High Anisotropy Molecular Magnets: Synthesis and Modelling' S Ramasesha, IFCP, 9/1/2012 to 8/31/2015, 28.74 Lakhs.
330. 'Theoretical Studies of The Correlated Electronic Structure of Graphene' S Ramasesha, IUSF 7/16/2013 to 7/15/2015, 17.15 Lakhs.
331. 'Polymer Microcapsules for Drug Delivery' Satish Patil, DRDO, 3/11/2010 to 3/10/2015, 48.37 Lakhs.
332. 'Novel Conjugated Polymers for Solar Cells' Satish Patil, DSTO, 8/19/2011 to 8/18/2014, 39.46 Lakhs.
333. Raja Ramanna Fellowship to S Yashonath, DSTO, 8/19/2011 to 8/18/2014, 34.80 Lakhs.
334. J C Bose Fellowship to T N Guru Row, DSTO, 2/23/2011 to 2/22/2016, 63.00 Lakhs.
335. 'Organic Fluorine, A Copious Reserve for Futuristic Materials' T N Guru Row, DSTO, 3/16/2012 to 3/15/2015, 14.07 Lakhs.
336. '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.
337. '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.
338. 'Experimental Investigation of Interaction of Carbon Fiber & Carbon Carbon Composites with High Enthalpy Test Gases in A Shock Tube' V Jayaram, JATP, 4/1/2013 to 3/31/2015, 7.40 Lakhs.

## MATERIALS RESEARCH CENTRE

**Projects: 17**

**Total: 2,522.61 Lakhs.**

339. 'Computational Design of Magnetic Shape Memory Alloys' Abhishek Kumar Singh, NPMA, 11/17/2011 to 8/31/2014, 62.91 Lakhs.
340. 'Design of Metallocarborane Based MOFs for Room Temperature Hydrogen Storage' Abhishek Kumar Singh, DAEO, 12/13/2011 to 3/31/2014, 19.14 Lakhs.
341. 'Design of carbon-based 'artificial SET' for Si anode for high performance Li-ion battery' Abhishek Kumar Singh, KIST, 10/1/2012 to 12/31/2014, 55.86 Lakhs.
342. '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.



363. 'Structural Investigations of Amyloid Peptide Fragments Implicated in Alzheimers Disea.' S Raghothama, DSTO, 7/16/2012 to 7/15/2015, 23.95 Lakhs.

375. 'Interdisciplinary Centre in Neuroscience at IISc, (Sub-Project of DSTO-943)' C E Veni Madhavan, DSTO, 3/30/2010 to 9/29/2015, 2.50 Lakhs.

## COMPUTER SCIENCE AND AUTOMATION

---

**Projects: 18**

**Total: 412.86 Lakhs.**

364. 'Probabilistic Models for Clustering With User Preferences and Side Information' Chiranjib Bhattacharyya, DSTO, 2/15/2012 to 2/14/2016, 32.28 Lakhs.

365. 'Algothmic Analysis of Software Compatibility' Aditya Sunil Kanade, DSTO, 2/17/2012 to 2/16/2015, 8.40 Lakhs.

366. IBM Faculty Award 2008 K Gopinath, IBMC, 2/25/2009 to 2/24/2016 4.00 Lakhs.

367. IBM Faculty Award 2008 K V Raghavan, IBMC, 2/25/2009 to 3/31/2016, 4.00 Lakhs.

368. INSPIRE Faculty Award (IFA12-ENG-31) to Neeldhara Mishra, DSTO, 3/1/2013 to 2/28/2018, 32.67 Lakhs.

369. 'Real – Time Scheduling Schemes for Multicore Operating Systems' R C Hansdah, JATP, 4/1/2013 to 7/31/2015, 7.48 Lakhs.

370. Ramanujan Fellowship to Shivani Agarwal, DSTO 7/14/2011 to 7/13/2016, 73.00 Lakhs.

371. 'Advanced Research in Machine Learning, Game Theory & Optimization' Shivani Agarwal, IUSF, 4/10/2012 to 12/31/2015, 43.48 Lakhs.

372. 'Efficient Algorithms for Optimization and Control in Stochastic Systems' Shalabh Bhatnagar, DSTO, 9/7/2012 to 9/6/2015, 26.64 Lakhs.

373. 'Parallelizing Compiler and Runtime Technology for Hybrid Multicore System' Uday Kumar Reddy B, CDAC, 6/1/2013 to 6/30/2014, 5.00 Lakhs.

374. 'Geometry and Topology-driven Analysis and Visualization of Scalar Fields' Vijay Natarajan, DSTO, 9/7/2012 to 3/6/2016, 24.14 Lakhs.

376. '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.

377. General Motors Y Narahari, GMOO, 11/24/2009 to 12/31/2015, 10.00 Lakhs.

378. IBM Faculty Award – 2009 Y Narahari, IBMC, 2/1/2010 to 12/31/2015, 4.00 Lakhs.

379. J C Bose Fellowship to Y Narahari, DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs.

380. 'Organizing a Workshop on Emerging Research & Development Trends in Programming Languages (WEPL) at TIFR Mumbai' – Y N Srikant, DSTO, 12/22/2010 to 12/21/2015, 5.00 Lakhs.

381. 'Research group under IMPECS on programme analysis and applications' – Y N Srikant, DSTO, 8/18/2011 to 8/17/2016, 37.95 Lakhs.

## ELECTRICAL COMMUNICATION ENGINEERING

---

**Projects: 28**

**Total: 6395.26 Lakhs.**

382. '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.

383. J C Bose Fellowship to Anurag Kumar, DSTO, 2/23/2011 to 2/22/2016, 68.00 Lakhs.

384. '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.

385. '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 9/30/2015, 25.69 Lakhs.



386. 'Interdisciplinary Centre in Neuroscience at IISc, (Sub-Project of DSTO-943)' D Narayana Dutt, DSTO, 3/30/2010 to 9/29/2015, 2.50 Lakhs.
387. '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, 498.11 Lakhs.
388. 'Upgrading Facilities for Mems Design Activities at National Resource Centres' K J Vinoy, NPMA, 3/31/2009 to 12/31/2014, 55.09 Lakhs.
389. 'Energy Harvesting Antenna Study' K J Vinoy, BOCO, 3/12/2013 to 12/31/2014, 13.21 Lakhs.
390. The Jed-I Project Challenge K V S Hari, LIMB, 3/25/2011 to 4/30/2015, 6.49 Lakhs.
391. '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 9/30/2015, 31.51 Lakhs.
392. '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 6/30/2015, 31.24 Lakhs.
393. '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.
394. '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.
395. '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 9/30/2015, 25.68 Lakhs.
396. 'Secure Multiparty Computation' Navin Kashyap, HEPA, 8/22/2011 to 8/21/2016, 10.00 Lakhs.
397. 'Coding for High-Capacity Data Storage Devices' Navin Kashyap, DSTO, 1/24/2012 to 7/23/2015, 20.74 Lakhs.
398. 'Microelectronics & Vlsi Research' Navakant Bhatt, EDNO, 12/5/2006 to 3/31/2016, 4.56 Lakhs.
399. IBM Faculty Award to Navakant Bhatt, IBMC, 7/6/2007 to 3/31/2015, 3.50 Lakhs.
400. 'Infra Structure & Human Resource Development – Parc#2' Navakant Bhatt, NPMA, 7/1/2008 to 3/31/2015, 37.00 Lakhs.
401. 'Transenstor: Transistor Embedded Sensor Technology Platform' Navakant Bhatt, DAEO, 1/25/2011 to 3/31/2016, 72.86 Lakhs.
402. 'Centres of Excellence of Nanoelectronics – PHASE II' Navakant Bhatt, MITO, 1/1/2012 to 12/31/2016, 4750.12 Lakhs.
403. 'Indian Nanoelectronics Users Programme (INUP) – PHASE II' Navakant Bhatt, MITO, 3/1/2014 to 2/28/2019, 37.01 Lakhs.
404. 'Wireless Sensor Networks for Protecting Wildlife & Humans' P Vijay Kumar, MITO, 7/10/2012 to 5/9/2015, 81.00 Lakhs.
405. 'Technology Verification Via Deployment of A Small-Scale Pir-Based Wireless Sensor' P Vijay Kumar, DRDO, 4/22/2013 to 3/31/2015, 62.47 Lakhs.
406. 'Network resource allocation in the presence of strategic users' Rajesh Sundaresan, DSTO, 10/11/2011 to 10/10/2014, 16.58 Lakhs.
407. 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.
408. 'Tunable Photonic Bandgap Resonators By Applying Mechanical Force' T Srinivas, DRDO, 5/3/2013 to 5/2/2016, 216.87 Lakhs.
409. '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.

## ELECTRICAL ENGINEERING

---

**Projects#13**

**Total: 1,472.69 Lakhs.**

410. '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 12/31/2015, 1057.91 Lakhs.
411. 'Development of Robust Document Image Understanding System for Documents in Indian Scripts (OCR) – PHASE II' A G Ramakrishnan, MITO, 7/1/2010 to 12/31/2015, 109.25 Lakhs.
412. 'Interdisciplinary Centre in Neuroscience at IISc, (This is a sub-project of DSTO-943)' Chandra Sekhar Seelamantula, DSTO, 3/30/2010 to 9/29/2015, 2.50 Lakhs.
413. 'Development of Text to Speech System in Indian Languages PHASE II' Chandra Sekhar Seelamantula, MITO, 2/29/2012 to 12/31/2015, 50.65 Lakhs.
414. '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.
415. 'Separation of Biosignals Sensors in Medical Applications' – Gift Donation Chandra Sekhar Seelamantula, HEPA, 7/24/2013 to 10/31/2014, 5.87 Lakhs.
416. 'Development of Off Line & Real Time Simulator for Electric Vehicle/ Hybrid Electric Vehicle Systems' G Narayanan, DHIO, 10/12/2012 to 10/11/2015, 78.08 Lakhs.
417. 'Development and Deployment of Fss Miniature Models in Educational Institutes' G Narayanan, CDAC, 5/17/2013 to 5/16/2016, 13.93 Lakhs.
418. 'Video algorithms development system. Sub project of DST879; K R Ramakrishnan, DSTO, 12/27/2011 to 3/31/2015, 48.05 Lakhs.
419. 'Development of low-cost photoacoustic imaging system for the noninvasive identification of sentinel lymph node during breast cancer staging'

Manojit Pramanik, DAEO, 5/21/2013 to 3/31/2016, 16.84 Lakhs.

420. 'Photoacoustic imaging with clinical ultrasound system' Manojit Pramanik, DSTO, 8/1/2013 to 7/31/2016, 37.60 Lakhs.
421. INSPIRE Faculty Award (IFA-ENG-18) to Prasanta Kumar Ghosh, DSTO, 12/18/2012 to 12/17/2017, 35.92 Lakhs.
422. 'Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors' Vinod John, DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs.

## DEPARTMENT OF ELECTRONIC SYSTEMS ENGINEERING

---

**Projects: 23**

**Total: 1,575.55 Lakhs.**

423. 'Unity Project' H S Jamadagni, TIPL, 7/11/2006 to 12/31/2015, 31.29 Lakhs.
424. 'Technology for Conservation' H S Jamadagni, NCF0, 9/13/2006 to 12/31/2014, 38.32 Lakhs.
425. 'Image Capture Systems for Biomedical Applications' H S Jamadagni, PEIL, 11/1/2006 to 12/31/2014, 6.00 Lakhs.
426. 'Aerospace Network Research Consortium (ANRC)' H S Jamadagni, BOCO, 1/1/2008 to 12/31/2016, 412.84 Lakhs.
427. 'Common – Sense Net 2.0: Wireless Sensor Networks for Marginal Farmers in Inida' H S Jamadagni, SDCO, 5/1/2009 to 12/31/2015, 56.80
428. 'Non Invasive Cockpit Monitoring' – Ref. BOC01 H S Jamadagni, BOCO, 1/21/2010 to 12/31/2014, 6.86 Lakhs.
429. 'Power Line Carrier for Data Transfer in Airports' – Ref. BOC01 H S Jamadagni, BOCO, 1/21/2010 to 12/31/2014, 6.86 Lakhs.
430. 'Embedded Systems at CEDT' H S Jamadagni, INTL, 10/14/2010 to 12/31/2015, 42.82 Lakhs.



431. 'EU-India Fostering Cooperation in Computing Systems' H S Jamadagni, EU00, 4/19/2012 to 12/31/2015, 10.29 Lakhs.
432. '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.
433. 'RFID based Aircraft Inventory System (RAIS)' H S Jamadagni, BOCO, 1/1/2014 to 12/31/2015, 41.86 Lakhs.
434. 'National Hub for Healthcare Instrumentation Development By Anna University' N S Dinesh, AU00, 7/15/2011 to 7/14/2016, 96.72 Lakhs.
435. '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.
436. 'Development of Important Functional Modules for Drug Delivery System' – Parc # 4.13 N S Dinesh, NPMA, 3/16/2012 to 10/31/2014, 74.38 Lakhs.
437. '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, 31.00 Lakhs.
438. 'Classic and Quantum Low Density Parity Check Codes: Construction and Performance Bounds' Shayan G Srinivasa, ISTC, 4/1/2013 to 3/31/2016, 20.15 Lakhs.
439. 'Timing Recovery techniques & architectures for Two-dimensional data storage channels' Shayan G Srinivasa, DSTO, 9/18/2013 to 9/17/2016, 35.73 Lakhs.
440. Raja Ramanna Fellowship to Santanu Mahapatra, DSTO, 3/8/2012 to 3/7/2015, 34.80 Lakhs.
441. 'Performance evaluation of (MOS)<sub>2</sub> FET Through novel Device simulator development' Santanu Mahapatra, DSTO, 12/27/2012 to 12/26/2015, 28.93 Lakhs.
442. Smart Car Racing Competition Haresh Dagale, FSIP, 9/1/2010 to 4/30/2015, 28.50 Lakhs.
443. '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 6/30/2015, 25.50 Lakhs.
444. 'CEDT – EPFL Joint Programme – 2010' K Gopakumar, EPFO, 5/18/2010 to 5/18/2016, 20.99 Lakhs.
445. '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.

## MANAGEMENT STUDIES

---

**Projects: 4 Total: 91.55 Lakhs.**

446. '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.
447. 'Internationalization of Small and Medium Enterprises (Smes) in Karnataka: Objectives, Strategies & Achievements' M H Balasubrahmanya, UGCO, 2/1/2011 to 3/31/2014, 3.91 Lakhs.
448. 'Implementation mechanism intergrating 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.
449. 'National Project Coordination and Management' RHEES-6 Sub project of DSTO1260 P Balachandra, DSTO, 9/2/2013 to 9/1/2016, 45.26 Lakhs.

## CENTRE FOR INFRASTRUCTURE, SUSTAINABLE TRANSPORTATION AND URBAN PLANNING

---

**Projects: 6 Total: 1,062.29 Lakhs.**

450. 'Centre for Infrastructure Transportation & Urban

- Planning' J M Chandra Kishen, CIST, 10/1/2009 to 9/30/2019, 978.30 Lakhs.
451. 'Studies on fatigue crack growth in graphite' J M Chandra Kishen, DAEO, 11/5/2012 to 3/31/2016, 48.27 Lakhs.
452. '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.
453. '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.
454. 'Future proof design of transportation systems- optimisation of KSRTC/BMTC bus schedules under uncertain demands' T G Sitharam, HSMI, 3/15/2013 to 6/14/2015, 9.93 Lakhs.
455. '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.
460. '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.
461. '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.
462. '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.
463. 'Biodesign-Bioengineering Initiative' – Core Project, Anantha Suresh G K, DBTO, 9/29/2011 to 9/28/2016, 1,000.42 Lakhs.
464. 'Particle/Cell Counting and Characterization on a Droplet Based Microfluidic Platform' Prosenjit Sen, DSTO, 1/10/2014 to 1/9/2017, 42.43 Lakhs.
465. 'Development of Surface Micromachined Mems Vibratory Gyroscopes' Rudra Pratap, NPMA, 12/23/2008 to 12/31/2014, 95.23 Lakhs.
466. 'Materials and Mechanical Characterization Facility for Microsystems' Rudra Pratap, NPMA, 10/8/2009 to 3/31/2014, 782.67 Lakhs.
467. 'Design, Development, Fabrication, Packaging, Qualification Testing of Pressure Sensors for Aerospace Applications' Rudra Pratap, NPMA, 5/18/2012 to 12/31/2014, 252.00 Lakhs.
468. 'Characterization facility operatin for NPMASS projects Rudra Pratap, NPMA, 1/1/2014 to 12/31/2014, 15.00 Lakhs.
469. '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.
470. 'Thermodynamic analysis for the deposition of oxides, nitrides, oxy-nitrides and sulphides' Sukanya Dhar, DSTO, 1/2/2013 to 1/1/2016, 18.90 Lakhs.

## CENTRE FOR NANO SCIENCE AND ENGINEERING

**Projects: 15                      Total: 3,100.58 Lakhs.**

456. 'Mass Spectrometry Using Carbon Nano Tubes' – Proj #: -1.26 Akshay Naik, NPMA, 12/19/2012 to 12/18/2014, 39.05 Lakhs.
457. 'Frequency stability of graphene based nanoelectromechanical devices' Akshay Naik, DSTO, 10/18/2013 to 10/17/2016, 36.45 Lakhs.
458. 'Propeller Shaped Nano-Particles and Nano-Structured Surfaces for Applications in Biotechnology' Ambarish Ghosh, DBTO, 5/21/2010 to 5/20/2015, 157.32 Lakhs.
459. 'Optical Investigation of Nano-Structured 3d Plasmonic Crystals' Ambarish Ghosh, ISTC, 4/1/2011 to 3/31/2014, 10.35 Lakhs.

## INTERDISCIPLINARY CENTRE FOR ENERGY

---

**Projects: 2**                      **Total: 78.83 Lakhs.**

471. INSPIRE Faculty Award (CG-73) to Sanchita Sen Gupta, DSTO, 7/22/2013 to 7/21/2018, 41.52 Lakhs.
472. INSPIRE Faculty Award (ENG-27) to Upendra Kumar Pandey, DSTO, 10/1/2013 to 9/30/2018, 37.32 Lakhs.

## SUPERCOMPUTER EDUCATION AND RESEARCH CENTRE

---

**Projects: 17**                      **Total: 572.41 Lakhs.**

473. 'Tightly Coupling Keyword Query Interfaces With Structured Database Repositories' Jayanth R Haritsa, DSTO, 11/1/2010 to 4/30/2014, 41.66 Lakhs.
474. 'Donation for Data Base System Lab @ SERC' Jayanth R Haritsa, IIS, 4/1/2011 to 3/31/2031, 50.41 Lakhs.
475. '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.
476. '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.
477. 'Accelerating Diffuse Optical Tomographic Image Reconstruction Using Graphics Processing Units and Multicore Architectures (RGYI)' Phaneendra Kumar Yalavarthy, DBTO, 6/4/2013 to 6/3/2016, 18.34 Lakhs.
478. 'Development of Novel Computational Methods for Optical Molecular Tomographic Imaging' Phaneendra Kumar Yalavarthy, DBTO, 9/13/2013 to 9/12/2016, 22.26 Lakhs.
479. 'Enabling Technology for Future High Performance Computing Applications in India' R Govindarajan,

INTL, 1/1/2005 to 3/31/2015, 21.70 Lakhs.

480. IBM Faculty Award 2008 R Govindarajan, IBMC, 2/25/2009 to 3/31/2017, 4.00 Lakhs.
481. 'High Performance Computing Research in India' R Govindarajan, AITP, 2/26/2010 to 3/31/2015, 2.29 Lakhs.
482. 'Compiling Open Cl for Amd Platforms' R Govindarajan, AMDO, 5/1/2010 to 3/31/2015, 43.95 Lakhs.
483. 'Face Recognition On A Coarse Grain Reconfigurable Architecture' S K Nandy, DRDO, 9/30/2011 to 9/29/2014, 213.21 Lakhs.
484. 'Virtualization and Security Aware Multi-Core Architecture' S K Nandy, MITO, 12/20/2013 to 12/19/2015, 55.95 Lakhs.
485. 'Computational Methods for Control of Multiscale Dynamics' Soumyendu Raha, NRBO, 1/11/2012 to 1/10/2015, 24.90 Lakhs.
486. 'Stability Issues in Computation of Stiff Stochastic Differential Equation Systems' Soumyendu Raha, DSTO, 6/5/2013 to 6/4/2015, 2.95 Lakhs.
487. 'A Robust Middleware for Job management in Supercomputer systems' Sathish S Vadhiyar, DSTO, 12/27/2012 to 12/26/2015, 28.37 Lakhs.
488. '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.
489. 'Image Analytics Using Feature-Match Technique' Venkatesh Babu R, JATP, 4/1/2013 to 3/31/2015, 5.34 Lakhs.

## AEROSPACE ENGINEERING

---

**Projects: 67**                      **Total: 11,637.18 Lakhs.**

490. 'Vision Based Guidance in Occluded Terrains' Ashwini Ratnoo, JATP, 4/1/2013 to 3/31/2015, 4.00 Lakhs.

491. 'Understanding Aeroacoustic Scattering of Supersonic Shrouded Jets' Arnab Samanta, ISTC, 4/1/2012 to 3/31/2015, 19.11 Lakhs.
492. 'Applications of Biofuels for Aviation' B N Raghunandan, DSTO, 7/12/2010 to 12/31/2014, 15.15 Lakhs.
493. '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.
494. 'National Centre for Combustion Research & Development' B N Raghunandan, DSTO, 12/13/2011 to 12/12/2016, 3674.49 Lakhs.
495. 'Development of Hydroxyl Ammonium Nitrate (Han) Monopropellant System' Charlie Oommen, ISRO, 4/10/2012 to 8/31/2014, 19.37 Lakhs.
496. '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.
497. 'Control Strategies for Guided Collective Motion' D Ghose, AOAD, 6/20/2011 to 1/31/2015, 19.24 Lakhs.
498. 'Development and Evaluation of Swarm Control Algorithms for Mavs' D Ghose, DSTO, 10/13/2011 to 10/12/2015, 82.76 Lakhs.
499. 'Contamination Monitoring Using Mobile Sensor Networks (Cm-Msn)' D Ghose, UKIE, 4/1/2012 to 2/1/2015, 7.67 Lakhs.
500. 'Consultancy Contract for Development of Tactics Algorithm for Survivability of Own Platform Under Torpedo Attack' D Ghose, NSTL, 9/17/2013 to 12/31/2014, 3.84 Lakhs.
501. 'Piezo-Composite Mav Wing As Integral Structure and Actuators' Dinesh Kumar Harur Sampath, DSTO, 10/13/2011 to 10/12/2015, 76.16 Lakhs.
502. 'Rapid Inspection of Aircraft Components Using Laser Doppler Vibrometry and Computational Techniques Debiprosad' Roy Mahapatra, NPMA, 7/28/2009 to 12/31/2014, 473.62 Lakhs.
503. 'Sample Preparation / Nucleic Acid Extraction From Biological Samples' Debiprosad Roy Mahapatra, BIGT, 10/3/2011 to 10/2/2014, 18.29 Lakhs.
504. 'Development of Sma-Composite Based Compliant Variable Area Plane-Forms' Debiprosad Roy Mahapatra, ARDB, 10/28/2011 to 10/27/2014, 18.25 Lakhs.
505. Acecsot PHASE-III - 'Development of Nano-Composite Structures With Enhanced Thermo-Mechanical Properties, Damping & Self-Sensing Capabilites' Debiprosad Roy Mahapatra, ARDB, 3/21/2012 to 3/20/2017, 171.83 Lakhs.
506. 'Establishing Fem Process for Design/Analysis of Air Breathing Hypersonic Vehicles' - Sub. Prj. OF DRDO622 Debiprosad Roy Mahapatra, DRDO, 4/1/2013 to 6/30/2014, 40.84 Lakhs.
507. 'Integration of Non-Destructive Evaluation based Ultrasonic Simulation (IN-DEUS)' Debiprosad Roy Mahapatra, DSTO, 4/1/2013 to 3/31/2016, 132.00Lakhs.
508. 'Sensor Intergrated Wireless Mote for Compressed Sensing and Health Monitoring' Debiprosad Roy Mahapatra, ISTC, 4/1/2013 to 3/31/2016, 10.44 Lakhs.
509. '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, 150.88 Lakhs.
510. '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.
511. 'Qualitative Assessment of 3d Failure Criteria of Composite Laminae Based On Initiating Failure Mechanisms' G Narayana Naik, JATP, 4/1/2013 to 5/31/2015, 5.00 Lakhs.
512. 'INSPIRE Faculty Award (IFA13-ENG-51) to K R Jayaprakash, DSTO, 10/31/2013 to

- 10/30/2018, 35.92 Lakhs.
513. 'Experimental Studies of Flow Control Using Passive Devices On Scaled Saras & Nm5-100 Models' J Dey, NALO, 3/30/2012 to 3/31/2014, 35.17 Lakhs.
514. 'Experimental Characterization of Aerodynamic Loading Aspects of A Scaled Radome On Carrier Aircraft for Surveillance Applications' J Dey, CABS, 11/30/2013 to 11/30/2014, 6.30 Lakhs.
515. 'Computational Transonic Flutter Analysis of A Delta Wing' Kartik Venkatraman, ADAO, 12/16/2010 to 6/30/2014, 15.39 Lakhs.
516. 'Evaluation of Armour Materials Subjected to Scaled Blast Loading Using Shock Tube' K P J Reddy, DMRL, 6/26/2013 to 2/25/2015, 47.30 Lakhs.
517. '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.
518. 'Aecocost PH-III – Novel Nde Methods for Porosity & Moisture Content Determination' M R Bhat, ARDB, 3/21/2012 to 3/20/2017, 44.85 Lakhs.
519. 'Development of Autonomous Mavs' M Seetharam Bhat, DRDO, 12/15/2011 to 6/14/2015, 263.93 Lakhs.
520. 'CFD analysis of base drag reduction for missile configuration' N. Balakrishnan, JATP, 12/1/2011 to 9/30/2014, 9.88 Lakhs.
521. 'Establishing The Cfd Process for Design/Analysis of Aerodynamic Configurations in Hypersonic Flows' – Sub. Prj of DRDO622 N. Balakrishnan, DRDO, 4/1/2013 to 6/30/2014, 5.50 Lakhs.
522. 'Joint Initiatives in Information Sciences (JIIS)' N Balakrishnan, DRDO, 10/1/2001 to 3/31/2016, 330.00 Lakhs.
523. 'Research in Information Science' N Balakrishnan, MSCI, 3/1/2005 to 12/31/2015, 25.66 Lakhs.
524. 'Information Security Education and Awareness (ISEA) Project' N Balakrishnan, MITO, 3/16/2007 to 3/31/2014, 569.14 Lakhs.
525. J C Bose Fellowship to N Balakrishnan, DSTO, 5/1/2007 to 4/30/2017, 121.10 Lakhs.
526. 'National Telecom Test Bed' N Balakrishnan, MITO, 8/1/2007 to 3/31/2016, 2150.00 Lakhs.
527. 'High Attitude Programme' N Balakrishnan, DSTO, 10/23/2008 to 3/31/2014, 40.00 Lakhs.
528. '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.
529. 'Indian Language to Indian Language Machine Translation System (LMT) PHASE II' N Balakrishnan, MITO, 5/1/2010 to 4/30/2015, 130.99 Lakhs.
530. 'Complex Networks in Cyber-Security' N Balakrishnan, DSTO, 11/1/2010 to 3/31/2015, 58.24 Lakhs.
531. 'Large – Scale Data Analytics and Intelligent Services' N Balakrishnan, IUSF, 12/12/2011 to 12/31/2015, 3.56 Lakhs.
532. 'Sponsorship Toward The Workshop on Large-Scale Data Analysis & Intelligence Services' N Balakrishnan, IIIS, 2/1/2012 to 12/31/2015, 3.80 Lakhs.
533. 'Setting Up Test Bed Facility at IISc. Bangalore' N Balakrishnan, MITO, 9/25/2012 to 9/24/2015, 125.00 Lakhs.
534. '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 5/21/2015, 17.12 Lakhs.
535. 'Indo-Us Workshop on 'High Performance Computing, Applications and Big Data Analytics' During 15-18 Dec. 2013' N Balakrishnan, IUSF, 12/6/2013 to 12/31/2015, 15.00 Lakhs.
536. 'Advanced Biomass Research Centre (ABRC)' N K S Rajan, MNRE, 3/15/2009 to 3/31/2014, 808.00 Lakhs.

537. 'Studies On Pulse Detonation Engine' N K S Rajan, JATP, 10/3/2011 to 3/31/2015, 31.51 Lakhs.
538. 'Combustion Instability Studies in Solid Rocket Motors' N K S Rajan, DRDL, 12/13/2013 to 12/12/2015, 3.50 Lakhs.
539. 'Wake Interaction Effects in Turbines and Compressors and Tip Clearance and Leakage Flows' O N Ramesh, GTRE, 9/1/2011 to 6/30/2015, 193.00 Lakhs.
540. '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.
541. 'Relaxation to Equilibrium in Complex Turbulent Flows' O N Ramesh, JATP, 5/1/2013 to 7/31/2015, 3.00 Lakhs.
542. '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.
543. '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.
544. 'Modelling primary atomization of liquid jets using the level-set method' Santosh Hemachandra, ISTC, 4/1/2013 to 3/31/2016, 18.42 Lakhs.
545. 'The Operating Expenses – Parc# 3' S Gopalakrishnan, NPMA, 7/1/2008 to 3/31/2015, 10.00 Lakhs.
546. '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.
547. '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.
548. 'Physics of Machining Advanced Composites' Suhasini Gururaja, ISTC, 4/1/2012 to 3/31/2014, 12.87 Lakhs.
549. 'Processing of Multiscale Nanocomposites Via Functionalized Nanomaterials Based Scalable Coating Technique' Suhasini Gururaja, ARDB, 5/11/2012 to 5/10/2015, 17.20 Lakhs.
550. 'Understanding Material removal mechanisms in advanced composites' Suhasini Gururaja, DSTO, 4/10/2013 to 4/9/2016, 40.89 Lakhs.
551. '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.
552. '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.
553. 'Multidisciplinary Optimization of Air Breathing Hypersonic Vehicles' – Sub.Prj of DRDO622 S N Omkar, DRDO, 4/1/2013 to 3/31/2015, 21.33 Lakhs.
554. 'Flame Stabilization and Blowoff Mechanism in Ramjet and Scramjet Relevant Steady and Intermittently Unsteady High Speed Flows' Swetaprovo Chaudhuri, DRDO, 9/1/2013 to 4/30/2015, 95.44871
555. 'Development of Prototype Mpd Thruster' T S Seshadri, ISRO, 4/10/2012 to 4/9/2014, 24.86 Lakhs.
556. 'Experimental Investigations of Lateral Instability Characteristics of Amca at Moderate to High Angles of Attack – PHASE I' V Surendranath, ADAO, 8/16/2012 to 7/31/2015, 67.00 Lakhs.

## CENTRE OF EXCELLENCE IN HYPERSONICS, AEROSPACE ENGINEERING

**Projects: 6**

**Total: 4,661.83 Lakhs.**

557. 'Study of Mach 8.0 Flow in The Newly Established 0.5m Hypersonic Wind Tunnel' – (Sub-Prj of DRDO622) B Vasudevan, DRDO, 2/1/2014 to 1/31/2015, 10.00 Lakhs.
558. Establishment of a Research Centre 'Centre

of Excellence in High Speed Aerodynamics' G Jagadeesh, DRDO, 6/12/2011 to 6/11/2021, 2968.48 Lakhs.

559. 'Transdisciplinary Shock Wave Research and Application' G Jagadeesh, DRDO, 8/1/2012 to 7/31/2017, 1,385.61 Lakhs.
560. 'Design of Hypersonic Waveriders' – SubPrj OF DRDO622 G Jagadeesh, DRDO, 4/1/2013 to 6/30/2014, 32.00 Lakhs.
561. 'AR & DB Aerodynamic Panel Coordinator's Grants' G Jagadeesh, ARDB, 1/21/2014 to 1/20/2019, 0.74 Lakhs.
562. '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.

## ISRO-IISC SPACE TECHNOLOGY CELL

**Projects: 2**                      **Total: 138 Lakhs.**

563. IISc-ISTC Contribution Convener, IIS, 3/31/2006 to 3/31/2016, 10.00 Lakhs.
564. Space Technology Cell Convener, ISTC, 3/31/2006 to 3/31/2016, 128.00002 Lakhs.

## CIVIL ENGINEERING

**Projects: 33**                      **Total: 2,044.36 Lakhs.**

565. 'Seismic site classification for Indian shallow soil deposits' Anbazhagan, DAEO, 10/10/2012 to 10/9/2015, 111.87 Lakhs.
566. 'Seismic Vulnerability Assesment using High Resolution Remote Sensing Data for Disaser Management' Anbazhagan, ISTC, 4/1/2013 to 3/31/2015, 10.66 Lakhs.
567. 'Stochastic Modeling of Hydration Process in Concrete: Investigation into Creep and Shrinkage' Ananth Ramaswamy, DAEO, 10/11/2012 to 3/31/2016, 41.68 Lakhs.

568. 'Development of a Model for evaluating Prestress Losses considering Creep & Shrinkage Losses in Concrete & Relaxation Losses in Steel over 100 Years' Ananth Ramaswamy, DAEO, 10/26/2012 to 3/31/2016, 36.60 Lakhs.

569. '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 4/30/2014, 46.68 Lakhs.

570. 'Developing Design Guidance for Rammed Earth Construction'- Project #;-4608-1 B V Venkatarama Reddy, IFCP, 12/1/2011 to 10/31/2015, 86.52 Lakhs.

571. 'Running of M.Tech programme in Transportation and Infrastructure Engg. Chairman, CIST, 1/1/2013 to 12/31/2017, 45.00 Lakhs.

572. 'IISc – IGCAR R&D CELL' C S Manohar, IGCA, 6/1/2004 to 12/31/2015, 3.00 Lakhs.

573. 'Vibration based condition assessment & reliability analysis of existing engineering structures' C S Manohar, DAEO, 5/5/2010 to 3/31/2014, 27.66 Lakhs.

574. 'Making Performance Based Structural Engineering for The Resistance Attainable' C S Manohar, UKIE, 6/22/2012 to 6/21/2014, 14.52 Lakhs.

575. 'Safety and Global sensitivity analyses of structures with alternative uncertainty models' C S Manohar, DAEO, 11/6/2012 to 3/31/2016, 32.95 Lakhs.

576. 'Organizing the BRNS review meeting' C S Manohar, DAEO, 6/18/2013 to 3/31/2014, 40 Lakhs.

577. 'Structural Safety Assessment of Large Structures Using Spectral Stochastic Finite Element Method' Debraj Ghosh, DAEO, 11/19/2011 to 3/31/2015, 16.76 Lakhs.

578. 'Uncertainty quantification in multiscale analysis of nonocomposite materials' Debraj Ghosh, DAEO, 10/11/2012 to 3/31/2016, 23.89 Lakhs.

579. '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.
580. '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.
581. '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.
582. 'An Integrated Experimental & Computational approach to Structural Design for Pallistic Impact & Blasts' Debasish Roy, DRDO, 3/28/2014 to 3/27/2018, 814.76 Lakhs.
583. 'Evaluation 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.
584. 'Guidelines for the use of Geocells in Flexible pavements' G L Sivakumar Babu, DSTO, 8/31/2012 to 8/30/2015, 66.03 Lakhs.
585. '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.
586. '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 12/31/2015, 34.50 Lakhs.
587. 'Determination of shear wave velocity for deeper ground using surface wave testing with the use of geophones' Jyant Kumar, DAEO, 10/26/2012 to 10/25/2015, 40.57 Lakhs.
588. '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.
589. '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.
590. 'Static and Cyclic loading Characteristics of Geocell Reinforced Aggregates' Madhavi Latha G, CIST, 4/15/2013 to 3/31/2016, 7.88 Lakhs.
591. '2013 IBM Faculty Award' M S Mohan Kumar, IBMC, 1/30/2014 to 1/29/2015, 6.14 Lakhs.
592. '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.
593. '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 5/31/2015, 4.67 Lakhs.
594. '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.
595. 'Remediation of Chromium Contaminated Groundwater Using Ferro-Particles Based Technology' Sudhakar M Rao, MDWS, 4/11/2012 to 10/10/2014, 11.50 Lakhs.
596. 'Exploratory evaluation of local kinematics on overall deformation in granular media' Tejas G. Murthy, DSTO, 7/28/2011 to 4/27/2015, 45.48 Lakhs.
597. 'Modelling hydrology of Mahanadi river basin considering changes in land-use/land-cover' V V Srinivas, MESO, 8/17/2011 to 5/16/2015, 43.55 Lakhs.

## INDO-FRENCH WATER SCIENCE PROJECT, CIVIL ENGINEERING

**Projects: 10**

**Total: 486.67 Lakhs.**

598. 'Water Science Technology Cell' M S Mohan

- Kumar, IRDO, 3/14/2001 to 12/5/2018, 197.20 Lakhs.
599. 'IBM Shared University Research Award' M S Mohan Kumar, IBMC, 2/18/2014 to 3/31/2016, 24.80 Lakhs.
600. '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 12/5/2018, 99.48 Lakhs.
601. '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.
602. '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, 24.84 Lakhs.
603. 'Energy and Mass Exchange in Vegetative Systems' M Sekhar, ISRO, 1/25/2012 to 7/31/2014, 6.75 Lakhs.
604. 'Stochastic Modeling of Groundwater Flow and Contaminant Transport Modeling at The Proposed Uranium Tailings Pond' M Sekhar, DAEO, 12/20/2012 to 3/31/2016, 39.66 Lakhs.
605. 'Adaptation of Irrigated Agriculture to Climate Change' – Project No.4700-W1 M Sekhar, IFCP, 2/1/2013 to 1/31/2016, 29.05 Lakhs.
606. '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.
607. '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.
- (IFA13-ENG-44) Arghya Samanta, DSTO, 11/6/2013 to 11/5/2018, 19.00 Lakhs.
609. '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, 61.19 Lakhs.
610. 'Investigations and Development of Technology for Dessicated Coconut Industry Effluent Water Treatment' J R Mudakavi, CDBO, 11/3/2011 to 10/31/2014, 17.57 Lakhs.
611. 'Solar-UV disinfection of Bacteria in contaminated Water by using TiO<sub>2</sub>' Jayant Modak, PIPO, 6/12/2012 to 7/31/2015, 25.78 Lakhs.
612. '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.
613. 'Solubilities & Adsorption of Pharmaceuticals in Supercritical Carbon Dioxide' M Giridhar, CSIR, 5/1/2011 to 5/31/2014, 6.17 Lakhs.
614. 'Polymer Nanocomposites: Monolithic Encapsulation of Organic Devices' M Giridhar, DSTO, 8/24/2011 to 8/23/2014, 44.91 Lakhs.
615. '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.
616. '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.
617. '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.

## CHEMICAL ENGINEERING

**Projects: 20**

**Total: 892.12 Lakhs.**

608. 'INSPIRE Faculty Award to Arghya Samanta'

618. 'Rheology, fabric anisotropy and constitutive modeling of dense granular materials and suspensions' Prabhu R Nott, DSTO, 3/20/2013 to 3/19/2016, 35.89 Lakhs.

619. DST-ANR Collaborative research programme – 'Dense particulate systems' Prabhu R Nott, DSTO, 2/24/2014 to 2/23/2017, 30.26 Lakhs.
620. 'Role of Allosterity 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.
621. 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.
622. 'Probing Replication by RNA-dependent RNA Polymerases from Flaviviruses' Rahulroy, WELT, 9/1/2013 to 8/31/2018, 349.40 Lakhs.
623. 'Facility for Design, Development and Demonstration for Advanced Batteries and Ultracapacitors' Sudeep Punnathanam, DSTO, 4/1/2013 to 3/27/2015, 3.00 Lakhs.
624. 'Nanoscale Chemoresistive Gas Sensor' S Venugopal, ISTC, 4/1/2012 to 3/31/2014, 13.69 Lakhs.
625. 'Fabrication of Nanostructured Strain Sensor' S Venugopal, CIST, 4/15/2013 to 4/14/2015, 4.5 Lakhs.
626. '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.
627. J C Bose Fellowship to V Kumaran, DSTO, 4/1/2007 to 12/31/2016, 121.05 Lakhs.
630. '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.
631. '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.
632. 'Analysis and Engineering of Particle-To-Particle Composition Distribution for Chemically Synthesized FEPT, CoPt, FePd AND MnAl Nanoparticles' Chandan Srivastava, DSTO, 11/8/2011 to 11/7/2014, 34.14 Lakhs.
633. 'Disorder-To-Order Transformation in Nano-Sized Particles' Chandan Srivastava, CSIR, 4/1/2012 to 3/31/2015, 12.00 Lakhs.
634. 'Investigation of Particle Size Effect On The Phenomenon of Miscibility Gap in Nano-Sized Particles.' Chandan Srivastava, DSTO, 7/13/2012 to 12/31/2015, 23.15 Lakhs.
635. '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.
636. J C Bose Fellowship to Dipankar Banerjee, DSTO, 2/23/2011 to 2/22/2016, 68.00 Lakhs.
637. 'Exploration of Cost Effective High Temperature Shape Memory Alloys Dipankar Banerjee, NPMA, 11/17/2011 to 12/31/2014, 275.00 Lakhs.
638. 'Physical Modeling of The Acheson Process' Govind S Gupta, CSIR, 4/1/2011 to 3/31/2014, 12.65 Lakhs.
639. 'Mineral Biotechnology for Mineral Beneficiation Metal Extraction and Mining Environmental Control' – Raja Ramanna Fellowship to K A Natarajan, DSTO, 1/1/2008 to 12/31/2014, 65.20 Lakhs.
640. J C Bose Fellowship to K Chattopadhyay, DSTO, 6/1/2006 to 5/31/2016 115.5 Lakhs.
641. 'Creation of A State-Of-The-Art Analytical Electron

## MATERIALS ENGINEERING

**Projects: 48**

**Total: 9861.23 Lakhs.**

628. J C Bose Fellowship to Atul H Chokshi, DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs.
629. 'Grain Boundary Sliding A Model Study With Bicrystals' Atul H Chokshi, CSIR, 4/1/2011 to 3/31/2014, 19.24 Lakhs.

- Microscopy Facility Capable of High Resolution Imaging and Analysis in The Nanoscale As A National Facility at IISc' K Chattopadhyay, DRDO, 11/3/2006 to 11/30/2014, 189.00 Lakhs.
642. 'Establishment of Networking Resource Centre in Science Departments' K Chattopadhyay, UGCO, 4/22/2008 to 7/31/2015, 985.33 Lakhs.
643. '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 Chattopadhyay, DAEO, 5/22/2009 to 3/31/2015, 215.00 Lakhs.
644. 'Friction Stir Processing of Steels for Surface Alloying & Wear Resistance' (Joint Project) K Chattopadhyay, NRBO, 9/30/2011 to 3/31/2014, 7.04 Lakhs.
645. 'Solar Power Generation & Research Centre at Challakere Campus' K Chattopadhyay, GKOO, 8/28/2012 to 8/28/2015, 850.00 Lakhs.
646. Award of Pre-Project Grant – 'Solar Energy Research Institute for India and US (Serius)' K Chattopadhyay, IUSF, 8/28/2012 to 10/31/2017, 5,017.53 Lakhs.
647. Ramanujan Fellowship to Kaushik Chatterjee, DSTO, 12/22/2011 to 12/21/2016, 73.00 Lakhs.
648. 'Bioinformetic nanocomposite scaffolds for bone tissue engineering' Kaushik Chatterjee, DAEO, 4/1/2012 to 3/31/2015, 13.90 Lakhs.
649. 'Studying Colon Cancer in 3d Tissue Scaffolds' Kaushik Chatterjee, CSIR, 11/1/2012 to 10/31/2015, 14.31 Lakhs.
650. 'Polymer/Calcium phosphate Nano composites as scaffolds for Tissue Engineering' Kaushik Chatterjee, DSTO, 3/18/2013 to 3/17/2016, 51.10 Lakhs.
651. 'Novel 3d Nanocompositescaffolds for Tissue Engineering' Kaushik Chatterjee, DBTO, 5/31/2013 to 5/30/2016, 61.99 Lakhs.
652. 'Development of Polydioxanone-Graphene composites for Biomedical applications' Kaushik Chatterjee, DSTO, 9/23/2013 to 9/22/2016, 53.24 Lakhs.
653. 'Creep Mechanisms & Micro Structural Stability in Ni-Based Single Crystal Blade Alloys' Karthikeyan, DMRL, 3/28/2012 to 3/27/2015, 64.99 Lakhs.
654. 'High Strain Rate Mechanical Properties of Ti-6Al-4V at Room and Elevated Temperatures' Karthikeyan, GTRE, 8/10/2012 to 8/31/2014, 4.00 Lakhs.
655. 'Low Band-gap Organic Bulk Heterojunction Organic Photovoltaics' Praveen C Ramamurthy, DSTO, 1/1/2014 to 12/31/2016, 117.14 Lakhs.
656. 'Electric Current Assisted Fracture in Mechanically Stressed Precracked Metallic Structures' Praveen Kumar, CSIR, 4/1/2012 to 3/31/2016, 21.44 Lakhs.
657. 'High Temperature Plasticity at Low Stresses in LiF' Praveen Kumar, NRBO, 5/16/2012 to 10/31/2014, 3.35 Lakhs.
658. '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.
659. 'Effects of Structure & Chemistry of Hetro-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.
660. '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.
661. '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, 16.31 Lakhs.
662. 'Structure-Property Correlations in Magnetostrictive and Ferroelectric Thin Films' Rajeev Ranjan, DMRL, 3/28/2012 to 12/27/2014, 46.20 Lakhs.

663. '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.
664. 'Design and Fabrication of Membranes for Water Purification Using Phase Separation in Polymeric Blends As a Tool' Suryasarathi Bose, DSTO, 1/25/2012 to 4/24/2015, 54.38 Lakhs.
665. '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.
666. '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.
667. 'EMI Shielding in Carbon Nanotubes Based Polymer Composites' Suryasarathi Bose, JATP, 3/15/2013 to 3/14/2015, 10.00 Lakhs.
668. '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, 14.69 Lakhs.
669. 'Surface Chemical & Biogeochemical Aspects of Heavy Metal Dissolution & Transportation With Particular Reference to Mining & its Effect on Water Quality' S Subramanian, IRDO, 3/14/2001 to 12/5/2018, 84.94 Lakhs.
670. 'Mineralogical and Leaching Studies for The Recovery of Uranium, Niobium and Rhenium Values From Rasimalai Alkali Syenite Pluton, Tamil Nadu, India' S Subramanian, DAEO, 6/14/2011 to 6/30/2015, 39.42 Lakhs.
671. '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.
672. 'Nanomechanics of Advanced Materials' U Ramamurthy, DSTO, 11/25/2011 to 11/24/2014, 124.69 Lakhs.
673. '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.
674. 'Mechanical Behavior of High Temperature Coating' Vikram Jayaram, DRDO, 2/11/2009 to 2/10/2015, 576.65 Lakhs.

## MECHANICAL ENGINEERING

**Projects: 40**

**Total: 4,640.51 Lakhs.**

675. 'Hybrid Isolator for Reaction/Momentum Wheel' Ashitava Ghosal, ISTC, 4/1/2013 to 3/31/2014, 9.50 Lakhs.
676. 'Feasibility Study of Exhaust Thermoelectric Generator for Urban Buses' Himabindu M, CIST, 4/15/2013 to 4/14/2014, 5.62 Lakhs.
677. 'Drag Reduction By Gas Lubrication' J H Arakeri, NRBO, 7/11/2011 to 4/30/2015, 52.72 Lakhs.
678. '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.
679. '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.
680. '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.
681. 'Acoustics of Ducts and Mufflers(Second Edition)' M L Munjal, DSTO, 7/16/2013 to 7/15/2015, 9.66 Lakhs.
682. Ramanujan Fellowship to Namrata Gundaiah, DSTO, 8/3/2010 to 8/2/2015, 73.00 Lakhs.
683. '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.

684. 'Mechanics of A Composite Protein Rubber in Arteries' Namrata Gundaiah, DSTO, 10/10/2011 to 10/9/2014, 13.48 Lakhs.
685. 'Machanobiology of Endothelial cells' Namrata Gundaiah, DSTO, 3/7/2012 to 3/6/2015, 18.50 Lakhs.
686. '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.
687. 'Development and Performance Evaluation of PCM coupled Heat pipe' Pramod Kumar, ISTC, 4/1/2013 to 3/31/2016, 16.68 Lakhs.
688. 'Fundamental studies on transport and kinetics of adsorption using silica gel as an adsorbate' Pramod Kumar, DSTO, 9/23/2013 to 9/22/2016, 30.00 Lakhs.
689. 'Facility for Rheo Pressure Die Casting' Pradip Dutta, DSTO, 11/9/2010 to 9/30/2014, 18.96 Lakhs.
690. '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.
691. 'Solar Cooling and Production of Potable Water With Two State Silica Gel-Water Adsorption System' Pradip Dutta, DSTO, 1/19/2012 to 7/31/2015, 189.84
692. 'Above Knee (Trans-Femoral ) Prosthetic Design' Rina Maiti, SBMT, 12/16/2010 to 6/15/2014, 44.41 Lakhs.
693. 'Study On Propulsion From Flexible 3d Foils: Fish Like Propulsion' Raghuraman N Govardhan, NRBO, 4/21/2011 to 10/20/2014, 24.15 Lakhs.
694. 'Transonic Stall Flutter: Unsteady Flow Over Turbo-Machine Blades in The Transonic Regime' Raghuraman N Govardhan, GTRE, 8/22/2011 to 8/9/2015, 165.71 Lakhs.
695. 'Design & Development of A Robotic Fish for Naval Applications' Raghuraman N Govardhan, NRBO, 2/10/2014 to 2/9/2017, 37.32 Lakhs.
696. J C Bose Fellowship to R Narasimhan, DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs.
697. '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.
698. 'Studies on Kerosene Spray Characterizations & Combustion in A Compact Trapped Vortex Combustor (Tvc) Rig' R V Ravikrishna, GTRE, 2/19/2011 to 3/31/2015, 129.86 Lakhs.
699. 'Friction Stir Welding of Ti/Ai & Ai/Mg Dissimilar Metals' Satish V Kailas, DRDO, 1/31/2011 to 1/31/2015, 218.47 Lakhs.
700. Car-Fraunhofer Project 'Multijoin' Satish V Kailas, ARCI, 10/12/2012 to 10/11/2017, 128.00 Lakhs.
701. '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.
702. 'Study of Contact Conditions in A Continuous Variable Transmission (Cvt)' Satish V Kailas, RNTB, 9/30/2013 to 3/31/2016, 49.22 Lakhs.
703. 'Optical Dizgnostics of Biofuel Spray Dynamics in A Premixer' Saptarshi Basu, CSIR, 4/1/2011 to 3/31/2014, 12.12 Lakhs.
704. '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.
705. 'Study of Combustion Dynamics in Stratified Swril Stablized Burner' Saptarshi Basu, ARDB, 1/31/2012 to 1/30/2015, 24.19 Lakhs.
706. '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.
707. 'Precipitation, vaporization and flow physics of levitated functional droplets' Saptarshi Basu, DSTO, 9/23/2013 to 9/22/2016, 38.00 Lakhs.

**CENTRE FOR ATMOSPHERIC  
AND OCEANIC SCIENCES**

<b>Projects#20</b>	<b>Total: 1770.61 Lakhs.</b>
708. 'Cloud Microphysics Characteristics and Modelling Over The Indian Region Using A Cloud Resolving Model' Arindam Chakraborty, MESO, 8/17/2011 to 5/16/2015, 18.89 Lakhs.	
709. 'Development of A Prognostic Cloud Scheme for Global Climate Models' Arindam Chakraborty, MESO, 8/17/2011 to 5/16/2015, 27.75 Lakhs.	
710. '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.	
711. 'Stochastic Parameterization and Forecasting of Wind Energy in India' Arindam Chakraborty, MESO, 3/1/2014 to 2/28/2017, 12.71 Lakhs.	
712. 'Monitoring Snow and Glaciers of Himalayan Region-Phase II' Anil Kulkarni, ISRO, 4/1/2011 to 3/31/2015, 20.85 Lakhs.	
713. J C Bose Fellowship to G S Bhat, DSTO, 8/4/2010 to 8/3/2015, 68.00 Lakhs.	
714. 'Surface Energy Balance and Atmospheric Structure Over The Ctcz Area: An Observational Study' G S Bhat, MESO, 8/17/2011 to 5/16/2015, 110.25 Lakhs.	
715. '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 5/16/2015, 238.46 Lakhs.	
716. 'Climate Modelling of Geiengineering' Govindaswamy Bala, DSTO, 3/19/2013 to 3/18/2016, 18.66 Lakhs.	
717. 'The Advection- Condensation Model and Water Vapour in The Atmosphere' Jai Suhas Sukhatme, ISTC, 4/1/2012 to 3/31/2015, 7.36 Lakhs.	
718. 'Underwater Radiation and Chlorophyll Measurements During CTCZ (2011-2012)' P N Vinaychandran, MESO, 8/17/2011 to 5/16/2015, 34.15 Lakhs.	
719. 'Modeling physical-biological interactions in the Indian Ocean' P N Vinaychandran, INCO, 8/1/2013 to 7/31/2017, 81.40 Lakhs.	
720. 'Impact of Bay of Bengal Cold Pool On The Seasonal and Intraseasonal Pattern of Rainfall' Ravi S Nanjundiah, MESO, 8/17/2011 to 5/16/2015, 32.47 Lakhs.	
721. 'Study of teleconnections & Ocean-Atmosphere coupling over Indian Region using AOGCM' Ravi S Nanjundiah, INCO, 8/1/2013 to 7/31/2017, 54.12 Lakhs.	
722. 'Estimation of Aerosol Radiative Forcing' S K Satheesh, ISRO, 8/20/2007 to 8/19/2015, 200.60 Lakhs.	
723. 'Retrieval of aerosols over land using Multi-Satellite data' S K Satheesh, ISRO, 1/28/2010 to 1/27/2015, 91.00 Lakhs.	
724. 'Climate Research Facility at Challakere' S K Satheesh, LANS, 8/17/2012 to 8/16/2018, 103.65 Lakhs.	
725. '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.	
726. '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.	
727. 'Understanding the Fine-scale Duration Characterization of Tropical Rain fall' V Venugopal, ISTC, 4/1/2013 to 3/31/2016, 10.95 Lakhs.	
728. J C Bose Fellowship Vikram Jayaram, DSTO, 8/16/2012 to 8/15/2017, 63.00 Lakhs.	
729. J C Bose Fellowship to J Srinivasan, DSTO, 5/1/2007 to 9/26/2015, 100.45 Lakhs.	
730. 'Divecha Centre for Climate Change' J Srinivasan, GFPE, 1/1/2009 to 12/31/2018, 2375.34 Lakhs.	

731. '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.
732. 'Strengthening an existing Centre of Excellence in Climate Change – Divecha Center for Climate Change' J Srinivasan, DSTO, 3/31/2013 to 3/30/2018, 340.56 Lakhs.
733. 'Demonstration of Renewable Energy Systems' J Srinivasan, MNRE, 4/1/2013 to 3/31/2014, 13.04 Lakhs.
734. 'Study of Glaciers in the Himalaya using Synthetic Aperture Radar Interferometry' J Srinivasan, DSTO, 5/30/2013, to 5/29/2015 14.76 Lakhs.
735. 'Local and Remote influences on Rainfall over India' J Srinivasan, UGCO, 3/1/2014 to 2/29/2016, 12.47 Lakhs.
736. 'Intel Parallel Computing Centre for Modeling Monsoons and Tropical Climate' Ravi S Nanjundiah, INTEL, 5/06/2014 to 4/06/2014, 211.6 Lakhs.
741. '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 27.23Lakhs.
742. 'Palaeoseismic History of The North Andaman From Coral Records' Kusala Rajendran, MESO, 12/2/2011 to 12/1/2014, 15.33 Lakhs.
743. 'Setting up a broadband seismic observatory at the new IISc Campus at Challakere, Karnataka' Kusala Rajendran, MESO, 6/5/2013 to 6/4/2016, 28.42 Lakhs.
744. 'Seismotectonic history, plate boundary deformation and state of stress in Andaman-Sumatra subduction zone and its adjoining ares' Kusala Rajendran, INCO, 7/18/2013 to 3/31/2016, 30.06 Lakhs.
745. 'Research, education & manpower development in the discipline of earth processess' D Nagesh Kumar, MESO, 10/16/2009 to 9/24/2015, 1127.47 Lakhs.
746. '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.

## CENTRE FOR EARTH SCIENCES

**Projects: 23                      Total: 1,624.18 Lakhs.**

737. 'Constructing Earth like Dynamo models. Swarna Jayanthi Fellowship' Binod Sreenivasan, DSTO, 8/31/2012 to 8/30/2017, 85.77Lakhs.
738. '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.
739. '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.
740. 'Setting up operation & maintanance of GPS stations at selected locations by various viz, IISc' Kusala Rajendran MESO 8/4/2011 to 8/3/2014 16.45 Lakhs.
747. '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.
748. 'Major, trace element and chromium isotopic study of the Loonar impact crater, India' Ramananda Chakrabarti, ISTC, 4/1/2013 to 3/31/2015, 18.69 Lakhs.
749. 'Major, trace element & calcium stable isotopic study of carbonatites & associated alkaline silicate volcanic: tracking carbonate matasomatism & major element recycling in the mantle' Ramananda Chakrabarti, DSTO, 6/26/2013 to 6/25/2016, 6.00 Lakhs.
750. 'Paleo-temperature determination using elemental concentration ratios and non-traditional stable

isotopes (Ca, Sr and clumped isotope systematics)' Ramananda Chakrabarti, DSTO, 10/23/2013 to 10/22/2016, 26.90 Lakhs.

- 751. 'Tectonic and climatic implication during deposition of tertiary sediments in NW Himalayan foreland basin India' Seema Singh, DSTO, 5/24/2013 to 5/23/2016, 22.35 Lakhs.
- 752. 'Paleo-Geographic Reconstruction: Development of A New Gis Based Methodology' Sajeev Kirishnan, ISTC, 4/1/2012 to 3/31/2015, 23.86 Lakhs.
- 753. 'Iron Formations and its associates: An inquisition to early earth dynamics' Sajeev Kirishnan, DAEO, 12/17/2012 to 3/31/2016, 40.70 Lakhs.
- 754. 'Petrographical, chemical and computational studies on concrete at high temperatures' Sajeev Kirishnan, DSTO, 6/18/2013 to 6/17/2016, 10.18 Lakhs.
- 755. 'Geological linkage between southern India and Antarctica: A probe on crustal processes from Archaean to Proterozoic' India-Japan Research project Sajeev Kirishnan, DSTO, 8/13/2013 to 8/12/2015, 6.03 Lakhs.
- 756. 'The Heat Source for Ultrahigh-Temperature Lower Crust, A Case Study On Central Madurai Bloc, Southern India to Test The Available Models' Sajeev Kirishnan, CSIR, 10/1/2013 to 9/30/2016, 6.50 Lakhs.
- 757. 'High Temperature lower crust of East Central Gondwana: Emphasis to southern Indian and Sri Lankan Geology' Indo-Srilankan project Sajeev Kirishnan, DSTO, 1/1/2014 to 12/31/2016, 18.75 Lakhs.
- 758. 'Mechanical strength of the Nilgiri and Billigirirangan Hills in the southern granulite terrain and its correlation with tecto-magmatic processes' Sajeev Kirishnan, KSTE, 2/21/2014 to 2/20/2016, 1.00 Lakhs.
- 759. 'Evolution of Upper Ramganga Valley and its catchment erosion during Quaternary' Shipra Chaudhary, DSTO, 7/2/2013 to 7/1/2016, 25.30 Lakhs.

## CENTRE FOR PRODUCT DESIGN AND MANUFACTURING

---

**Projects: 5**

**Total: 200.72 Lakhs.**

- 760. 'Design of An Aluminium-Intensive Electric Car Prototype' Anindya Deb, MSME, 1/8/2014 to 1/7/2015, 0.75 Lakhs.
- 761. 'Sub.Project 2 – Patient Transfer Device (CORE PROJECT DBT324)' B Gurumoorthy, DBTO, 9/29/2011 to 9/28/2016, 157.01 Lakhs.
- 762. 'Cad Representation of Systems Having Multiplicity of Length Scales' B Gurumoorthy, GMOO, 12/28/2011 to 7/31/2015, 10.00 Lakhs.
- 763. 'Organising AR&DB's High Temperature Materials Workshop at IISC., Bangalore On 23 Mar 2012' B Gurumoorthy, ARDB, 6/18/2012 to 3/31/2015, 21.80 Lakhs.
- 764. 'DHM Based Precision Assembly Simulation of Mmic Packages' Dibakar Sen, ISTC, 4/1/2012 to 3/31/2014.

## CENTRE FOR SUSTAINABLE TECHNOLOGIES

---

**Projects: 13**

**Total: 1,012.16 Lakhs.**

- 765. 'Carbon sequestration assessment and population status of threatened mangroves in Bhitarkanika National Park, Odisha, India – Implications for conservation and management' Sudam Charan Sahu, DSTO, 7/2/2013 to 7/1/2016, 20.00 Lakhs.
- 766. '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.
- 767. '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.
- 768. '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.



769. '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.
770. 'Village level demonstration of RHEES in South India-Biomethanation and VAP' RHEES-4-Subproject of DSTO1260 H N Chanakya, DSTO, 9/2/2013 to 9/1/2016, 54.57 Lakhs.
771. '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.
772. 'Rural Hybrid Energy Enterprise Systems(RHEES)' H N Chanakya, DSTO, 9/2/2013 to 9/1/2016, 380.00 Lakhs.
773. 'Technology & human development – a capability approach' Monto Mani, DUTO, 1/1/2010 to 12/31/2015, 30.77 Lakhs.
774. '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.
775. 'Climate change mitigation and adaptation in forest plantation sector – An ecological and economic assessment for India' N H Ravindranath, CICE, 9/3/2012 to 3/31/2015, 62.73
776. 'Village level demonstration of RHEES in South India-Biomass Gasifier' RHEES-5 – Subproject of DSTO1260 S Dasappa, DSTO, 9/2/2013 to 9/1/2016, 120.67 Lakhs.
777. '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.
778. '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.
779. 'Carbon Nanotubes Based Flame Sensor' Abha Misra CIST 4/16/2012 to 4/15/2014 4.00 Lakhs.
780. 'Graphene-carbon nanotubes based hierarchical structure for lithiumion battery anode' Abha Misra, DSTO, 9/18/2013 to 9/17/2016, 17.92 Lakhs.
781. 'Development of Methodologies for Strain Monitoring of High Pressure Compressor Modules of Titanium Alloys Through Conformal Thin Film Sensors' G Mohan Rao, GTRE, 3/30/2013 to 3/31/2016, 95.89 Lakhs.
782. '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.
783. 'Process Design and Fabrication of Thin Film Strain Gauges' G Mohan Rao, DRDO, 1/8/2014 to 1/7/2015, 3.24 Lakhs.
784. 'Cantilever- Based Multiplex Detection Systems. Sub Project of DSTO879' G R Jayanth, DSTO, 12/27/2011 to 12/26/2014, 17.29 Lakhs.
785. 'Development of A Robust, Low Cost Traffic Measurement System' G R Jayanth, CIST, 4/16/2012 to 4/15/2014, 2.40 Lakhs.
786. 'A novel liquid-droplet based bistable MEMS switch' G R Jayanth, ISTC, 4/1/2013 to 3/31/2016, 12.65 Lakhs.
787. '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, 5.64 Lakhs.
788. '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, 31.00 Lakhs.
789. 'Development of Radiation Detectors Based On Thick Gas Electron Multiplier (THGEM). Sub

## INSTRUMENTATION AND APPLIED PHYSICS

**Projects: 24**

**Total: 4,269.27 Lakhs.**

778. 'Fabrication of Hybrid Cnt Array for Electronic

- Project of DST879' K Rajanna, DSTO, 12/27/2011 to 12/26/2014 ,46.00 Lakhs.
790. '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.
791. 'High efficiency nano-generator for energy harvesting and sensors applications' K Rajanna, DSTO, 8/1/2013 to 7/31/2017, 22.40 Lakhs.
792. 'Aperture Engineering and Image Reconstruction Techniques for Nanoscale Imaging' Partha Pratim Mondal, DSTO, 3/2/2012 to 3/1/2015, 24.24 Lakhs.
793. '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 12/31/2015, 30.583 Lakhs.
794. 'Robert Bosch Centre for Research in Cyber Physical Systems' S Asokan, RBCO, 10/10/2011 to 10/9/2021, 3709.60 Lakhs.
795. 'AGATHA-Advanced Grating for Thin Films Solar Cell' S Asokan, DSTO, 12/26/2012 to 12/25/2015, 96.79 Lakhs.
796. 'Development of a versatile optofluidic-microscope for initiating Indian space research programs in biomedicine and telepathology' Sai Siva Gorthi, ISTC, 4/1/2013 to 3/31/2015, 14.65 Lakhs.
797. '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.
798. 'Self Healing Circuits-implementing open Fault Repair in Circuits using Micro-particle Automaton' Sanjiv Sambandan, ISTC, 4/1/2013 to 3/31/2015, 8.46 Lakhs.
799. 'Brain Machine Interface for Thought Based Control' Sanjiv Sambandan, ARDB, 8/12/2013 to 8/11/2015, 14.35 Lakhs.
800. 'Self assembled nano tips for field emission display' Sanjiv Sambandan, DSTO, 8/12/2013 to 8/11/2015, 21.39 Lakhs.
801. '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.

## MATHEMATICS

**Projects: 22**

**Total: 1,675.67 Lakhs.**

802. Raja Ramanna Fellowship to Alladi Sitaram, DAEO, 12/1/2009 to 11/30/2014, 35.81 Lakhs.
803. 'Building triangulations for fast topological computing' Basudeb Datta, DSTO, 12/19/2013 to 12/18/2016, 6.10 Lakhs.
804. 'Inspire Faculty Award (IFA13-MA-28)' Jaban Meher, DSTO, 10/31/2013 to 10/30/2018, 35.92 Lakhs.
805. 'Convergence and optimality of adaptive finite element methods and applications' Thirupathi Gudi, DSTO, 11/28/2013 to 11/27/2016, 12.66 Lakhs.
806. 'Asymptotic behaviour of rational difference equation and that of a biological application' Esha Chatterjee Ghosh, DSTO, 11/21/2012 to 11/20/2015, 18.72 Lakhs.
807. J C Bose Fellowship to Gadadhar Misra, DSTO, 9/1/2008 to 8/31/2018, 124.90 Lakhs.
808. 'Interdisciplinary Centre in Neuroscience at IISc, (This is A Sub-Project of DSTO-943)' Govindan Rangarajan, DSTO, 3/30/2010 to 9/29/2015, 2.50 Lakhs.
809. J C Bose Fellowship to Govindan Rangarajan, DSTO, 2/23/2011 to 2/22/2016, 68.00 Lakhs.
810. 'National Mathematics Initiative' (NMI) Govindan Rangarajan, DSTO, 9/12/2012 to 9/11/2017, 351.59 Lakhs.

811. 'Indo-French Center for Applied Mathematics (IFCAM) at IISc' Govindan Rangarajan, DSTO, 1/23/2013 to 1/22/2017, 215.55 Lakhs.
812. 'National Network for mathematical and Computational Biology' Govindan Rangarajan, DSTO, 11/26/2013 to 11/25/2016, 42.89 Lakhs.
813. 'National Network for Mathematical and Computational Biology' Joint Activities, Govindan Rangarajan, DSTO, 11/26/2013 to 11/25/2016, 138.92 Lakhs.
814. 'DST Centre for Mathematical Biology Phase II' Govindan Rangarajan, DSTO, 12/10/2013 to 12/9/2018, 277.76 Lakhs.
815. INSPIRE Faculty Award (IFA-MA-04) to Koushik Saha, DSTO, 3/1/2012 to 2/28/2017, 26.00 Lakhs.
816. 'Swarnajayanthi Fellowship – Holomorphic Mappings and Intrinsic Metrics' Kaushal Verma, DSTO, 2/8/2011 to 2/7/2016, 48.86 Lakhs.
817. INSPIRE Faculty Award (IFA-MA-12) to Mousumi Mandal, DSTO, 2/25/2013 to 2/24/2018, 35.92 Lakhs.
818. 'Quantitative Imaging Using Ultrasound Assisted Optical Tomography: Mathematical & Numerical Implementation' Nandakumaran A K, CSIR, 4/1/2011 to 3/31/2014, 1.99 Lakhs.
819. 'Inspire Faculty Award for Pooja Singla (IFA-MA-10)' Pooja Singla, DSTO, 11/2/2012 to 11/1/2017, 47.60 Lakhs.
820. INSPIRE Faculty Award (IFA-MA-13) to Soumya Das, DSTO, 11/29/2012 to 11/28/2017, 19.00 Lakhs.
821. 'Function spaces on product domains (new project application)' Thirthankar Bhattachryya, DSTO, 6/18/2013 to 6/17/2016, 4.67 Lakhs.
822. J C Bose Fellowship to Thangavelu S, DSTO, 9/1/2008 to 8/31/2018, 124.40 Lakhs.
823. INSPIRE Faculty award (IFA13-MA-25) to Umesh V Dubey, DSTO, 10/22/2013 to 10/21/2018, 35.92 Lakhs.

## PHYSICS

**Projects: 45**

**Total: 5,159.26 Lakhs.**

824. 'Towards Fluctuation-Based Quantum Information Processing with Semiconductor Nanostructures' Arindam Ghosh, UKIE, 3/24/2008 to 5/31/2015, 43.92 Lakhs.
825. 'A Study of Electronic and Mechanical Properties of Nanoscale Systems With Integrated Experimental Techniques. (Swarnajayanth Fellowship)' Arindam Ghosh, DSTO, 5/1/2009 to 4/30/2014, 228.50 Lakhs.
826. '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.
827. 'Electronic Transport in Graphene Nanostructures' Arindam Ghosh, TOEL, 10/13/2011 to 11/30/2014, 188.62 Lakhs.
828. 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.
829. 'Photophysics of Nanosystems' A K Sood, DSTO, 3/18/2010 to 9/17/2014, 226.35 Lakhs.
830. J C Bose Fellowship of A K Sood, DSTO, 11/1/2012 to 10/31/2017, 68.00 Lakhs.
831. 'Centre for Quantum Information and Quantum Computation (CQIQC)' Anil Kumar (SR), DSTO, 6/15/2010 to 6/14/2015, 314.80 Lakhs.
832. J C Bose Fellowship to Arnab Rai Choudhuri, DSTO, 8/3/2010 to 8/2/2015, 68.00 Lakhs.
833. 'Solar and Stellar Dynamo models' Arnab Rai Choudhuri, DSTO, 11/14/2012 to 11/10/2014, 1.87 Lakhs.
834. '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.
835. 'Study of The Feasibility of Using Graphene Monolayers as A Single Molecule Sensor & Radition

- Sensor'- Project Ref.#: -1: 24 Aveek Bid, NPMA, 12/7/2011 to 11/30/2014, 28.50 Lakhs.
836. '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
837. 'Measuring Fundamental Properties of Compact Objects and Underlying Accretion Process' Banibrata Mukhopadhyay, ISRO, 4/20/2011 to 4/19/2015, 12.65
838. 'Search for Low-Dimensional Chaos in Time Series of Accreting Objects' Banibrata Mukhopadhyay, DSTO, 5/22/2013 to 5/21/2016, 12.15 Lakhs.
839. J C Bose Fellowship to Chandan Dasgupta, DSTO, 7/1/2006 to 6/30/2016, 115.60 Lakhs.
840. 'Cryogenic Experiments in Low-Dimensional Solid State Physics at Indian Institute of Science' Chandan Dasgupta, DSTO, 8/24/2011 to 8/23/2016, 387.52 Lakhs.
841. '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.
842. J C Bose Fellowship to H R Krishnamurthy, DSTO, 6/1/2006 to 5/31/2016, 115.55 Lakhs.
843. 'Investigation of Protein Nanoparticle Interaction With Supported Bilayer Membranes' Jaydeep K Basu, DSTO, 6/13/2010 to 6/12/2016, 779.04 Lakhs.
844. 'Insights Into Dynamic Phase Transitions in Soft Hybrid Colloidal Materials From Novel Micro-Rheology Based Techniques' Jaydeep K Basu, DSTO, 10/27/2011 to 2/26/2015, 53.14 Lakhs.
845. '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.
846. 'Development of 3-Dimensional Diffuse optical tomography system' K Rajan, DSTO, 8/18/2012 to 8/17/2015, 29.10 Lakhs.
847. '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.
848. 'Preparation of Carbon nitrides for space applications' K Ramesh, ISTC, 4/1/2013 to 3/31/2015, 17.32 Lakhs.
849. 'Synthesis of nanostructured carbon nitrides' K Ramesh, DSTO, 6/11/2013 to 6/10/2016, 14.33 Lakhs.
850. 'Physical ageing, Intermediate phases and phase change properties of chalcogenide glasses' K Ramesh, DSTO, 11/6/2013 to 11/5/2017, 53.95 Lakhs.
851. 'Multi-scale modelling of mechanical properties of biomaterials' Prabal K Maiti, DAEO, 9/1/2013 to 8/31/2018, 76.51 Lakhs.
852. 'Computational Studies of Gas in Galaxies and Clusters' Prateek Sharma, DSTO, 9/12/2013 to 9/11/2016, 43.06 Lakh
853. '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.
854. '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.
855. '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.
856. 'Physics and Technology of Nano Assemblies' P S Anil Kumar, DSTO, 1/3/2012 to 1/2/2017, 1,216.62 Lakhs.
857. '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.
858. 'GaSb and InSb Nano inclusion with filled Skutterudite (Rx-CO4Sb12) Material for Thermoelectric Generator' Ramesh Chandra Mallik,

- DSTO, 11/6/2013 to 11/5/2017, 52.15 Lakhs.
859. J C Bose Fellowship to Rahul Pandit, DSTO, 8/1/2007 to 7/31/2017, 121.25 Lakhs.
860. '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.
861. Ramanujan Fellowship to Subroto Mukerjee, DSTO, 7/2/2010 to 7/1/2015, 73.00 Lakhs.
862. 'Studies on new generation multiferric crystals' Suja Elizabeth, DSTO, 10/27/2011 to 10/26/2014, 41.02 Lakhs.
863. 'Structure Elucidation of Hu (Mycobacterium Tuberculosis) Through X-Ray Crystallography and Structure Based Design of Lead Molecules for TB Therapy' S Ramakumar, CSIR, 4/1/2012 to 3/31/2015, 29.23 Lakhs.
864. J C Bose Fellowship to Sriram Ramaswamy, DSTO, 8/1/2007 to 7/31/2017, 121.25 Lakhs.
865. '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.
866. 'Electron correlation effects in topological insulators' Vijay B Shenoy DSTO 8/20/2013 to 8/19/2016 8.5 Lakhs.
867. '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.
868. 'Coherent population trapping and its applications to precision measurements' Vasant Natarajan, DSTO, 8/6/2013 to 8/5/2016, 43.20 Lakhs.

## CENTRE FOR CRYOGENIC TECHNOLOGY

**Projects: 8** **Total: 299.69 Lakhs.**

869. 'Study of tribological properties of polytetrafluoroethylene (PTFE) at cryogenic

temperatures' D S Nadig, ISTC, 4/1/2013 to 3/31/2015, 15.23 Lakhs.

870. 'High Temperature Superconductor Based Liquid Level Probe for Lox System' R Karunanithi, ISTC, 4/1/2012 to 3/31/2014, 16.27 Lakhs.
871. 'Design and Fabrication of The Flexure Spring of The Self-Regulating Joule Thomson Cooler' R Karunanithi, DRDO, 11/5/2013 to 3/31/2015, 4.44 Lakhs.
872. '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.
873. 'Development of Helium Recondensation Systems Based On Two Stage Pulse Tube Cryocoolers' Upendra Behera, DAEO, 4/1/2011 to 11/30/2014, 19.33 Lakhs.
874. '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.
875. '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.
876. 'Studies on vortex tubes for in-flight LOX collection' Upendra Behera, DSTO. 8/6/2013 to 8/5/2017. 30.50 Lakhs.

## CENTRE FOR HIGH ENERGY PHYSICS

**Projects: 6** **Total: 578.28 Lakhs.**

877. 'Advanced Centre for Applications of Quantum Field Theory' B Ananthanarayan, DSTO, 1/10/2012 to 1/9/2017, 180.98 Lakhs.
878. J C Bose Fellowship to Diptiman Sen, DSTO, 2/23/2011 to 2/22/2016, 68.00 Lakhs.
879. J C Bose Fellowship to Rohini M Godbole, DSTO, 9/1/2008 to 8/31/2018, 124.90 Lakhs.

880. Ramanujan Fellowship to Aninda Sinha, DSTO, 12/7/2010 to 12/6/2015, 73.00 Lakhs.

881. Ramanujan Fellowship to Justin R David, DSTO, 12/7/2010 to 12/6/2015, 58.40 Lakhs.

882. Ramanujan Fellowship to Sudhir K Vempati, DSTO, 11/4/2009 to 11/3/2014, 73.00 Lakhs.

### **KISHORE VAIGYANIK PROTHSAHAN YOJANA**

---

**Projects: 6**

**Total: 2,533.62 Lakhs.**

883. '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.

884. 'Kishore Vaigyanik Prothsahan Yojna' (KVPY),

IISc P K Das, DSTO, 7/1/2013 to 6/30/2017, 2,363.18 Lakhs.

885. 'Gas Phase Infrared Spectroscopy of Aromatic Hydrocarbons' P K Das, CSIR, 11/1/2013 to 3/31/2016, 10.31 Lakhs.

886. 'VIJOYSHI-2013/Science Camp' P K Das, DSTO, 11/1/2013 to 10/31/2014, 52.00 Lakhs.

887. '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.

888. 'Kishore Vaigyanik Prothsahan Yojana (KVPY) programme under SC Empowerment initiative, in FY 2013-14' P K Das, DSTO, 1/3/2014 to 2/2/2016, 69.2119 Lakhs.

## LIST OF SPONSORS AND FINANCIAL OUTLAY AS ON 31.03.2015

Sl. No.	Sponsors	No.	Outlay ₹ in Lakhs	Sl. No.	Sponsors	No.	Outlay ₹ in Lakhs
1	Aeronautical Development Agency (ADA)	2	84.12	22	Defence Research and Development Lab (DRDL)	2	97.57
2	Asian Technology Programme (AITP)	1	2.29	23	Defence Research & Development Organisation (DRDO)	45	8,963.84
3	Advanced Micro Devices (AMDO)	1	43.95	24	Department of Science and Technology (DSTO)	359	39,648.13
4	Asian Office Of Aerospace Research and Development (AOAD)	2	81.07	25	Delft University of Technology (DUTO)	1	30.77
5	Armament Research Board (Armreb) (ARBO)	1	297.27	26	Electron Device News (EDNO)	1	4.56
6	International Advanced Reserch Centre For Powder Metallurgy and New Materials pabalapur (ARCI)	1	128.00	27	Ecole Polytechnique De Federal (EPFO)	1	20.99
7	Aeronautics Research and Development Board (ARDB)	13	505.65	28	Europeon Commission (EUCCO)	1	104.43
8	Anna University (AUOO)	1	96.73	29	Europeon Union (EUOO)	1	10.29
9	British Council (BCOO)	1	1.30	30	Freescale Semiconductor India Pvt. Ltd. (FSIP)	1	28.50
10	Boeing Company (BOCO)	3	472.80	31	Ge India Technology Centre (Geit)	1	6.00
11	Board of Research in Fusion Science and Technology (BRFS)	2	97.15	32	The Grantham Foundation for The Protection of The Environment (GFPE)	1	2,375.34
12	Centre for Airborne System (CABS)	1	10.80	33	Government of Karnataka, Department of Science (GKOO)	1	850.00
13	Centre for Development of Advanced Compu (CDAC)	2	205.18	34	General Motors Technical Centre India Pvt. Ltd. (GMOO)	2	20.00
14	Centre for International Climate & Environmental Research (CICE)	1	62.73	35	Gas Turbine Research Establishment (GTRE)	5	664.04
15	Centre for Infrastructure Transportation and Urban Planning (CIST)	9	1,069.80	36	Hewlet Packard (HEPA)	1	10.00
16	The Commonwealth of Learning (COLO)	2	25.42	37	Human Settlement Management Institute (HSMI)	1	9.93
17	Council of Scientific & Industrial Research (CSIR)	36	699.42	38	International Business Machine Corporation (IBMC)	7	52.95
18	Department of Atomic Energy (DAEO)	36	1,454.16	39	Indian Council of Agricultural Research (ICAR)	1	1.00
19	Department of Biotechnology (DBTO)	116	10,509.69	40	Indian Council of Medical Research (ICMR)	2	61.31
20	Department of Environment (DEOO)	2	81.51	41	Indo-French Centre for the Promotion of Advanced Research (IFCPAR) (IFCP)	14	609.84
21	Department of Heavy Industry (DHIO)	1	78.08				

Sl. No.	Sponsors	No.	Outlay ₹ in Lakhs
42	Indira Gandhi Centre for Atomic Research (IGCA)	2	19.65
43	Indian Institute of Science (IIS)	3	64.21
44	Indian National Centre for Ocean Information Services (INCO)	4	188.80
45	Indian National Science Academy (INSA)	1	15.00
46	Intel Technologies India Pvt. Ltd. (INTL)	2	64.52
47	Instruments Research & Development Estt. (IRDE)	1	9.60
48	Institut De Recherche Pour Le Development, France (IRDO)	3	381.62
49	Indian Space Research Organisation (ISRO)	8	900.08
50	Isro-Iisc Space Technology Cell (ISTC)	51	879.21
51	International Union of Crystallography (IUCR)	1	2.97
52	Indo-US Science & Technology Forum (IUSF)	11	5,162.41
53	Joint Advanced Technology Programme (JATP)	16	134.67
54	Kerala State Council for Science, Technology & Environment (KSTE)	1	1.00
55	Los Alamos National Laboratory (LANS)	1	103.65
56	Limberlink Technologies Pvt. Ltd. (LIMB)	1	6.49
57	Lady Tata Memorial Trust. (LTMT)	1	24.00
58	Ministry of Drinking Water and Sanitation (MDWS)	1	278.58
59	Ministry of Environment & Forests (MEFO)	4	81.99
60	Merck & Co., Inc (MERK)	2	120.59
61	Ministry of Earth Sciences (MESO)	14	2,059.54
62	Ministry of Information Technology (MITO)	21	10,634.95

Sl. No.	Sponsors	No.	Outlay ₹ in Lakhs
63	Max Planck Institute of Microstructure Physics (MPIM)	1	11.33
64	Microsoft Corporation India (P) Ltd. (MSCI)	1	25.66
65	Microsmall Medium Enterprises (MSME)	3	501.50
66	National Brain Research Centre (NBRC)	1	88.10
67	Nokia (NKIO)	1	12.53
68	National Program on Micro and Smart Systems (NPMA)	5	366.33
69	Naval Research Board (NRBO)	3	114.02
70	Office of The Principal Scientific Adviser (OPSA)	1	491.74
71	Panasonic India Pvt (PIPO)	1	25.78
72	Robert Bosch Engineering & Business Solutions Limited (RBCO)	1	3,709.60
73	Renault Nissan Technology & Business Centre India Pvt. Ltd. (RNTB)	1	51.30
74	Rolls Royce (RROO)	1	40.91
75	Rail Vikas Nigam Limited (RVNL)	1	24.00
76	The Swiss Agency For Development and Cooperation (SDCO)	1	56.80
77	Texas Instruments Pvt Ltd (TIPL)	1	31.29
78	Tokyo Electron Limited (TOEL)	3	83.17
79	The University of Melbourne (TUMO)	1	9.80
80	University Grants Commission (UGC)	7	2,244.04
81	Uk-India Education and Research Initiative (UKIE)	3	91.62
82	University of Southern California (USCO)	1	6.65
83	Uppsala University (UUOO)	1	12.45
84	Vetenskapsradet (VTSK)	1	4.05
85	The Wellcome Trust, UK (WELT)	16	4,437.82
<b>GRAND TOTAL</b>		<b>887</b>	<b>1,03,150.50</b>

---

## 8.2 Centre for Scientific and Industrial Consultancy

(Chairperson: 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, 2014 to March 31, 2015, 182 consultancy project proposals costing ₹ 13.57 crores were communicated to the clients. In the period above 134 consultancy projects with an outlay of ₹ 9.32 crores materialised. Receipts from consultancy projects, short projects, consultancy test projects and consultancy tests amounted to ₹ 14.76 crores.

---

### BIOCHEMISTRY

---

**Projects: 1**                      **Value: 0.78 lakhs**

1. Development of bioassay for human interferon gamma: M/s. Ras Lifescience Pvt Ltd, Hyderabad: Prof. Dipankar Nandi: ₹ 0.78 lakhs: 6 Weeks.

---

### CENTRE FOR ECOLOGICAL SCIENCES

---

**Projects: 1**                      **Value: 0.95 lakhs**

2. Mapping of trees in Bangalore city: M/s. Karnataka State Pollution Control Board, Bangalore: Dr. T V Ramachandra: ₹ 0.95 lakhs: 6 Months.

---

### INORGANIC AND PHYSICAL CHEMISTRY

---

**Projects: 4**                      **Value: 59.12 lakhs**

3. Spectral analysis of microemulsions: M/s. GE India Technology Centre Pvt Ltd, Bangalore: Prof. P K Das: ₹ 4.60 lakhs: 9 Months.
4. Process characterization and phase identification of an iron based drug: Padaav – Speciality Ayurvedic Treatment Centre, Dehradun: Prof. S Vasudevan: ₹ 16.07 lakhs: 18 Months.
5. Technical assistance: M/S. World Agroforestry Centre, New Delhi: Prof. S Umopathy: ₹ 0.25 lakhs: 1 Week.
6. Application of Raman Spectroscopy in selenium removal from refinery water: M/S. Shell Technology Centre, Bangalore: Prof. S Umopathy: ₹ 38.20 lakhs: 1 Year.

---

### INSTRUMENTATION AND APPLIED PHYSICS

---

**Projects: 2**                      **Value: 11.92 lakhs**

7. Upgradation of computerised totalizers: Bangalore Turf Club Ltd, Bangalore: Dr. S Ramgopal: ₹ 1.98 lakhs: 1 Year.
8. Integrated fiber optic systems for various sensing applications – feasibility studies: Southern Electronics Pvt Ltd., Bangalore: Prof. S Asokan: ₹ 9.94 lakhs: 12 Months.

## COMPUTER SCIENCE AND AUTOMATION

---

**Projects: 3      Value: 33.13 lakhs**

9. Advanced topics in computers systems design – storage, Mgmt and Security: M/S. Unisys Global Services – India, Bangalore: Prof. K Gopinath: Rs. 4.00 lakhs: 3 Months.
10. Study of cyber security issues based on the documents provided pertaining to the SCADA part of PGCIL: Power Grid Corporation of India, Gurgaon: Prof. K Gopinath, Prof. P S Nagendra Rao, Prof. Joy Kuri: ₹ 16.63 lakhs: 3 Months.
11. Learning to cache: A learning approach to caching: M/S. Netapp India, Bangalore: Prof. Chiranjib Bhattacharyya: ₹ 12.50 lakhs: 12 Months.

## ELECTRICAL COMMUNICATION ENGINEERING

---

**Projects: 4      Value: 18.89 lakhs**

12. Technical support for RF energy harvesting circuits: M/S. Richoh Innovations Pvt Ltd, Bangalore: Dr. T V Prabhakar, Prof. K J Vinoy: ₹ 4.90 lakhs, 1 Year.
13. Design of antennas for wireless networking of energy meters at 865-86 Mhz: M/S. Kalki Communication Technologies Limited, Bangalore: Prof. K J Vinoy: ₹ 4.16 lakhs: 4 Months.
14. Network simulator: M/S. Tetcos, Bangalore: Prof. Anurag Kumar: ₹ 0.83 lakhs: 4 Months.
15. Solving large resistive networks towards DC power integrity solution: M/s. Altium, USA: Dr, Dipanjan Gope: ₹ 9.00 lakhs: 5 Months.

## ELECTRICAL ENGINEERING

---

**Projects: 8      Value: 16.12 lakhs**

16. Technical advice through experimental investigation on the insulation design for AC/ DC voltage M/s. Electrohms Private Limited, Bangalore: Prof, Udaya Kumar, Dr. B Subba Reddy: ₹ 1.79 lakhs: 6 Months.
17. Technical advice on the development of high voltage transmission/ substation hardware and C/A: M/S. IAC Electrical Pvt Ltd, Kolkatta: Dr. B Subba Reddy: ₹ 1.11 lakhs: 1 Year.
18. Technical advice and experimental investigations on the 210 KN HVDC and 90 KN ceramic disc insulators: M/s. Aditya Birla Insulators, Rishra, Hoogly: Dr, B Subba Reddy: ₹ 0.48 lakhs: 1 Month.
19. Technical advice on modelling and control of induction motor drives: M/s. Larsen & Toubro Limited, Bangalore: Prof. G Narayanan: ₹ 4.94 lakhs: 12 Months.
20. Technical consultancy in the area of sensors for electric parameters measurement: M/s. C-DAC, Trivandrum: Dr. Vinod John: ₹ 1.00 lakh: 1 Year.
21. Detection and tracking of bloomed cotton: M/S. Green Robot Machinery Pvt Ltd, Bangalore: Dr. Soma Biswas, Prof. K R Ramakrishnan: ₹ 2.25 lakhs: 9 Months.
22. Technical consultancy in the area of sensors for electric parameters measurement electrical test: M/s. Electrohms Pvt Ltd, Bangalore: Dr. Vinod John: ₹ 2.47 lakhs: 1 Year.
23. Technical advice on R & D in the electric power generation and T & D: M/s. Toshiba Software (I) Pvt Ltd, Bengaluru: Prof. P S Nagendra Rao: ₹ 2.08 lakhs: 6 Months.

## MANAGEMENT STUDIES

---

**Projects: 1      Value: 0.15 lakhs**

24. Consultation in data on domestic workers: M/s. Mitr Sanketa, Bengaluru: Prof. Anjula Gurtoo ₹ 0.15 lakhs: 1 Month.



## CENTRE FOR INFRASTRUCTURE, SUSTAINABLE TRANSPORTATION AND URBAN PLANNING

---

**Projects: 3**      **Value: 52.64 lakhs**

25. Preparation of third national communication and other new information to the UNFCC: M/S. Inspire Network For Environment, New Delhi: Prof. G Bala, Prof. N H Ravindranath: ₹ 11.47 lakhs: 1 Year.
26. TEEB case study of forest ecosystem in western ghats: M/s. German Development Corporation, New Delhi: Prof. N H Ravindranath, Dr. P Balachandra: ₹ 19.17 lakhs: 1 Year.
27. Preparation of third national communication and study domestic MRV arrangements in forestry and agriculture: Inspire Network For Environment, New Delhi: Prof. G Bala, Prof. N H Ravindranath: ₹ 22.00 lakhs: 1 Year.

## NANOSCIENCES AND ENGINEERING

---

**Projects: 1**      **Value: 7.99 lakhs**

28. Silicon photonic integrated circuit design skill development: M/s. Anurag/DRDO, Ministry of Defence, Hyderabad: Dr. Shankar Kumar Selvaraja: ₹ 7.99 lakhs,: 6 Months.

## SUPERCOMPUTER EDUCATION AND RESEARCH CENTRE

---

**Projects: 1**      **Value: 4.25 lakhs**

29. Virtual object placement over images: M/s. Shri Arthi Jewellers, Coimbatore: Dr. R Venkatesh Babu: ₹ 4.25 lakhs: 2 Months.

## AEROSPACE ENGINEERING

---

**Projects: 7**      **Value: 91.45 lakhs**

30. Non-linear autopilot design of Astra missile; M/s. DRDL, , Hyderabad: Prof. Radhakanth Padhi: ₹ 8.93 lakhs; 20 Weeks.

31. Evaluation of aerodynamic characteristic of LJT 1:3 scale model with potential stall fixes: M/s. Hindustan Aeronautics Limited, Bangalore: Prof. J Dey, Mr. V Surendranath, Dr. S B Kandagal: ₹ 50.00 lakhs: 6 Months.

32. Design of uninhabited aerial vehicle systems: Hindustan Aeronautics Limited, Bangalore: Dr. S N Omkar: ₹ 5.95 lakhs: 3 Months.

33. Optimal soft lunar landing guidance with hazard avoidance: M/s. Team Indus Axiom Research Labs Pvt Ltd, Bangalore: Prof. Radhakant Padhi: ₹ 12.36 lakhs: 6 Months.

34. Soft landing of aerospace vehicles using nonlinear control: Asian Office Aerospace Research & Development, Tokyo, Japan: Prof, Radhakant Padhi.: ₹ 4.86 lakhs: 6 Months.

35. High pressure turbine characterization Phase I & II: Honeywell Technology Solutions Lab Pvt Ltd, Bangalore: Dr. B Vasudevan: ₹ 8.60 lakhs: 8 Months.

36. Design review and expert advice for suitability of shock absorber & isolators for industrial washing: Novem Solutions Pvt Ltd, Bengaluru: Dr. S B Kandagal: ₹ 0.75: 1 Week.

## CIVIL ENGINEERING

---

**Projects: 74**      **Value: 513.74 lakhs**

37. Feasibility study and design of height raising of tailing dam at Rampura Agucha mines: M/s. Hindustan Zinc Limited, Bhilwara: Prof. T G Sitharam: ₹ 20.22 lakhs: 3 Months.

38. Assessment and proof checking of structural designs & drawings of proposed PDC building at BEL: M/s. Nektor Engineers and Project Consultant, Ahmedabad: Prof. J M Chandra Kishen: ₹ 5.62 lakhs: 6 Weeks.

39. R&D activities and capacity building in the area of sump pump model studies: M/s. National Thermal Power Corporation Ltd, Greater Noida: Prof. M S Mohan Kumar, Prof. M Sekhar: ₹ 25.68 lakhs: 18 Months.

40. Suitability of blast furnace slag as fine aggregate in structural concrete and mortar applications: Public Works, Ports & Inland Water Transport Dept, Bellary: Prof. B V Venkatarama Reddy: ₹ 6.81 lakhs: 8 Months.
41. Surge analysis for Cuttack Paradip pipeline to IOCL refinery: M/s. A One Infraconsultants Pvt Ltd, Jaipur: Mr. P Raghuvver Rao: ₹ 1.12 lakhs: 1 Week.
42. Testing of IIDPE sheet in compliance with geomembrane specifications: M/s. Krish Bhagya Jala Nigam Limited, Bheemarayangudi: Prof. G L Sivakumar Babu: ₹ 1.12 lakhs: 1 Week.
43. Assessment and proof checking OS structural designs and drawings of proposed multistoried residential: M/s Ace Technocrats Pvt Ltd, Udupi: Prof. J M Chandra Kishen: ₹ 2.25 lakhs: 6 Weeks.
44. Assessment and proof checking of structural designs & drawings of proposed multistoried Institute: M/s. Klim Art Pvt Ltd, Bangalore: Prof, J M Chandra Kishen: ₹ 222473: 6 Weeks.
45. Project appraisal report for continuous pressurized water supply to Tumkur city: Karnataka Urban Water Supply And Drainage Board, Tumkur Division, Tumkur: Prof. M S Mohan Kumar: ₹ 3.00 lakhs: 2 Months.
46. Project appraisal report for continuous pressurized water supply to Mandya city: Karnataka Urban Water Supply And Drainage Board, Manyda Division, Mandya: Prof. M S Mohan Kumar: ₹ 3.00 lakhs: 2 Months.
47. Assessment and proof checking of structural designs and drawings of proposed court building at Hubli: M/s. K M K Projects Limited, Bangalore: Prof. J M Chandra Kishen: ₹ 2.67 lakhs: 6 Weeks.
48. Transient analysis of 2 CW pumps: M/S. Siemens Limited, Gurgoan: Mr. P Raghuvver Rao: ₹ 1.25 lakhs: 1 Week.
49. Traffic impact assessment of proposed barricading on elevated section of NH7 near Jakkur aerodrome: M/s. National Highways Authority of India, Bangalore: Mr. P Raghuvver Rao: ₹ 3.74 lakhs: 2 Weeks.
50. Proof checking of bridge and ROBS for SWR: M/S. South Western Railway, Bangalore: Prof. G L Sivakumar Babu: ₹ 2.29 lakhs: 1 Month.
51. Stability analysis for slopes between S10 – S40: CBPU/ Afcons, Jammu: Prof. T G Sitharam, Dr. G Madhavi Latha: ₹ 10.00 lakhs: 2 Months.
52. Stabilized weak forms of mesh-reee and smooth finite element methods for dynamic systems involving: ARDE, Pune: Prof. R M Vasu – INAP, Prof. Debashish Roy: ₹ 4.50 lakhs: 2 Years.
53. Scheme for stabilization of excavation: M/S. Sumadhura Infracon Pvt Ltd, Bangalore: Prof. G L Sivakumar Babu: ₹ 1.16 lakhs: 1 Week.
54. Review of structural designs & drawings of proposed AWHO residential project at Jabalpur: M/s. Army Welfare Housing Organization, New Delhi: Prof. J M Chandra Kishen: ₹ 4.84 lakhs: 6 Weeks.
55. Proof checking of the structural desings of Gadag Institute of Medical Sciences Building: PWD Division, Gadag: Prof. B V Venkatarama Reddy: ₹ 15.28 lakhs: 6 Months.
56. Stability analysis for slopes between S50 to S80: CBPU C/o Afcons Infrastructure Ltd, Jammu: Prof. T G Sitharam, Dr. Madhavi Latha: ₹ 10.00 lakhs: 2 Months.
57. Development of urban mobility for indore city: WBCSD, Geneva, Switzerland: Dr. Ashish Verma: ₹ 3.83 lakhs: 6 Months.
58. Review of air vessel and foundation designs – Khargone lift canal scheme: M/s. MEIL, Hyderabad: Mr. P Raghuvver Rao, Prof. M M Allam: ₹ 1.02 lakhs: 1 Week.
59. Analysis and design of surge protection for Goa water supply and sewerage project: M/s. Technomatics Engineering Company, Coimbatore: Mr. P Raghuvver Rao: ₹ 2.67 lakhs: 4 Weeks.
60. Identification of suitable applications for lead slag lased on its properties: M/s. Eswari Global Metal Indsustries Pvt Ltd, Mangalore: Prof. P V Sivapullaiah: ₹ 3.01 lakhs: 3 Months.

61. Assessment of structural feasibility for the proposed two additional floors of apartment complex: M/s. Ashed Properties & Investments (Pvt) Ltd, Bangalore: Prof. J M Chandra Kishen: ₹ 2.98 lakhs: 3 Weeks.
62. Slope stability analysis of tailing dam at Dariba – additional analyses: M/s. Hindustan Zinc Limited, Udaipur: Prof. T G Sitharam: ₹ 6.14 lakhs: 2 Months.
63. Proof checking of design of ROB at Mathikere consisting of composite girder and approaches: M/s. Krishi Infratech, Bangalore: Prof G L Sivakumar Babu: ₹ 3.62 lakhs: 2 Months.
64. Verification hydraulic design and CFD analysis of 1600 MW Vindychal pump: M/s. Jyoti Limited, Vadodara: Prof. M S Mohan Kumar: ₹ 3.19 lakhs: 1 Month.
65. Review of structural designs and drawings of proposed ASHO residential project Jai Javan Avas Yojna: M/s. Army welfare housing organization, New Delhi: Prof. J M Chandra Kishen: ₹ 3.71 lakhs: 6 Weeks.
66. Suitability of manufactured sand for structural concrete and mortar applications: M/s. J S W Steel Ltd, Bellary Dist: Prof. B V Venkatarama Reddy: ₹ 5.82 lakhs: 8 Months.
67. Failure of foundation in Helahanka-Dharmavaram section site visit to assess the damage: M/s. Rail Vikas Nigham Limited, Bangalore: Prof. J M Chandra Kishen: ₹ 0.34 lakhs: 1 Day.
68. C value test for 1524 od 12 mm wt MS pipe: M/s. Topworth Pipes And Tubes Pvt Ltd, Raigad: Prof. M S Mohan Kumar: ₹ 0.45 lakhs: 4 Weeks.
69. Proof checking of the structural design of 750 bed hospital building for BIdar Institute of Med Science: PWD, Bidar: Prof. B V Venkatarama Reddy: ₹ 11.40 lakhs: 6 Months.
70. Scheme for stabilization of excavation: M/s. Nitesh Timesquare, Bangalore: Prof. G L Sivakumar Babu: ₹ 1.16 lakhs: 1 Week.
71. Surge analysis for rising main from Datiwara to Ransigaon: M/s. Vishnu Prakash R Punglia Ltd, Mumbai: Mr. P Raghuveer Rao: ₹ 1.02 lakhs: 1 Week.
72. Review of structural designs and drawings of proposed AWHO residential project at Belgaum: M/s. Army Welfare Housing Organization, New Delhi: Prof. J M Chandra Kishen: ₹ 1.57 lakhs: 6 Weeks.
73. Simulation studies on Eap-based dimples for MAV applications through forward and inverse problems: M/s. National Aerospace Laboratories, Bangalore: Prof. R M Vasu – INAP, Prof Debasish Roy: ₹ 4.00 lakhs: 1 Year.
74. Proof checking of design of ROB: M/s. Essvy Construction India Pvt Ltd, Secunderabad: Prof. G L Sivakumar Babu: ₹ 0.80 lakhs: 2 Months.
75. Dynamic analysis of slope S50 to S80 in flac with rock bolts and rock anchors: M/s. Chenab Bridge Project Undertaking, Afcons Infrastructure Ltd, Jammu: Prof. T G Sitharam, Prof. Madhavi Lata: ₹ 10.00 lakhs: 2 Months.
76. Proof checking of designs and provisions for pavement, structures and highways in the project widening: M/s. Centrodorstroy (India) Pvt Ltd, New Delhi: Prof. G L Sivakumar Babu: ₹ 19.04 lakhs: 1 Year.
77. Performance assessment of identified irrigation tanks in Tamilnadu using remote sensing and GIS: M/s. Hindustan Unilever Foundation, Bangalore: Prof. D Nagesh Kumar: ₹ 8.43 lakhs: 6 Months.
78. Probabilistic seismic hazard analysis for Comacoe: M/S. Costal Marine Construction & Engineering Ltd, Mumbai: Prof. T G Sitharam: ₹ 7.65 lakhs: 3 Months.
79. Stabilisation of expansive soil using condor soil stabilizer: M/S. Aeonian Earth Solutions (P) Ltd, Mumbai: Prof. G L Sivakumar Babu: ₹ 3.75 lakhs: 2 Months.
80. Design proof check for precast twin techbox for three underpasses of signal free corridor of BBMP: M/s. Reinforced Earth India Pvt Ltd, Bangalore: Prof. Ananth Ramaswamy: ₹ 3.28 lakhs: 1 Month.

81. Integrated hydrological assessment monitoring and documentation for KWDP-II: Watershed Development Department, Bangalore: Prof. M S Mohan Kumar, Prof. M Sekhar: ₹ 121.00 lakhs: 5 Years.
82. Proof checking of design of ROB at LC no.72 at Km 92/000-100 between Palahalli-Mysore stations: M/S. Essay Constructions India Pvt Ltd, Secunderabad: Prof. G L Sivakumar Babu: ₹ 0.68 lakhs: 2 Months.
83. Review and proof checking of PEB structure design and drawings: M/S. Kirby Building Systems India Ltd, Medak Dist: Prof. J M Chandra Kishen: ₹ 4.66 lakhs: 2 Weeks.
84. Expert technical services for arbitration proceedings of Chenab bridge undertaking: M/s. CBPU, Afcons, Mumbai: Prof, T G Sitharam: ₹ 4.06 lakhs: 2 Months.
85. Review and proof checking of PEB structure design and drawings for Shree Renuka Sugar: M/s. Kirby Building Systems India Ltd, Medak Dist: Prof. J M Chandra Kishen: ₹ 1.99 lakhs: 2 Weeks.
86. Proof checking of the structural design of automatic hanger door in the main hangar at CABS: M/s. Garrison Engineer, Bangalore: Prof. J M Chandra Kishen: ₹ 3.43 lakhs: 2 Weeks.
87. Proof checking the structural designs of Karwar Institute of Medical Science building: PWD, Karwar Division, Karwar: Prof. B V Venkatarama Reddy: ₹ 17.81 lakhs: 6 Months.
88. Consultancy service for the partition dykes at NALCO, Damanjodi: M/s. Nalco, Damanjodi: Prof, T G Sitharam: ₹ 0.48 lakhs: 1 Week.
89. Review of suitability of structural system of Febede technology with reference to tall buildings: M/s. Chetana Consultants, Bangalore: Prof. Ananth Ramaswamy: ₹ 2.90 lakhs: 6 Months.
90. Proof checking of ROB in lieu of LC 198 at Davanagere: South Western Railway, Bengaluru: Prof. G L Sivakumar Babu: ₹ 2.24 lakhs: 1 Week.
91. Proof checking of the structural designs for Chamarajanagara Institute of Medical Sciences Building: PWD, Chamarajanagara: Prof. B V Venkatarama Reddy: ₹ 9.95 lakhs: 6 Months.
92. Analysis of liquefaction resistance based on field CPT test results and dynamic tests: M/S. Comacoe Marine Construction & Engineering, Mumbai: Prof. T G Sitharam: ₹ 8.00 lakhs: 3 Months.
93. Assessment and proof checking of structural design & drawings of proposed training centre at BEL: M/s. Nektor Engineers and Project Consultants, Ahmedabad: Prof. J M Chandra Kishen: ₹ 2.16 lakhs: 2 Weeks.
94. Review of structural designs and drawings of new flight test centre building at HAL: M/s. Flora – Arcade Consultancy, Bangalore: Dr. K S Nanjuda Rao: ₹ 0.73 lakhs: 1 Month.
95. Proof checking of the proposed construction of RPB: South Western Railway, North Construction, Bengaluru: Prof. G L Sivakumar Babu: ₹ 2.30 lakhs: 1 Month.
96. Proof checking of ROB/RUB: M/s. South Western Railway, Bengaluru: Prof. G L Sivakumar Babu: ₹ 3.03 lakhs: 1 Week.
97. Evaluation of dynamic properties on soil samples for assessment of liquefaction resistance part II: Costal Marine Construction And Engineering Ltd, Thane: Prof. T G Sitharam: ₹ 6.00 lakhs: 1 Month.
98. Structural investigations of nine spans of viaduct of the Bengaluru Metro: Bengaluru Metro, Bangalore: Prof. J M Chandra Kishen: ₹ 33.03 lakhs: 1 Year.
99. Investigation to study the on effect of acid contamination on soils and its effects: M/s. Hindustan Zinc Limited, Rajasthan: Prof. P V Sivapullaiah, Prof. T G Sitharam: ₹ 8.87 lakhs: 3 Months.
100. Surge analysis for water supply scheme for Gadag Betageri city municipal council: M/s. Doshion Pvt Ltd, Ahmedabad: Mr. P Raghuveer Rao: ₹ 1.12 lakhs: 1 Week.

101. Proof checking of wing wall designs: M/s. Chetan Infratech Consultants Pvt Ltd, Bengaluru: Prof. G L Sivakumar Babu: ₹ 3.31 lakhs: 1 Week.
102. Technical advice on alternative construction techniques for the Balrampur district headquarters building: The Collector And District Magistrate, Balarampur, Chhattisgarh: Prof. B V Venkatarama Reddy: ₹ 7.71 lakhs: 1 Year.
103. Evaluation of proposal for increasing water storage capacity of Bugudanahally tank Tumkur: Karnataka Urban Water Supply & Drainage Board, Division, Amarjyothinagar, Tumkur: Prof. P V Sivapullaiah, Prof. G L Sivakumar Babu: ₹ 14.66 lakhs: 3Months.
104. Vetting of surge analysis design: Larsen And Toubro Limited, Chennai: Prof. M S Mohan Kumar: ₹ 3.80 lakhs: 3 Weeks.
105. Proof checking of design of ROB at Channapattna station yard: Essvy Constructions India Pvt Ltd, Secunderabad: Prof, G L Sivakumar Babu: ₹ 0.80 lakhs: 1 Week.
106. Consultancy assistance for construction of new administrative building: Karnataka Road Development Corporation Ltd, Bengaluru: Prof. G L Sivakumar Babu: ₹ 1.35 lakhs: 1 Week.
107. Proof checking of the structural designs of buildings for Govt Maharani's Commerce & Mgmt College: Naveen Consultants, Bengaluru: Prof. B V Venkatarama Reddy: ₹ 8.31 lakhs: 6 Months.
108. Excavation stability and inspection of projects: Mantri Developers Pvt Ltd, Bengaluru: Prof. G L Sivakumar Babu: ₹ 1.40 lakhs: 1 Week.
109. Proof checking of the structural designs and drawings of 100 LLD sewage treatment plant for HAL: Green Envirotech Services, Bengaluru: Prof. J M Chandra Kishen: ₹ 1.12 lakhs: 1 Week.
110. Proof checking of the structural designs and drawings of bar association at court complex, Hubli: Sankalp Associates, Hubli: Prof. J M Chandra Kishen: ₹ 1.12 lakhs: 1 Week.

## CHEMICAL ENGINEERING

---

**Projects: 5                      Value: 19.71 lakhs**

111. Product evaluation: M/s. Sadhana Enviro Engineering Services, Bangalore: Dr. J R Mudakavi: ₹ 0.80 lakhs: 1 Week.
112. Molecular simulation of electrolytes in batteries and super capacitors: Center for Study of Science and Technology, Bangalore: Dr. Sudeep Punnathanam: ₹ 2.25 lakhs: 6 Months.
113. Investigation on the Noxall water treatment compound: M/S. Ozo Nano Sciences, Bangalore: Dr. J R Mudakavi: ₹ 7.69 lakhs: 3 Months.
114. Interfacial properties of solid-liquid interfaces – development of novel computational method: M/S. Shell Technology Centre, Bengaluru: Prof. Sudeep Punnathanam: ₹ 6.72 lakhs: 4 Months.
115. Molecular simulation of electrolytes in batteries and super capacitors: Centre for Study of Science And Policy (CSTEP), Bengaluru: Prof. Sudeep Punnathanam: ₹ 2.25 lakhs: 6 Months.

## MATERIALS ENGINEERING

---

**Projects: 7                      Value: 28.35 lakhs**

116. Accumulative roll bonding of some copper based materials: M/s. Reliance Industries Limited, Raigad: Dr. Satyam Suwas: ₹ 1.25 lakhs: 1 Month.
117. Technical advice: M/s. Sundaram Fasteners Limited, Bangalore: Prof. U Ramamurty: ₹ 2.24 lakhs: 1 Week.
118. Technical advice: M/s. Emco Energy Limited, Charapur: Prof. U Ramamurty: ₹ 1.68 lakhs: 1 Week.
119. Technical advice: M/s. Sundram Fasteners Ltd, Bangalore: Prof. U Ramamurty: ₹ 0.83 lakhs: 1 Week.
120. Cold spray coatings – fundamental understanding of severe plastically deformed structures: M/s. G E

India Technology Centre Pvt Ltd, Bangalore: Prof. Satyam Suwas, Dr. Chandan Srivastava: ₹ 18.00 lakhs: 1 Year.

121. Consultancy assistance for short term project: M/s. Emco Energy Ltd, , Bangalore: Prof. Satyam Suwas, Dr. Chandan Srivastava: ₹ 1.54 lakhs: 1 Week.
122. Consultancy advice: M/s. Sundram Fasteners Limited, Salem: Prof. U Ramamurty: ₹ 2.81 lakhs: 1 Week.

## MECHANICAL ENGINEERING

---

**Projects: 10 Value: 62.65 lakhs**

123. Technical advice: GE BE Pvt Ltd., Bangalore: Prof. Satish V Kailas: ₹ 0.26 lakhs: 1 Week.
124. Advice on design, development and testing of quieter tyres: M/s. M R F Limited, Chennai: Prof. M L Munjal: ₹ 19.80 lakhs: 2 Years.
125. Design of silencers for gas trubines, compressors and fans: M/S. P R Acoustical Engineering Work (P) Limited, Tiruchy: Prof. M L Munjal: ₹ 2.85 lakhs: 1 Year.
126. Silencers for gas industries – design and validation: M/s. Control Component India Pvt Ltd, Bangalore: Prof. M L Munjal: ₹ 10.56 lakhs: 1 Year.
127. Measure and control of the forging operations noise: M/s. Gearock Forge Pvt Ltd, Bangalore: Prof. M L Munjal: ₹ 4.27 lakhs: 9 Months.
128. Development of bi-model, bi-stable, three-port complaint mechanism: M/s. Eaton Corporate Research & Technology, Pune: Prof. G K Anathasuresh: ₹ 2.20 lakhs: 18 Months.

129. Technical advice: M/s. GE-BE Pvt Ltd, Bengaluru: Prof. Satish Vasu Kailas: ₹ 0.12 lakhs: 1 Week.

130. Efficiency test for acoustic works at index stadium: National Games Secretariat, Thiruvanthapuram: Prof. M L Munjal: ₹ 0.97 lakhs: 1 Month.
131. TAFE 47 PS engine muffler development: M/s. TAFE, Chennai: Prof. M L Munjal: ₹ 2.97 lakhs: 6 Months.
132. Characterization of port fuel injectors in terms of structure, cone angle and drop sizing: M/s. T V S Motor Company, Hosur: Prof. R V Ravikrishna: ₹ 18.65 lakhs: 1 Year.

## CENTRE FOR PRODUCT DESIGN AND MANUFACTURING

---

**Projects: 1 Value: 6.93 lakhs**

133. Behaviour of cylindrical aluminium tubes under impact loading: Corporate Technology Centre, Tube Investment Of India Ltd., Chennai: Prof. Anindya Deb: ₹ 3.37 lakhs: 2 Months.

## ATMOSPHERIC SCIENCES

---

**Projects: 1 Value: 6.93 lakhs**

134. Climate change impact on ecosystems in selected river basins in the Indu Kush Himalayas: International Centre for Integrated Mountain Development, Nepal: Prof. G Bala, Prof. N H Ravindranath: ₹ 6.92 lakhs: 1 Year.

## 8.3 Intellectual Property Cell

(Chairperson: Jayant M Modak)

The Intellectual Property Cell of the Indian Institute of Science was set up in 2004. It was started with primary objective of protecting and maintaining the intellectual property of the institute. It also involved in the objectives of technology transfer and intellectual property management consultation.

In its drive towards achieving the objective of IISc's IP Policy, the IISc IP policy is revised from time to time outlines details of IP activities that the IP Cell oversees. 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, Pratimesh Lab, Tau Instruments. 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. In addition to the above, agreements with patent commercialization companies, viz., Think Village, Skyquest and Synergia continue to be in force. In addition, IP Cell together with the IISc alumni with SID is working towards identifying various avenues in commercializing the Institute's patented technologies. The IP Cell is also working towards simplified and standardised "Model agreements" that serve the needs and interest of IISc.

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 faculty. The increased disclosures is 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, IP .In addition to above activities, IP cell continues to review various research agreements such as NDA's, MTA's and license agreements. Based on the requirements, 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 2014, are illustrated below:

#### Number of patent Applications filed in the year 2014:

No of Indian application filed	26
No of Indian application granted	1
No of Foreign application filed	6
No of Foreign application granted	6

#### Expenses incurred and Revenue generated for the year 2014:

Expenses incurred:	₹ 54,97,724/-
Revenue generated:	₹ 20,98,666/-

#### Basic portfolio index (1995-2014)

<b>Total Patents filed:</b>	<b>457</b>
Granted Patents in force	58
Patents Lapsed	62
Patents under Prosecution	337
<b>Total</b>	<b>457</b>

#### Total Number of Patents filed: Year wise break-up (1995-2014)

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	23	7	30
2014	26	6	32
<b>Total</b>	<b>267</b>	<b>190</b>	<b>457</b>

**Licensed Patent Details for the year 2014:**

1. **Pratimesh Lab:** Patent application number: 3020/CHE/2014 titled “Micro-fluidic device”.
2. **Tau Instruments:** Patent application number: 3091/CHE/2012 titled “Apparatus and method for preparation of free nanoparticles”.
3. **Super-Wave Technology Private Limited:**
  - a. Indian Patent Application Number 454/CHE/2005 entitled “Device for treatment of sample using shock waves and methods thereof.”
  - b. Indian Patent Application Number 1583/CHE/2007 (patent pending) entitled “Novel technique for hypersonic drag control using heat addition in the shock layer”

- c. Indian Patent Application Number 9783/CHENP/2012 (patent pending) entitled “A device for extracting liquid sample and method thereof”
- d. PCT Application Number PCT/IN2010/00254 entitled “A device for extracting liquid sample and method thereof”

**List of Agreements handled by IP Cell:**

**Partnership agreement:** KAS Technologies

**Renewal Agreement:** Honeywell Technologies

**Research Agreement:** Renault Technology, LG Soft India, Intel, Shell

**Collaborative study Agreement:** Merck, CEFIPRA

**Material Transfer Agreement:** Institute of Microbiology, Chinese Academy of Sciences, China, Jubilant Biosys Ltd., Chromous Biotech Pvt. Ltd.,

**Amendment Agreement:** Mesha

**IP Management Plan:** SERIUS consortium

**Co-operation agreement:** Tech Mahindra & IMA

**Non Disclosure Agreement:** Manipal Pritrronics, Span Diagnostics, LG Soft India Pvt. Ltd., Tejas Networks, Nokia Solutions, GE, Tau Instruments, Mesha LLC, 3M India Ltd., Tata Power Solar Systems, BEL, Godrej, Chromous Biotech Pvt. Ltd.

**License Agreement:** Prathmesh, Tau Instruments

**Contract Agreement:** Inspire Network for Environment

**Consultancy Agreement:** GE, ITC Pvt. Ltd.

---

## 8.4 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 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**

Testing of the 500 kWe lean burn engine is being initiated at Sattur as a part of Cummins Co-generation project. The system has been tested till about 340 kWe and two engines have been operational. Issues related to increasing the power level to its possible potential

of about 500 kWe is being explored. Similar capacity engine is also ready for testing at Gadag, in Karnataka.

This will be for the first time in India an indigenously developed engine will operate beyond 240 kW capacity to operate on producer gas.

#### PRECIPITATED SILICA

The 5 Ton per day plant set up by M/S Usher Agro Pvt Limited has been commissioned and about 3 batches of silica equivalent to about 2 tons have been produced. The teething issues with respect to the filters and drying is being attended to and the plant is expected to operate continuously.

This is first of its kind in the world, where a commercial scale plant which would convert rice husk ash to precipitated silica.

#### HYDROGEN SULPHIDE SCRUBBING

System to handle 750 m<sup>3</sup>/hr of biogas with a inlet H<sub>2</sub>S concentration of about 5000 ppm has been designed and set up at Bio-Sysnergy, Sambalkot. The key challenge here is the sweet gas H<sub>2</sub>S concentration which has to be less than 2 ppm. The system design is based on ejector based scrubbing and regeneration.

#### CURRENT PROJECTS

The following three R & D projects have been sanctioned from MNRE and are ongoing:

- Hydrogen and Liquid Fuels from Biomass Gasification
- Advanced RDF Gasification Systems

#### PATENTS AND PUBLICATION:

- EPO Patent application titled “**Producer Gas Carburetor**” has been accepted for the grant of patent and publication of the grant is awaited.
- About 15 International and National publications have been made.

---

## 8.5 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 & Technology.

**The following summarizes the activities and achievements during 2014-15:**

- Projects Sanctioned           26
- MOUs signed                     7

**Projects Sanctioned:** During the period under review, SID got 26 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 Vaignanik Prothsahan Yojana, Centre for Infrastructure, Sustainable Transportation and Urban Planning, Spectroscopy Analytical Test Facility.

**Companies/Industries with which Agreements/ MOUs have been signed during 2014-15:** 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:

- Gubbi Labs LLP
- Mesha, Inc
- Agora Analytics LLP
- Cummins Technologies India Limited
- Samarth Life Sciences Private Limited
- Safran
- Tata Steel Limited

### 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:

- Thales
- Usher
- Bharat Electronics Ltd
- Boeing
- Exxon Mobil
- General Electric
- Airbus
- Ingsol
- Unilever
- IREQ
- LAM Research
- HPCL
- ITC
- Philips
- IMI
- Ministry of Education, Muscat
- TCS
- SAFRAN
- VHP Tech
- Solonics
- McAfee
- Bharath Forge
- Marico
- Oxford University
- Tech Mahindra

### INCUBATION CENTRE

The following incubatees continue to operate under the Incubation Centre provided by SID.

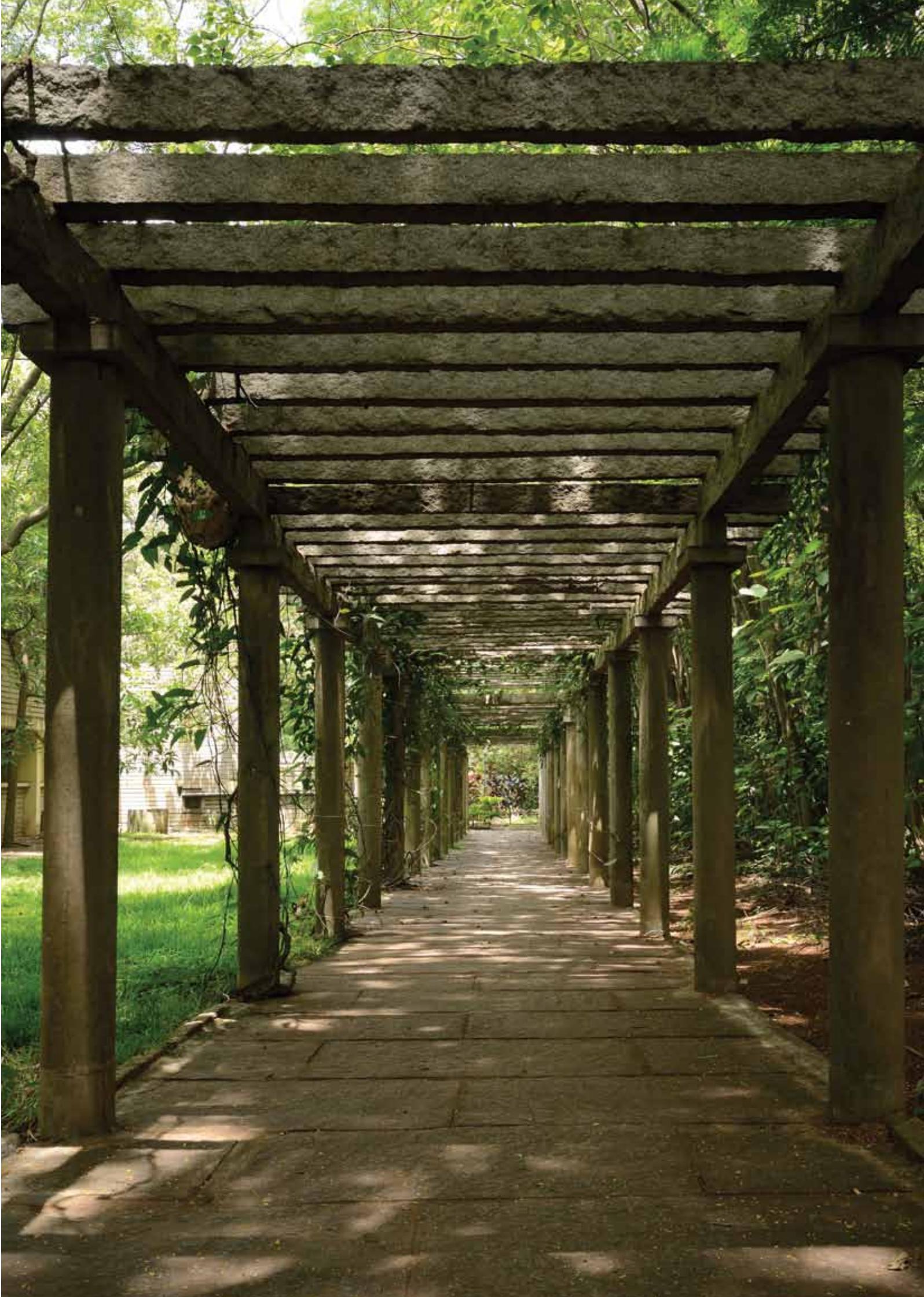
Company	Incubatees	Technology Area
Instrumentation Scientific Technologies Pvt. Ltd.	Mr. Sumeet Yamdagni, Alumnus of IISc	Structural Health Monitoring using Fiber Bragg Grating to cater to the needs of the aerospace, civil and risk management sectors Energy
Gamma Porite ElectroTech Pvt. Ltd.	Mr. Adhiraj Deshpande, Alumnus of IISc	Efficient Lighting products
Pratimesh Labs Pvt. Ltd.	Mr. Prakhar Jain Alumnus of IIT-BHU, Varanasi	Microfluidics based portable, low cost complete blood count test device

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.





## 9

# CENTRAL FACILITIES

## 9.1 Infrastructure – Buildings

### WORKS 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	Asphalting of peripeheral road (D Gate to NIAS to junction near centenary visitors hostel) new Aerodynamics Building and Internal roads to campus	200.00	-
2	Covering the open spaces on the southern side of Prakruthi Canteen	31.23	-
3	Construction of additional rooms and dismantling of existing class rooms at Kendriya Vidyalaya	265.00	1,698.00
4	Construction of Mezzanine rooms in Hypersonic Laboratory Aerospace Engineering Department	44.70	-
<b>ADDITIONS AND ALTERATIONS</b>			
5	Replacing wooden windows with aluminium windows and grilla in old E tupe quarters at New Housing Colony	36.00	-
6	Renovation of ground floor rooms and laboratories at ICER Department	31.50	-
7	Renovation to ground floor and first floor of sothern wing of old MRDG Building	16.00	-
8	Providing electrical works with fixtures at SSCU annexe (old MRDG Building)	15.70	-
9	Concreting the internal roads at New Hostel Buildings and construction of parking lot on the other side of New Hostel Building Road	29.65	-

### WORKS-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	2,751.00
2	Construction of laboratories, classrooms, conference hall and office space in Material Engineering Department	465.60	2,265.00
3	Construction of shopping complex and tea Kisok	301.52	2,067.00
4	Construction of Dinning facility and parking at main guest house	43.26	300.90
5	Construcrion of New Block for Electronics and Communication Engineering Department	643.93	3,206.00

6	Construction of new Hydraulics building for Civil Engineering Department	791.09	4,875.00
7	Construction of additional second floor to Department of Electronic System Engineering (DESE) Building	258.17	1,705.00
8	Construction & renovation of centre for Neuroscience in old TIFR Building, IISc.,	626.64	2,692.00
9	Additional constructions for Divecha Centre for Climate Change at CAOS premises	368.77	1,840.00

### ADDITIONS AND ALTERATIONS

10	Acoustic treatment and connected Civil and Electrical works at Raja Ramanna Auditorium in Gymkhana Campus	66.24	-
11	Establishment of 0.5 MLD domestic STP	294.00	-
12	Renovation and improvement to "E" Block Hostel	162.61	-
13	Renovation and addition to old Aerospace Department building to accommodate Administrative Officers	267.56	653
14	Modification of 'C' Mess including adding new patio and annexe	275.57	-
15	Conversion of class rooms, renovation of students Laboratory and other renovation works to Management Studies building at IISc	106.08	-
16	Providing new sanitary line from NNE Quarters/New 8 storeyed quarters under construction upto the proposed STP behind swimming Pool	51.75	-
17	The work of Painting and vitrified tile flooring work at CSA building	37.48	-
18	The work of renovation, painting and other allied works to Biochemistry annexe building	25.74	-
19	Renovation of toilets in Gymkhana, IISc	16.56	-
20	Construction of toilets and upgrading of kitchen flooring at Kabini Canteen	13.43	-

## 9.2 Official Language Unit (Chairperson: Govind S Gupta)

Dr. V Thilagam is officiating as Senior Hindi Officer in this 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/respond in Hindi, many incentives have been provided.

### HINDI DAY

Hindi Day was celebrated on September 15, 2014. Mr. K. N. Bhatt, Principal, Kendriya Vidyalaya IISc. Bangalore was the guest of Honour. Mr. K. N. Bhatt gave away cash prizes and certificates to the staff members who did well in Examinations.

## 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. P.S.R. Murthy, Member Secretary, Town Official Language Implementation Committee (TOLIC) and Senior Hindi Officer, National Aerospace Limited (NAL), Bangalore conducted a workshop on “Hindi and I.T. Applications” on March 04, 2015.

Mr. Damodaran, Deputy Director, Hindi Teaching Scheme, Bangalore conducted a workshop on “Importance of Hindi in Implementation of Government Policies” on December 18, 2014.

## DARSHINI MAGAZINE

Published Hindi Quarterly Magazine “Darshini” regularly. For the year 2014-15, April-June 2014, July-September 2014, October-December 2014 and January-March 2015 issues had been published.

## HINDI LECTURE SERIES

- Dr. Hemant Kumar Shukla, Principal Scientist, National Aerospace Laboratories, Bangalore delivered a Hindi Technical Lecture on “Polyurethane” on March 20, 2015.

- Dr. Alok Kumar Srivastava, Project Director, ISRO Satellite Centre, Bangalore delivered a Hindi Technical Lecture on “Mangalyaan” on December 12, 2014.
- Dr. Rajiv Ranjan, Assistant Professor, Department of Materials Science, IISc., Bangalore delivered a Hindi Technical lecture on “Pressurized Electric Materials” on September 26, 2014.
- Dr. Ravibhushan Tiwari, Principal Scientist, Indian Institute of Horticulture Research, Bangalore delivered a Hindi Technical Lecture on “Growing market of Healthy Food” on June 06, 2014.

## TOLIC COMPETITIONS

Many participants from various Central Government offices participated in different competitions conducted by TOLIC office, Bangalore. Under the guidance of TOLIC office our Institute organized a Dictation Competition for participants on October 16, 2014.

## 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 Hindi materials from KVPY, IISc, Bangalore

---

## 9.3 SC/ST Cell

(Liaison Officer: Puttabasavaiah)

---

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.



---

## 9.4 Counselling and Support Centre (Chairperson: N C Shivaprakash)

---

The Centre for Counselling & Support (CCS) provides professional support to employees in various kinds of distress, especially those related to debts, alcoholism, absenteeism, family, health & 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 interaction with Students (Student support network committee, Students Council) for Counselling.

### WOMEN'S CELL

The Women's Cell was established in the year 2004 under Centre for Counseling and Support with the objective of addressing matters relating to women in the Institute. This Committee was reconstituted by the Director and Ms. Indumati Srinivasan, Financial Controller of the Institute is the present Chairperson of the committee.

To facilitate the Committee to prepare an agenda, several meetings were organized with each category of women, viz., faculty, students and administrative staff to understand the needs of each group.

An interactive session on 'Effective Communication at the Workplace' was organized. Dr. Jayagowri

Shivakumar, Head, Department of English NMKRV College for Women conducted the Workshop.

An online portal of the Institute was created and inaugurated on International Women's Day 2015. This will facilitate women (past & present) associated with the Institute to register and key in essential details to create a data base, which can be put to effective use for organizing targeted programs such as gender sensitization, career training lectures & workshops, discussion forums, etc. in the future.

### SEXUAL HARASSMENT COMPLAINTS COMMITTEE

The Hon'ble Supreme Court has laid down certain guidelines and norms to be observed in institutions to ensure the prevention of sexual harassment of women in the work place. Sexual harassment of any kind constitutes an action unbecoming of an employee of the Institute and therefore constitutes misconduct in employment and will attract appropriate disciplinary action. Any complaint of sexual harassment would be examined by a complaints committee for redressal of the complaints. The committee would broadly be as follows:

- Redressal of complaints of women employees on sexual harassment while on duty and recommend suitable action wherever necessary
- Suggest steps to ensure that there is no hostile environment towards women at work place
- Counselling the staff concerned
- Any other work as entrusted to the Committee regarding welfare of women employees at the Institute.

The sexual harassment complaints committee was constituted during 2003 and functioning under the Centre for Counseling and Support. During this year the committee received five (5) complaints and all of them were dealt with appropriately. Also six workshops on awareness programme against sexual harassment were conducted during this year.

---

## 9.5 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, has taken charge as Public Information Officer (PIO) since May 2014. The Institute

has disseminated certain information through its website, which is accessible to the public. During the year, the Public have made 130 requests seeking information and prompt action has been taken and the applicants have been informed accordingly.

---

## 9.6 Alumni Association

---

The Indian Institute of Science Alumni Association (IIScAA) was formed in the year 1976 to provide a common platform for the alumni of the institute to reach out other alumni across various batches, branches, and interests. Following report summarizes the activities of IIScAA:

The IISc Alumni Association (IIScAA) has about 9156 members, During 2014-15, a total of 109 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 9 popular lectures on different topics. In addition, it arranged several Alumni Network Meets and Alumni Reunion meet. It also periodically brought out IIScAA Newsletters.

The 39th Annual General Body Meeting was organized on August 31, 2014. The Distinguished Alumnus Awards 2014 were also presented by the Director on that day.

IIScAA organised the presentation of Prof.N.Appaji Rao Best Mentor Award for the year 2014 to Prof.Raghavendra, Gadagkar, INSA SN Bose Research Professor and JC Bose National Fellow at the Centre for Ecological Sciences, IISc, on Thursday, September 25, 2014.

The IIScAA organized the first lecture under **Prof. M. Vijayan Lecture Series** by Prof. E N Baker, University of Auckland, New Zealand on the topic “Foundations of X-ray crystallography and its ability to transform biology and chemistry” on December 2, 2014.

The 5th Sports Meet among IISc alumni was held on 18th January 2014 (Sunday) at the IISc Gymkhana ground. A total of 90 members participated in the event.

---

## 9.7 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
- IEEE Signal Processing Society, Bangalore chapter
- Indian Institute of Metals, Bangalore Chapter
- Indian Institute of Mineral Engineers, Bangalore Chapter
- Indian Structural Integrity Society
- Institute of Smart Structures & Systems (ISSS)
- Instrument Society of India
- International Association for Gondwana Research
- 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)



# 10

## CAMPUS FACILITIES

### 10.1 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 Medclaim 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.

---

### 10.2 Sports and Recreation

---

#### 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 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, 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.

#### 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.

### **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.

---

## **10.3 Auditoria**

---

### **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.

### **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.

### **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.

### **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.



---

## 10.4 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.

# IISc SECOND CAMPUS

## Challakere Campus, Chitradurga

(Advisor: B N Raghunandan)



The Institute is in possession of 1,500 acres of land allotted by the Government of Karnataka during 2009 in Challakere Taluk of Chitradurga District. The Institute's second campus being set up in Kudapura village named as "**Challakere Campus**". It is 220km away from Bangalore and takes about 4 hours to reach the campus.

The Institute has completed construction of approximately 7km of compound wall, 10km of peripheral road with 4 major drains, Main Entrance Gate with Security cabin. In order to conserve the water during rainy season, two check dams are under construction for rain water harvesting.

11 KV power line has been drawn in to the campus to meet the power requirement in the near future. The underground water pipe line has been laid by the Karnataka Urban Water Supply Board for providing drinking water to the campus from the Vani Vilasa Sagar Reservoir.

The work of construction of Solar Power Generation and Research Centre, and Centre for Climate Observatory are in progress. The Centre for Ecological Sciences is continuing its research activities in the campus. The Centre for Sustainable Technologies (CST) has

commenced its activities under the project entitled "C-BELT" i.e., Bio-energy and Low Carbon Technologies. The proposed project work aims at dissemination and capacity building in adopting, promoting low-C and biomass centric technologies developed by CST. The activities also include dissemination of technology developed at CST for the rural community and providing training and exposure programmes to make them self-sufficient.

The Talent Development Centre ([www.tdc.iisc.ernet.in](http://www.tdc.iisc.ernet.in)) is continuing its novel programme of providing training for High School Science Teachers, supported by the Government of Karnataka, has completed 4 years and around 6000 teachers have been trained at the centre.

The Ministry of Human Resource Development, Government of India has identified the IISc Challakere Campus as the Centre of Excellence in Science and Maths under the Scheme "Pandit Madan Mohan Malaviya National Mission on Teachers & Teaching (PMMMNMTT).

The Institute has also proposed construction of Skill Development Centre and Hostel Complex. Architectural Plan has since been finalized and the construction will commence shortly.



A building under construction

Financial Controller: Indumati Srinivasan

The Ministry of Human Resource Development provides Non-Plan and Plan grant to the Institute for meeting Recurring expenditure & for creation Capital assets, respectively. 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 respectively.

The total receipts covering all major areas for the year 2014-15 was ₹ 76,830.62 lakhs and the payments for various activities of the Institute was ₹ 82,788.63 lakhs.

## THE DETAILS OF RECEIPTS AND PAYMENTS ARE AS FOLLOWS

Sl No.	Particulars	₹ in lakhs	
		Receipts	Payments
1	Non-Plan Grant – Recurring	25,016.03	*25,016.49
2	Plan Grants	12,210.00	21,726.98
3	Developmental Projects	4,558.29	4,119.37
4	Centre for Sponsored Schemes & Projects	25,696.05	23,051.83
5	Centre for Scientific & Industrial Consultancy	1,267.41	928.91
6	Centre for Continuing Education	155.98	121.31
7	Sponsored Scholarships (CSIR/AICTE/UGC)	2,421.02	2,317.90
8	Academic / Other Income	1,274.64	*1,274.64
9	Interest earnings / Project Overheads	4,231.20	4,231.20
	<b>Total</b>	<b>76,830.62</b>	<b>82,788.63</b>
	* Salaries & Allowances	20,905.23	
	Working Expenses	5,385.90	
	<b>Total</b>	<b>26,291.13</b>	





#### **ANNUAL REPORTS COMMITTEE**

T A Abinandanan  
B Anantharayan  
P Manivannan  
Y Narahari (Convener)  
K Panneer Selvam  
G Rangarajan  
P S Sastry

#### **ASSISTANCE**

R M Alagappan  
Karthik Ramaswamy

#### **DESIGN**

[www.thefool.in](http://www.thefool.in)

#### **PHOTOGRAPHY**

Manoj Sudhakaran  
Public Relations Office, IISc  
Centre For Nano Science And Engineering, IISc  
B N Raghunandan

#### **ARCHIVES & PUBLICATIONS CELL**

##### **Indian Institute of Science**

Bangalore 560 012  
Ph: +91 80 2293 2444  
Fax: +91 80 2360 0757  
Email: [office@apc.iisc.ernet.in](mailto:office@apc.iisc.ernet.in)



**IISc**  
**Press**

[www.iiscpress.iisc.in](http://www.iiscpress.iisc.in)