ANNUAL REPORT

IISc 2017-18

INDIAN INSTITUTE OF SCIENCE

VISITOR
The President of India

PRESIDENT OF THE COURT
N Chandrasekaran

CHAIRMAN OF THE COUNCIL
P Rama Rao

DIRECTOR
Anurag Kumar

DEANS
SCIENCE: Biman Bagchi
ENGINEERING: K Kesava Rao
UG PROGRAMME: Anjali A Karande

REGISTRAR
V Rajarajan

IISc RANKED INDIA'S TOP UNIVERSITY

In 2016, IISc was ranked Number 1 among universities by the National Institutional Ranking Framework (NIRF) under the auspices of the Ministry of Human Resource Development. It was the first time the NIRF came out with rankings for Indian universities and institutions of higher education. In both 2017 and 2018, the Institute was again ranked first among universities, as well as first in the overall category.

CONTENTS

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 109 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 a 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 and, in particular, in such branches of knowledge as are likely to promote the material and industrial welfare of India."*

During 2017-18, the Institute initiated the practice of undergoing international peer academic reviews over a 5-year cycle. Each year a set of departments will be reviewed by a small team of international experts who will be invited to spend 3-4 days in the Institute. During this period, they interact closely with the faculty and students of these departments, and tour the facilities, aiming to assess the academic work against international benchmarks. This initiative was kicked off by a review of the EECS Division (the erstwhile Electrical Sciences Division), and the Department of Aerospace Engineering (which was celebrating its 75th anniversary). As part of their evaluations, the invited experts provided valuable feedback. We will study and act upon their input to ensure that IISc follows the best practices to achieve international performance levels.

Again, in 2017-18, IISc has topped the MHRD NIRF rankings not only in the universities category, but also overall among all ranked institutions. The Times Higher Education has placed IISc at the 8th position in its Small University Rankings (that is, among universities with fewer than 5000 students), at the 13th position in its ranking of universities in the Emerging Economies, and in the range 91-100 in its World Reputation Rankings. IISc is placed at 170 in the QS World University Rankings, where IISc is at the Number 2 position on the metric of Citations per Faculty.

The Society for Innovation and Development (SID) was established in the mid-90s to promote interaction with the industry, by way of attracting industry funded research projects, hosting industry research laboratories, and, since 2001, promoting the formation of companies around innovations emerging from IISc. During the past year, the efforts of SID have been given an extra impetus by inducting industry professionals into the management team. An experienced senior technologist from a major national company has joined IISc to help increase the industry- research interactions. This has resulted in a renewed influx of industry funded research projects, which we plan to sustain. Two other professionals have also been inducted, one to strengthen the interactions with medium, small, and micro enterprises (MSMEs), and the other to encourage start-up activities. It may be noted that since IISc set up mechanisms for incubating companies, 25 start-ups have been launched, of which 16 have started in the past 3 years. It is interesting to note that some of these start-ups are coming out of very basic laboratory research, for example, one start-up aims to develop more effective influenza vaccines based on new fundamental understanding of the structure of the virus. Influenza is a major viral pathogen that causes about 300,000 deaths annually, and is deadly if there is a pandemic. The influenza virus, which causes the common flu, has many variants. This makes the process of generation of a universal vaccine for flu difficult. Conventional vaccines try to elicit antibodies against the variable head domain of an unstable protein called hemagglutinin which resides on the surface of the virus. Prof. Raghavan Varadarajan's group and collaborators instead focused on the conserved stem domain, and designed modified fragments of this domain. These fragments protect mice from infection with diverse strains of influenza virus. A startup (Mynvax) has been formed to develop and commercialize this work.

The new Office of Career Counselling and Placement (OCCaP) has recruited a Placement Officer (on contract), and has had a successful first full year of operation. 80% of the registered Master's Degree students have been successfully placed. OCCaP has also been seeking internship opportunities for students, which in turn strengthens their chance of getting a job offer in the following year.

This year also saw initiation of special efforts towards laboratory and food safety. The Food Safety and Standards Authority of India (FSSAI) was engaged for auditing all the eateries on the campus (those in the hostels, and also the various food outlets). Through a process of auditing and training, the aim is to ensure safe food handling practices in all these entities. An Office of Laboratory Safety and Environmental Health was launched this year, along with the recruitment of a Safety Officer (on contract). Safety auditing of all the laboratories has been initiated, the aim being to ensure world-class safety practices everywhere on the campus.

In order to further expand the sources of support for the Institute's activities, in 2015, the Institute set up an Office of Development and Alumni Affairs (ODAA). This office has been aiming to raise funds from organizations under Corporate Social Responsibility, as well as from philanthropists and alumni. During the past year, ODAA has raised funds for the construction of two of the blocks of a 475-occupancy women's hostel (from Jindal Aluminium Group and Bharat Petroleum), in addition to CSR support for renewable energy and sustainable technologies projects.

I am honoured to present the IISc Annual Report which reports the academic output and related achievements during the period 2017-18. 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.

As I complete my fourth year as Director of this unique institution, I place on record my personal gratitude to the Chairman and the Members of the Council of the Institute for their valuable support and guidance.

Anurag Kumar
Director
September 2018

ACADEMIC STRUCTURE

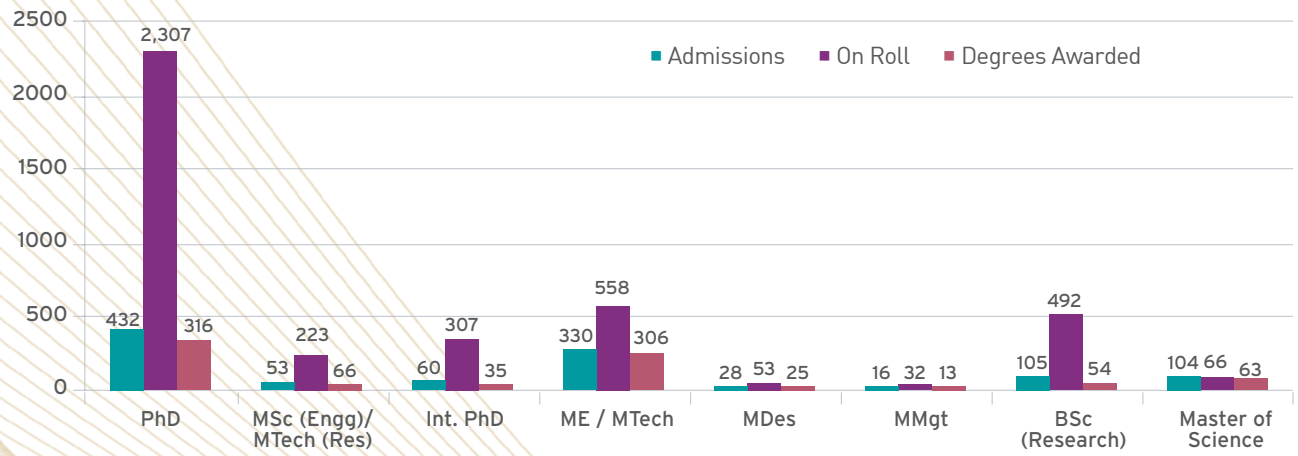
Division of Biological Sciences	BC	Biochemistry
	CAF	Central Animal Facility
	CES	Centre for Ecological Sciences
	CIDR	Centre for Infectious Disease Research
	CNS	Centre for Neuroscience
	MCB	Microbiology and Cell Biology
	MBU	Molecular Biophysics Unit
	MRDG	Molecular Reproduction, Development and Genetics
Division of Chemical Sciences	IPC	Inorganic and Physical Chemistry
	MRC	Materials Research Centre
	NRC	NMR Research Centre
	OC	Organic Chemistry
	SSCU	Solid State and Structural Chemistry Unit
Division of Electrical, Electronics, and Computer Science	CSA	Computer Science and Automation
	ECE	Electrical Communication Engineering
	EE	Electrical Engineering
	ESE	Electronic Systems Engineering
Division of Interdisciplinary Research	BSSE	Centre for BioSystems Science and Engineering
	CCS	Centre for Contemporary Studies
	CiSTUP	Centre for Infrastructure, Sustainable Transportation and Urban Planning
	CeNSE	Centre for Nano Science and Engineering
	CDS	Computational and Data Sciences
	MS	Management Studies
	ICER	Interdisciplinary Centre for Energy Research
	ICWaR	Interdisciplinary Centre for Water Research
	RBCCPS	Robert Bosch Centre for Cyber Physical Systems
	SERC	Supercomputer Education and Research Centre

IISc AT A GLANCE
2017-18

Division of Mechanical Sciences	AE	Aerospace Engineering
	CPDM	Centre for Product Design and Manufacturing
	CE	Chemical Engineering
	MT	Materials Engineering
	ME	Mechanical Engineering
	CiE	Civil Engineering
	CEaS	Centre for Earth Sciences
	CAOS	Centre for Atmospheric and Oceanic Sciences
	CST	Centre for Sustainable Technologies
	DCCC	Divecha Centre for Climate Change
Division of Physical and Mathematical Sciences	CCT	Centre for Cryogenic Technology
	CHEP	Centre for High Energy Physics
	IAP	Instrumentation and Applied Physics
	MA	Mathematics
	PHY	Physics
Centres under the Director	LIB	JRD Tata Memorial Library
	APC	Archives and Publications Cell
	OIR	Office of International Relations
	CCE	Centre for Continuing Education
	CSSP	Centre for Sponsored Schemes & Projects
	ODAA	Office of Development and Alumni Affairs
	IPTeL	Office of Intellectual Property and Technology Licensing
	CC	Challakere Campus
	CSIC	Centre for Scientific and Industrial Consultancy
	DIGITS	Digital Campus and IT Services Office
Other Centres/ Activities	SID	Society for Innovation and Development
	CBR	Centre for Brain Research
	KVPY	Kishore Vaigyanik Protsahan Yojana
	KSCST	Karnataka State Council for Science and Technology
	IIScAA	IISc Alumni Association

STUDENTS

STUDENTS - ADMISSIONS, ON ROLL AND DEGREES AWARDED 2017-18



HOSTELS (3,019)

Men	2,215
Women	804
Messes (4)	

CONTINUING EDUCATION (1,318)

QIP Degree program	17
QIP Short Term Courses	435
CCE Proficience	472
Industry sponsored courses	394

SCHOLARSHIPS/FELLOWSHIPS (2,477)

IISc	1861
UGC/CSIR/Others	473

FACULTY 2017-18

STAFF (935)

	SC/ST	OBC	GN
Academic, Scientific & Technical (547)			
Academic	10	8	416
Scientific	26	3	44
Technical	17	1	22
Support (389)			
Officers	5	3	11
Administrative	62	8	84
Technical	21	3	31
Maintenance	58	5	93
Others	1	2	2

INTERACTIONS

On Campus	
Institute Lectures	15
Conferences	223
Visitors	829
Delegations	56
Staff	
Visits	514
Conferences	861
Lectures delivered	843
Assistance in other Institutions	964

PUBLICATIONS (2,566)

Biological Sciences	349
Chemical Sciences	362
Electrical Sciences	392
Mechanical Sciences	869
Physical & Mathematical Sciences	283
Interdisciplinary Research	311

AWARDS AND DISTINCTIONS (215)

Fellows	
National Science and Engineering Academies	16
Other Science and Engineering Academies	44
Shanti Swarup Bhatnagar Prize	2
Swarnajayanti fellowship	2
J.N. Tata Chair of Indian Institute of Science	1
Awards and Honours	225

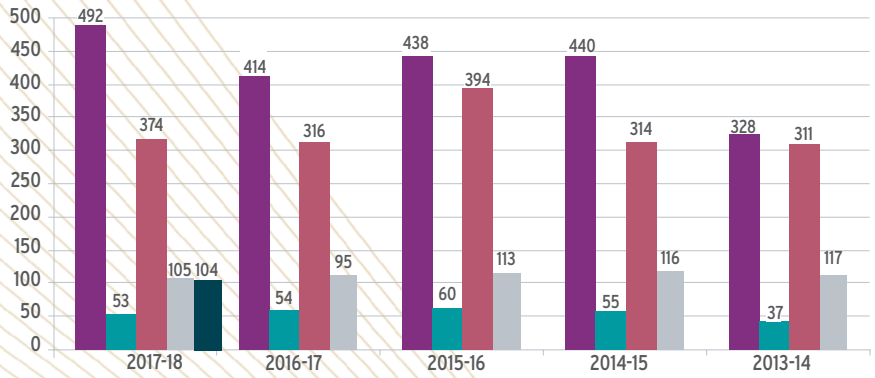
ACADEMIC DIVISIONS: 6 DEPARTMENTS: 42

Biological Sciences	8
Chemical Sciences	5
Electrical Sciences	4
Mechanical Sciences	10
Physical & Mathematical Sciences	5
Interdisciplinary Research	10

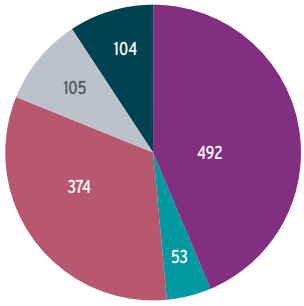
STUDENTS

ADMISSIONS, CONFERMENTS, ON ROLL

STUDENTS ADMISSIONS FROM 2013 TO 2018

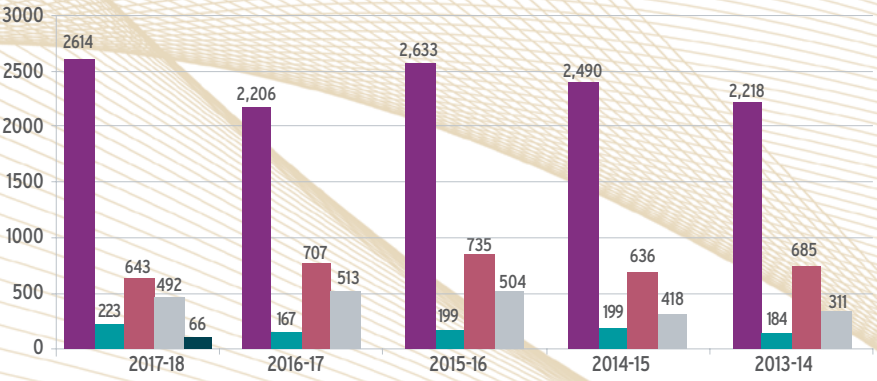


2017-18

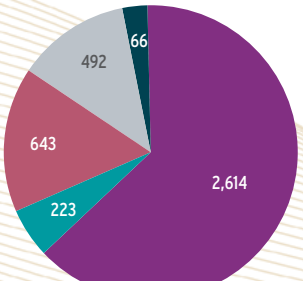


Total: 1128

ON ROLL FROM 2013 TO 2018

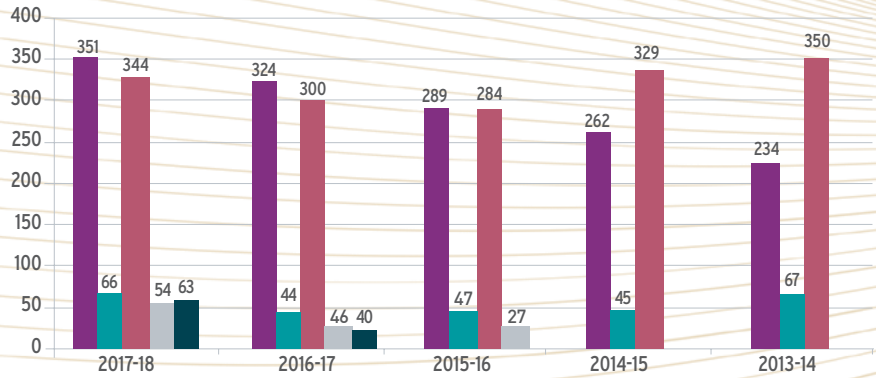


2017-18

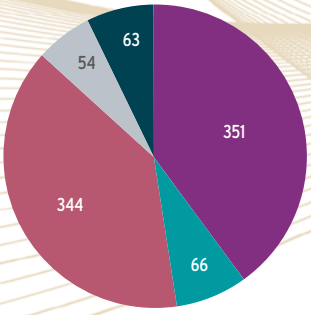


Total: 4038

CONFERMENTS FROM 2013 TO 2018



2017-18

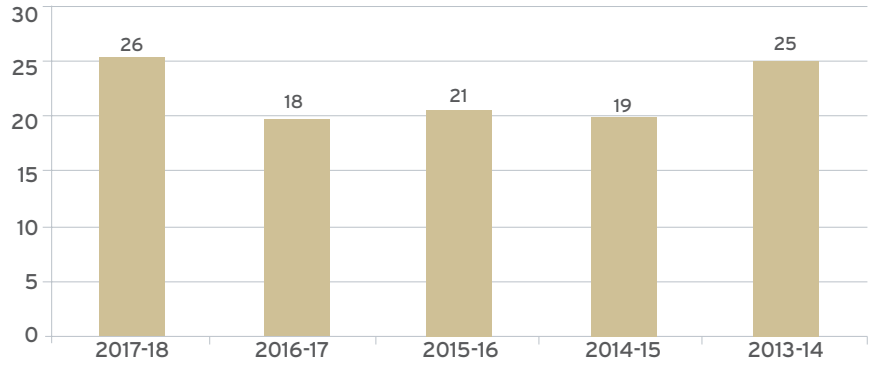


Total: 878

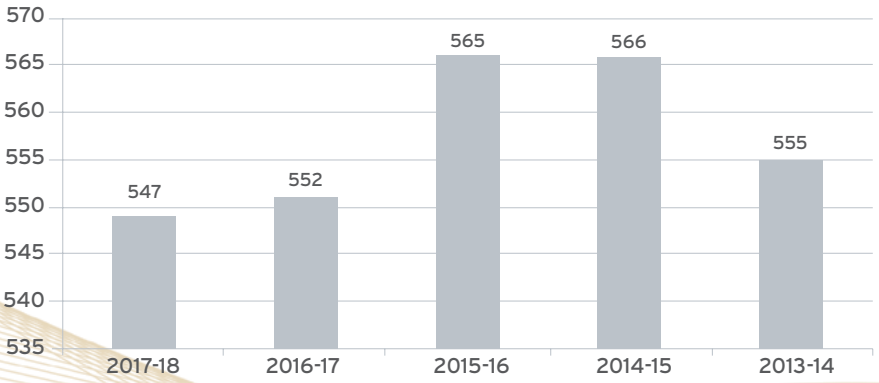
PhD / Int PhD ■ MSc (Engg) / MTech (Res) ■ Masters Programme ■ BSc (Research) ■ Master of Science

FACULTY 2017-18

NEW FACULTY INDUCTED DURING 2013-2018



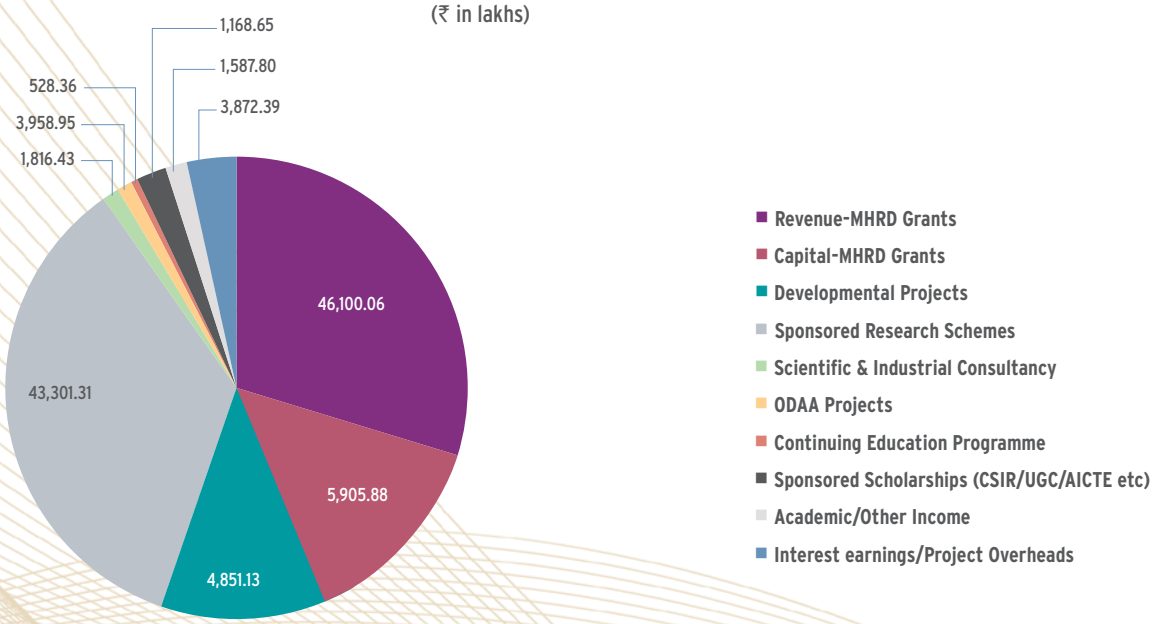
ACADEMIC, SCIENTIFIC AND TECHNICAL STAFF ON ROLL FROM 2013-2018



FINANCE 2017-18

RECEIPTS

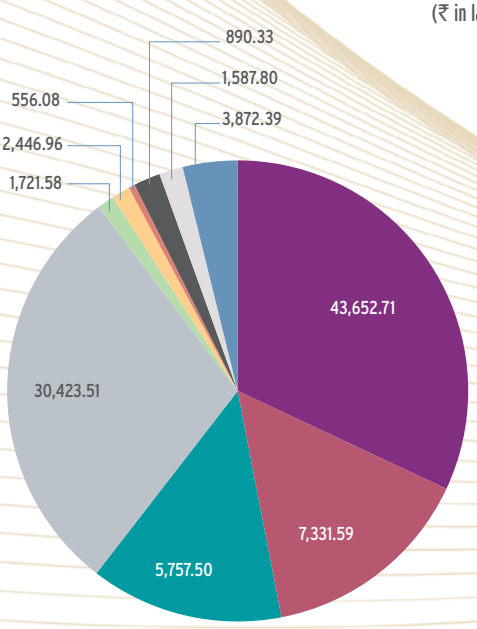
(₹ in lakhs)



Total: 1,13,090.96

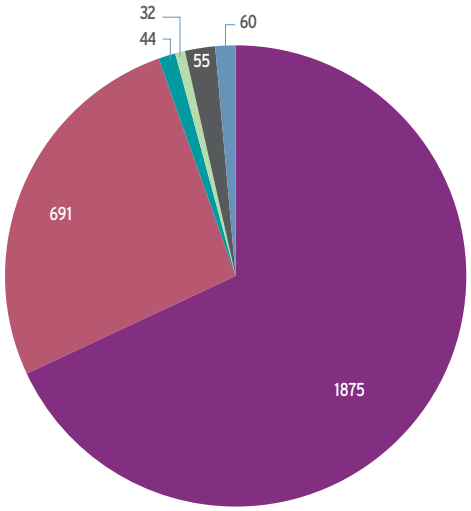
PAYMENTS

(₹ in lakhs)



Total: 98,240.45

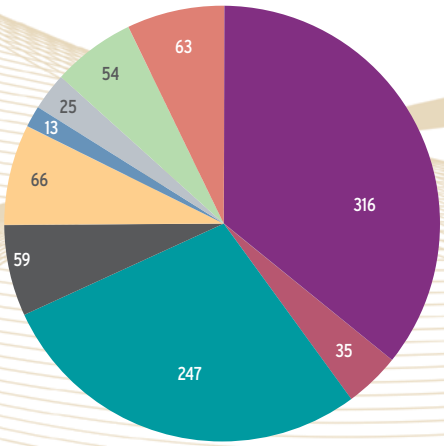
PUBLICATIONS 2017



- Journal Publications
- Conference Publications
- Popular Articles
- Books & Monographs
- Books & Book Chapters
- Reports

Total: 2,757

DEGREES AWARDED 2017-18



- PhD
- Int. PhD
- ME
- MTech
- MSc (Engg.)
- MMgt
- MDes
- BSc (Research)
- Master of Science

Total: 878

PROGRAMMES

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

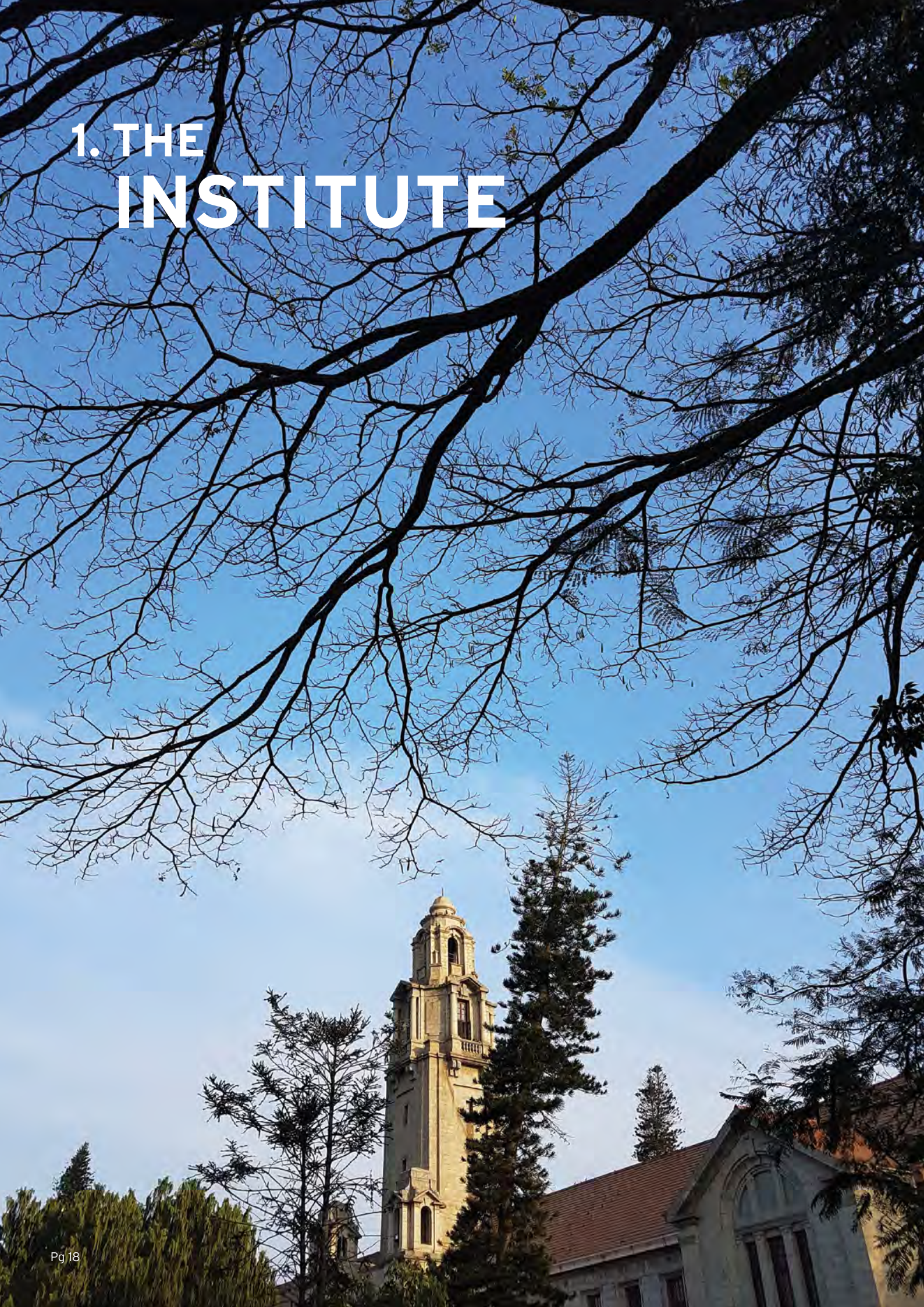
■ME ■MTech ■MDes ■MMgt ✦BSc (Research)

ENGINEERING

Civil Engineering	●	●	■	■
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	●	●		■
Instrumentation	●	●		■
Computational and Data Science	●			■
Nano Science & Nano Technology	●			
Energy Research	●			
Management Studies	●			■
BioSystems Science and Engineering	●			
Water Research	●			■

COURSES OFFERED 2017-18

Division	100 level	200 level	300 level	400 level
Biological Sciences	1	35	19	5
Chemical Sciences	0	20	29	0
Physical & Mathematical Sciences	0	54	50	1
Electrical, Electronic and Computer Sciences	0	129	29	2
Mechanical Sciences	3	250	42	1
Centres /IDP	0	18	3	0
Undergraduate (BS)	17	19	41	17



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 The Court

The membership of the Court is drawn from different cross sections of the country such as Industry, Universities, Scientific Institutions, etc. In addition to eminent persons of science, learning and industry, it also contains the nominees of the Government of India, the Government of Karnataka and the Tata Trusts. The Professors of the Institute and the members of the Council are also ex-officio members of the Court. The following are the members of the Court:

N CHANDRASEKARAN
President of the Court
Chairman, Tata Sons Ltd,
Bombay House, 24, Homi Mody
Street, Mumbai 400 001

MANJULA N
Commissioner, Office of the
Commissioner,
Dept. of Collegiate Education
2nd Floor, DTE Building
Palace Road
Bangalore 560 001

R K KRISHNA KUMAR
Director, Tata Sons Ltd
Bombay House, 2nd Floor
24, Homi Mody Street
Fort, Mumbai 400 001

PANKAJ R PATEL
President
FICCI & Chairman & Managing
Director,
Cadila Healthcare Ltd., Zydus Tower
Satellite Cross Roads
Ahmedabad 380 015

S N AGARWAL
Chairman, Bhoruka Power
Corporation Ltd., 5th Floor,
Hitananda-II, 48, Lavelle Road,
Bangalore 560 001

VIJAY PADATE
Director General, The Employers
Federation of India, 1703, World
Trade Centre-I, Cuffe Parade,
Mumbai 400 005

ANIL D SAHASRABUDHE
Chairman, The All India Council
for Technical Education, 7th Floor,
Chander Lok Building
New Delhi 110 001

GIRISH SAHNI
Director General, Council of
Scientific & Industrial Res.
Anusandhan Bhawan, 2, Rafi Marg,
New Delhi 110 001

P RAMA RAO
Former Vice-Chancellor, Univ. of
Hyderabad, Chairman, Governing
Council, IISc. "NAIMISAM", Flat No.
301, Plot No. 22, Srinagar Colony,
Hyderabad 500 073

M K BHAN
Former Secretary, Dept. of
Biotechnology, Govt. of India, Min. of
Science and Technology, New Delhi

R S BAWA
Vice Chancellor
Chandigarh University
Gharuan, District Mohali
Punjab 140 413

SANDEEP SANCHETI
Vice Chancellor, SRM Institute of
Science & Technology
SRM Nagar, Kattankulathur
Kancheepuram District
Chennai 603 203

RAKESH BHATNAGAR
Vice Chancellor, SRM Institute of
Vice Chancellor
Banaras Hindu University
Varanasi 221 005

P N RAZDAN
Vice Chancellor
Dr. D.Y. Patil Vidyapeeth
Sant Tukaram Nagar, Pimpri
Pune 411 018

M P RAVINDRA
President, IISc. Alumni Association
IISc Campus, Bengaluru 560 012

ANURAG KUMAR
Director (Ex-officio)

ALL PROFESSORS OF
THE INSTITUTE
(Ex-officio)

ALL MEMBERS OF
THE COUNCIL
(Ex-officio)

V RAJARAJAN
Registrar (Ex-officio Secretary)

During the year, the Court met once on Mar 16, 2018.

1.2 THE COUNCIL

The Council is the principal governing authority of the Institute and its membership includes the Nominees of the Court, Parliament, Government of India, Government of Karnataka, Tata Trusts, Representatives of Indian Universities, University Grants Commission and Scientific bodies. The following are the members of the Council:

P RAMA RAO
Chairman of the Council
Former Vice Chancellor
University of Hyderabad
Hyderabad (Nom. GOI)

R SUBRAHMANYAM
Secretary, Min. of Human Resource Development, Dept. of Higher Education, Govt. of India
Shastri Bhavan, New Delhi 110 001

V L V S S SUBBA RAO
Senior Economic Advisor
Ministry of Human Resource Development, Higher Education Department, Govt. of India
107-C, Shastri Bhawan
New Delhi 110 001

A S KIRAN KUMAR
Former Secretary
Department of Space
Antariksh Bhavan
New BEL Road
Bangalore 560 231

RAJKUMAR KHATRI
Principal Secretary, Higher Education Dept, Govt. of Karnataka
Bangalore 560 001

I S N PRASAD
Additional Chief Secretary
Finance Dept., Govt. of Karnataka
Bangalore 560 001

J J IRANI
Director, Tata Sons Ltd.
7, Beldih Lake
Northern Town
Jamshedpur 831 001

R VENKATARAMANAN
Managing Trustee
Sir Dorabji Tata Trust
World Trade Centre - 1, 26th Floor
Cuffe Parade, Mumbai 400 005

RAJENDRA PRASAD
Director, Amity Institute of Biotechnology, Amity Univ
Gurgaon (Haryana) 122413

MURLI MANOHAR JOSHI
Hon'ble Member of Parliament (LS)
6, Raisina Road
New Delhi 110 001

SURESH C ANGADI
Hon'ble Member of Parliament (LS)
"Spoorthi" Sampige Road,
Vishweshwarayya Nagar
Belgaum 590 009

NARENDRA JADHAV
Hon'ble Member of Parliament (RS)
304, Shalaka, 4th Floor, Maharshi Karve Road, Near Cooper age Telephone Exchange
Mumbai 400021

M K BHAN
Former Secretary, Dept. of Biotechnology, Govt. of India, Min. of Science & Technology, New Delhi

ANIL D SAHASRABUDHE
Chairman, The All India Council for Technical Education, 7th Floor, Chander Lok Building
New Delhi 110 001

GIRISH SAHNI
Director General, Council of Scientific & Industrial Res.
Anusandhan Bhawan, 2, Rafi Marg,
New Delhi 110 001

R S BAWA
Vice Chancellor, Chandigarh University
Gharuan, District Mohali
Punjab 140 413

SANDEEP SANCHETI
Vice Chancellor, SRM Institute of Science & Technology
SRM Nagar, Kattankulathur
Kancheepuram District
Chennai 603 203

ANURAG KUMAR
Director (Ex-officio)

BIMAN BAGCHI
(Ex-officio)
Dean, Science Faculty

K KESAVA RAO
(Ex-officio)
Dean, Engineering Faculty

V RAJARAJAN
Registrar (Ex-officio Secretary)

The Council met quarterly on Jun 24, 2017; Sep 23, 2017; Dec 9, 2017 and Mar 17, 2018.

1.3 FINANCE COMMITTEE

The following are the members of the Finance Committee:

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

PAVAN KUMAR MALAPATI
Deputy Secretary
(Budget & Resources)
Finance Department Bangalore
(Nom.GOK)

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

DARSHANA M DABRAL
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)

M K BHAN
former Secretary, Dept. of
Biotechnology, Govt. of India
Min.of Science and Technology
New Delhi

V L V S S SUBBA RAO
Senior Economic Advisor,
Ministry of Human Resource
Development, Higher Education
Department, Govt. of India, 107-C,
Shastri Bhawan, New Delhi 110 001

R NARESH
Pr. Accountant General (G&SSA)
Karnataka, Bangalore (Ex-officio)

ANURAG KUMAR
Director (Ex-officio)

V RAJARAJAN
Registrar (Ex-officio Secretary)

The Finance Committee met quarterly on Jun 23, 2017; Sep 22, 2017; Dec 8, 2017 and Mar 16, 2018.

1.4 THE 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 organise 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 May 23, 2017; Sep 5, 2017; Nov 7, 2017 and Feb 12, 2018.

The Senate recommended the award of various degrees as follows:

• PhD	316
• Int. PhD	35
• MSc (Engg)	66
• ME/MTech	306
• MDes	25
• MMgt	13
• BSc (Research)	54
• Master of Science	63
Total	**878**

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 Apr 20, 2017 and Oct 24, 2017. The Engineering Faculty met on Apr 21, 2017 and Oct 20, 2017 during the year.

The Joint meetings of Faculty members were held on Aug 28, 2017 and Jan 9, 2018. The Director chaired the Joint meetings.

2.STAFF

DIRECTOR: ANURAG KUMAR

DEAN, FACULTY OF SCIENCE
BIMAN BAGCHI

DEAN, UG PROGRAMME
ANIL KUMAR P S

DEAN, FACULTY OF ENGINEERING
K KESAVA RAO

DEPUTY DIRECTOR (INFRASTRUCTURE AND PLANNING)
RUDRA PRATAP

DEPUTY DIRECTOR (ADMINISTRATION AND FINANCE)
JAYANT M MODAK

CHAIR, DIVISION OF BIOLOGICAL SCIENCES
UMESH VARSHNEY

CHAIR, DIVISION OF CHEMICAL SCIENCES
P K DAS

CHAIR, DIVISION OF ELECTRICAL SCIENCES
Y NARAHARI

CHAIR, DIVISION OF INTERDISCIPLINARY RESEARCH
G RANGARAJAN

CHAIR, DIVISION OF MECHANICAL SCIENCES
VIKRAM JAYARAM

CHAIR, DIVISION OF PHYSICAL & MATHEMATICAL SCIENCES
RAHUL PANDIT

REGISTRAR
V Rajarajan, MSc
(TNAU, Coimbatore)

JOINT REGISTRAR
K Panneer Selvam, MA (Madras) LLB (Bangalore), PhD (Gandhigram Rural)

DEPUTY REGISTRAR
V Nagaraja, MA (Mysore)

ASSISTANT REGISTRARS
Aparna Kandi, BE (Gulbarga)
Veeranna Kammar, MSc (Bangalore)
M C Jayaprakash, MCom, MBA, BL
B N Sreedhar, MBA (KSOU)
P Selva Kumar, MA (KSOU)

SR. SECURITY OFFICER
MR Chandrasekhar
BSc (Mysore), LLB (Bangalore)

SR. HINDI OFFICER
V Thilagam, PhD (Bangalore)

SR. SPORTS OFFICER
CP Poonacha
BA (Mysore), MPEd (Karnataka)

FINANCIAL CONTROLLER
Indumati Srinivasan, MA (JNU) MPhil (JNU), PGDPPM (IIMB)

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

INTERNAL AUDITOR
Gurumurthy, MCom

Health Centre

OFFICER-IN-CHARGE
C Sathish Rao

MEDICAL OFFICERS
Aditya Malladi, MBBS (NTR)
R Nirmala, MBBS (Madras)
C Sathish Rao, MBBS (Mysore)
L Sharada, MBBS, DGO (CMC, Vellore)
Neethi Raveendran MBBS (Kerala)

Campus Management and Development

PROJECT ENGINEER-CUM-ESTATE OFFICER
Col. Arun Sharma, M Tech (IIT, Bombay)

ASSISTANT EXECUTIVE ENGINEERS
G Lohithesh Kumar, BE (Kuvempu) MTech (Visvesvaraya)
Prabhakar M P

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

Gymkhana

PRESIDENT
Ambedkar Dukkipati, PhD (IISc)

Student Affairs

CHAIR, COUNCIL OF HOSTEL WARDENS
Ashok M Raichur, PhD (Nevada)

WARDENS
Abha Misra, PhD (IIT-B)
Aveek Bid, PhD (IISc)
Dipshikha Chakravortty, PhD (Pune)
Ganesh Nagaraju
Muddu Shekar
P Thilagar

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

STUDENT COUNSELLORS
Vishwesha Guttal, PhD (Ohio State)
Ambedkar Dukkipati, PhD (IISc)
Prabal K Maiti, PhD (IIT/K)
Partha Pratim Mondal, PhD (IISc)
Ravishankar Narayan, PhD (IISc)
Abha Misra, PhD (IIT-B)
Annapoorni Rangarajan PhD (NCBS)

3. DIVISIONS

3.1 DIVISION OF BIOLOGICAL SCIENCES

The Division of Biological Sciences forges important links between basic science and innovative research. It is committed to enhancing frontline studies in almost all aspects of modern biology: Neuroscience in health and disease, Infectious Disease, Structural Biology, Oncology, DNA Repair and Genomic Stability, Systems Biology and Bioinformatics, Immunology, Enzymology, Reproductive and Developmental Biology, Diverse Ecological Studies and more.

Themes

Investigators in the Division focus on numerous processes central to the understanding of life, emphasising on areas with considerable translational potential, namely, Cognition and Neuronal Reprogramming, Infectious Diseases, Drug and Molecular Design, Diagnostics and Therapeutics in Cancer, Gene Targeting, Genetic Disorders and Genetic Diversity.

Research Highlights

The Division of Biological Sciences consists of the Departments of Biochemistry, Microbiology & Cell Biology, Molecular Reproduction, Development & Genetics, Molecular Biophysics Unit, Ecological Sciences, Centre for Neuroscience, Centre for Infectious Disease Research and Central Animal Facility including Primate Research Laboratory

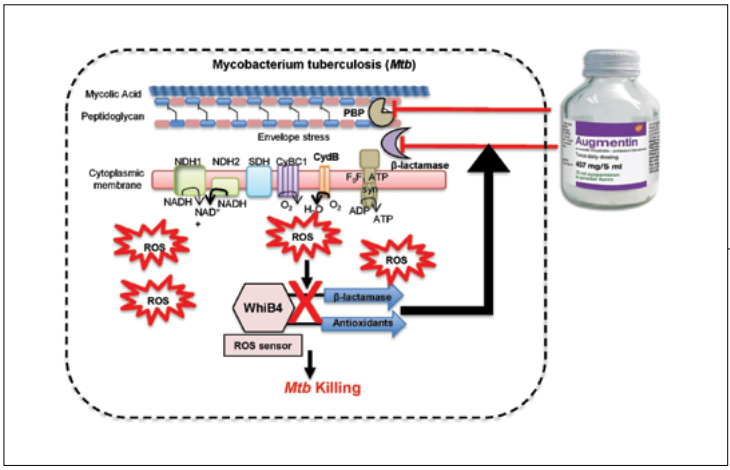
DEPARTMENTS | CENTRES | UNITS

- BIOCHEMISTRY
- CENTRAL ANIMAL FACILITY
- CENTRE FOR ECOLOGICAL SCIENCES
- CENTRE FOR INFECTIOUS DISEASE RESEARCH
- CENTRE FOR NEUROSCIENCE
- MICROBIOLOGY AND CELL BIOLOGY
- MOLECULAR BIOPHYSICS UNIT
- MOLECULAR REPRODUCTION, DEVELOPMENT AND GENETICS

IN NUMBERS

- 77 FACULTY MEMBERS
- 343 PhD STUDENTS
- 55 INTEGRATED PhD STUDENTS

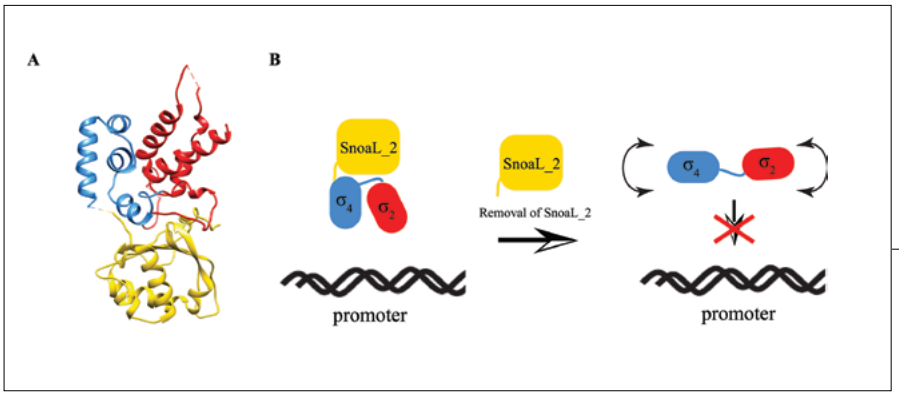
RESEARCH SNAPSHOTS 2017-18



1. Amit Singh (MCB)

Mycobacterium tuberculosis (Mtb) is resistant to the most commonly used antibiotic: Beta-lactam (e.g., Augmentin). The bacterium produces Beta-lactamase enzyme that destroys Beta-lactams, and also several antioxidants, which protect *Mtb* from toxic reactive oxygen species (ROS). This study identified a protein WhiB4 in *Mtb,* which inhibits Beta-lactamase and antioxidants production to reverse drug resistance and promote killing by Augmentin.

Reference: S Mishra, P Shukla, A Bhaskar, Anand K, P Baloni, KR Jha, A Mohan, RS Rajmani, V Nagaraja, N Chandra, and A Singh. (2017) Efficacy of β-lactam\β-lactamase Inhibitor Combination is Linked to WhiB4 Mediated Changes in Redox Physiology of *Mycobacterium tuberculosis. eLife* 6:e25624 DOI: 10.755/eLife.25624

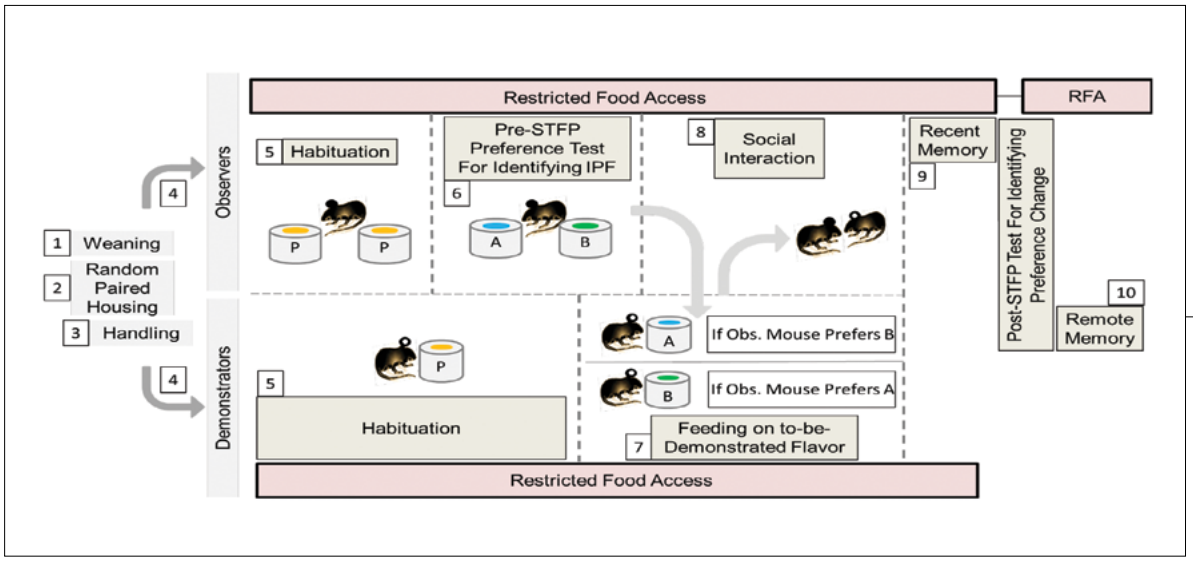


2. B Gopal (MBU)

The crystal structure of M. tuberculosis σJ (A) suggests that the SnoaL_2 domain at the C-terminus can modulate the activity of this initiation factor in the absence of a cognate regulatory anti-σ factor. (B) The SnoaL_2 domain modulates σJ activity by regulating promoter DNA binding as well as interactions with the RNA polymerase enzyme.

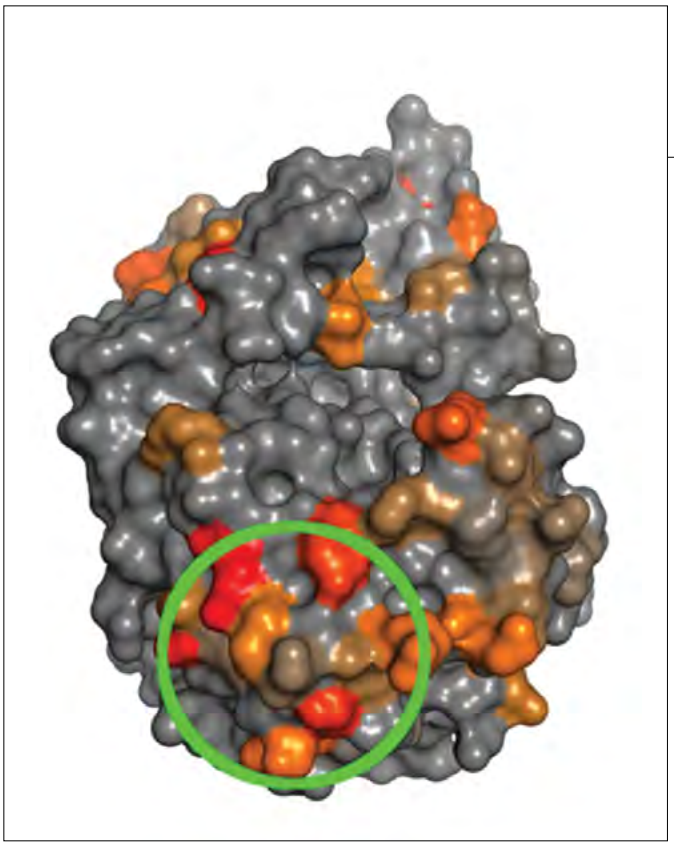
Reference: K Gautam, AK Gupta, and B Gopal (2017) The fused Snoal_2 domain of the Mycobacterium tuberculosis sigma factor σJ modulates promoter recognition. *Nucleic Acids Research.* 54:9760-9772.

3. Balaji Jayaprakash (CNS)



A novel protocol for conducting social transmission of food preference task in mice. Using this task to study the retrieval dynamics of non-spatial memory, the study showed that the long-term retention of food-preference memory is flavor specific.

Reference: A Singh and Balaji J (2017), Sensitive Estimation of Flavor - Preferences in STFP using Cumulative Time Profiles.) *Bio-protocol.* 7(21): e2601 (DOI: 10.21769/BioProtoc.2601)

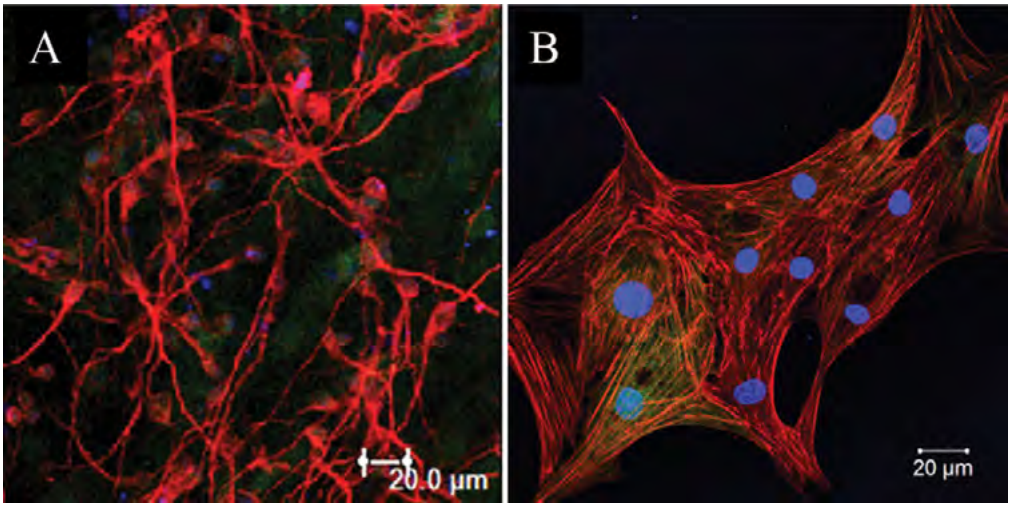


4. N Srinivasan (MBU)

Protein interaction site on the surface of Protein Kinase G predicted using functional specialization site prediction method developed by Srinivasan and and his co-workers.

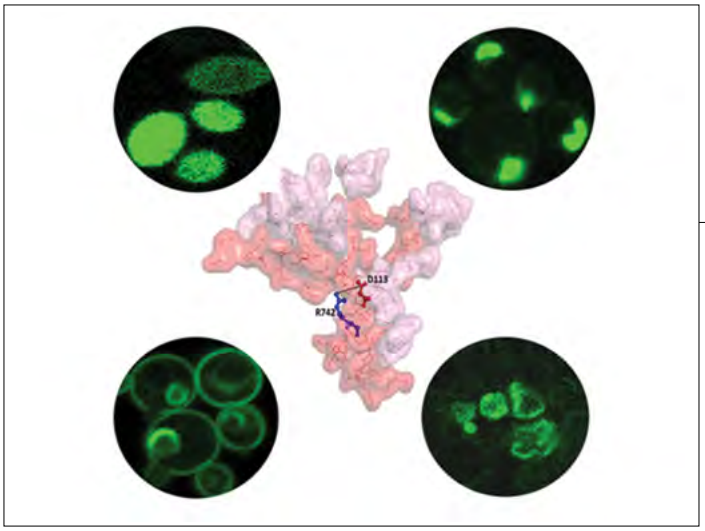
Reference: R Kalaivani, R Reema and N Srinivasan (2018) Recognition of sites of functional specialization in all known eukaryotic protein kinase families. PLoS Comp. Biol. (accepted for publication).

5. P Seshagiri (MRDG)



Heart and Brain Cells derived from Stem Cells. It shows the differentiation of In-house derived embryonic stem cells (GS-2) into mature neurons (A) and cardiomyocytes (B).

Reference: I Verma, Z Rashid, SK Sikdar, PB Seshagiri (2017) Efficient neural differentiation of mouse pluripotent stem cells in a serum-free medium and development of a novel strategy for enrichment of neural cells. *Int J Dev Neurosci.* 61: 112-124.



6. PN Rangarajan (BC)

Methionine synthase, normally a cytosolic enzyme involved in methionine biosynthesis, localizes to the nucleus in the yeast, Pichia pastoris and performs novel, moon lighting functions. The image shows cytosolic and nuclear localization of methionine synthase in Saccharomyces cerevisiae (top left) and Pichia pastoris (top right). MS was targeted to plasma membrane (bottom left) or cytoplasm (bottom right) to understand its cellular functions. Two monomers of MS associate with each other through ionic interaction involving R742 and D113 (centre).

Reference: U Sahu, VKH Rajendra, SS Kapnoor, R Bhagavat, N Chandra, PN Rangarajan (2017) Methionine synthase is localized to the nucleus in Pichia pastoris and Candida albicans and to the cytoplasm in *Saccharomyces cerevisiae. J. Biol. Chem.* 292:14730-14746.

7. SP Arun (CNS)

Symmetry has a special status in art, as exemplified by the Belur Somnathpur temple above. But does the brain respond differently to symmetric objects? In a recent publication in Psychological Science, researchers have shown that symmetric objects become special in perception because of entirely generic computations in single neurons.

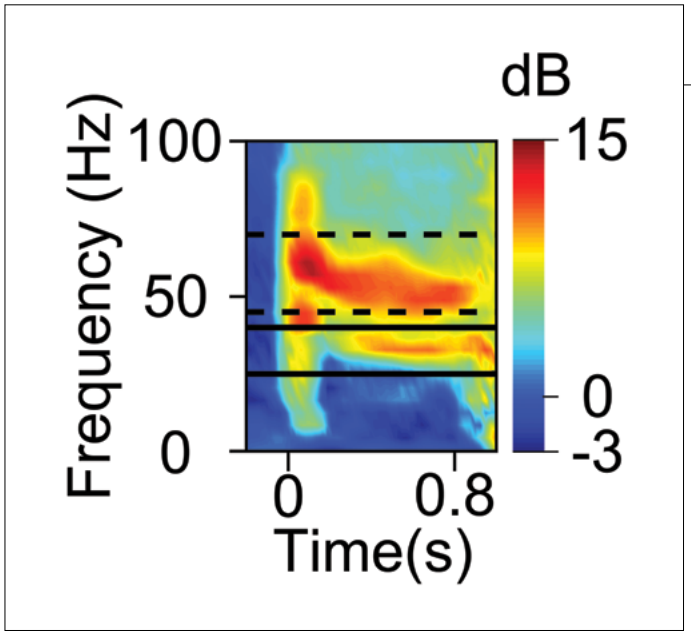
Reference: RT Pramod, & SP Arun (2017). Symmetric Objects Become Special in Perception Because of Generic Computations in Neurons. *Psychological Science.* 29(1): 95-109

8. Sumanta Bagchi (CES)

Grazing is a dominant land use on earth, and influences the global carbon (C) cycle through its effects on soil. In the Trans-Himalaya, this study found that grazing suppresses soil microbes, and is important for the stability and size of potential C-sink in soil.

Reference: S Bagchi, S Roy, A Maitra, and RS Sran (2017). Herbivores suppress soil microbes to influence carbon sequestration in the grazing ecosystem of the Trans-Himalaya. *Agric. Ecosys. Environ.* 239:199-206

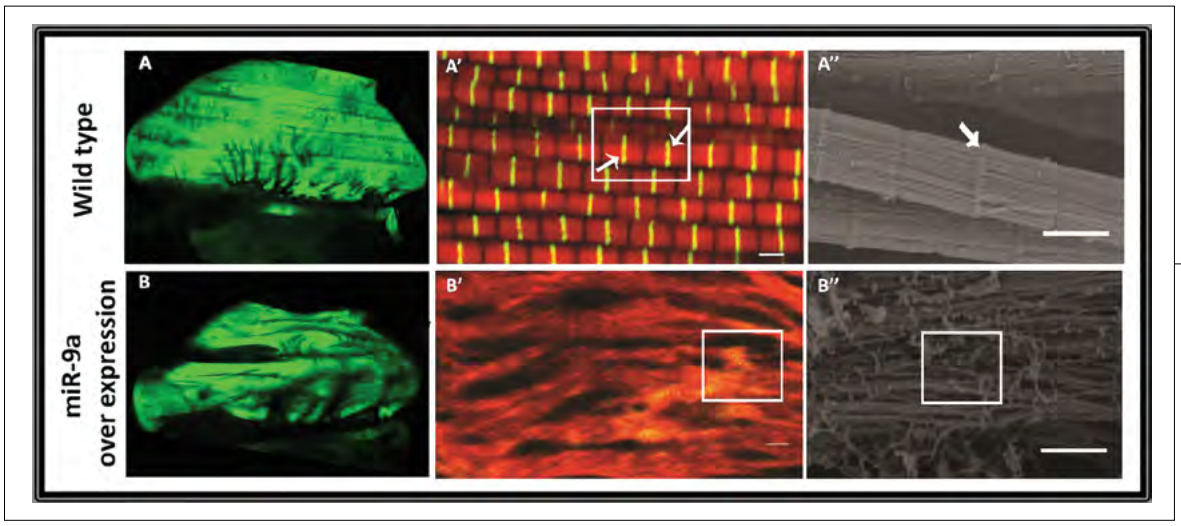
9. Supratim Ray (CNS)



Unlike previous studies that have shown a single gamma rhythm in the primate visual cortex, we found that large visual gratings induce two distinct gamma oscillations in both monkeys and humans that exhibit distinct tuning preferences and potentially reflect processing at two different scales. Figure shows the spectrogram of the brain signal with slow/fast gamma rhythms between solid/dotted lines, respectively.

Reference: MVPS Dinavahi*, V Shirhatti*, P Ravishankar* and S Ray. Large visual stimuli induce two distinct gamma oscillations in primate visual cortex. *Journal of Neuroscience.* In Press. (* indicates joint first author).

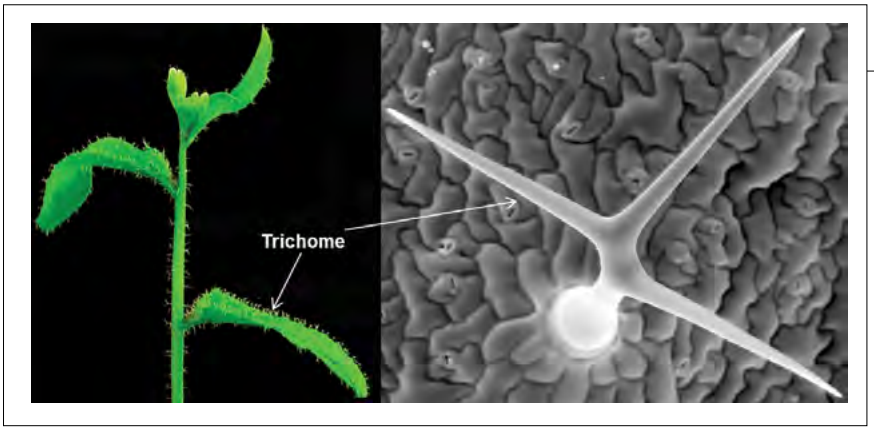
10. Updendra Nongthomba (MRDG)



miR-9 has been implicated in human myocardial hypertrophy. The study demonstrates a new role for miR-9a in Drosophila muscle, where it regulates levels of Troponin-T, a structural protein, during sarcomeric assembly. Findings from this study have implication in understanding the cellular pathophysiology of cardiomyopathies. Fig A, A' and A''- normal muscle structure in flies. Fig B, B' and B''- miR-9a over expression causes muscle abnormality.

Reference: P Katti, D Thimmaiya, A Madan and U Nongthomba (2017) Over-expression of miRNA-9 generates Muscle Hypercontraction through Translational Repression of the Troponin-T in Drosophila Indirect Flight Muscles. *G3: Genes, Genomes, Genetics.* 7(10): 3521-3531.

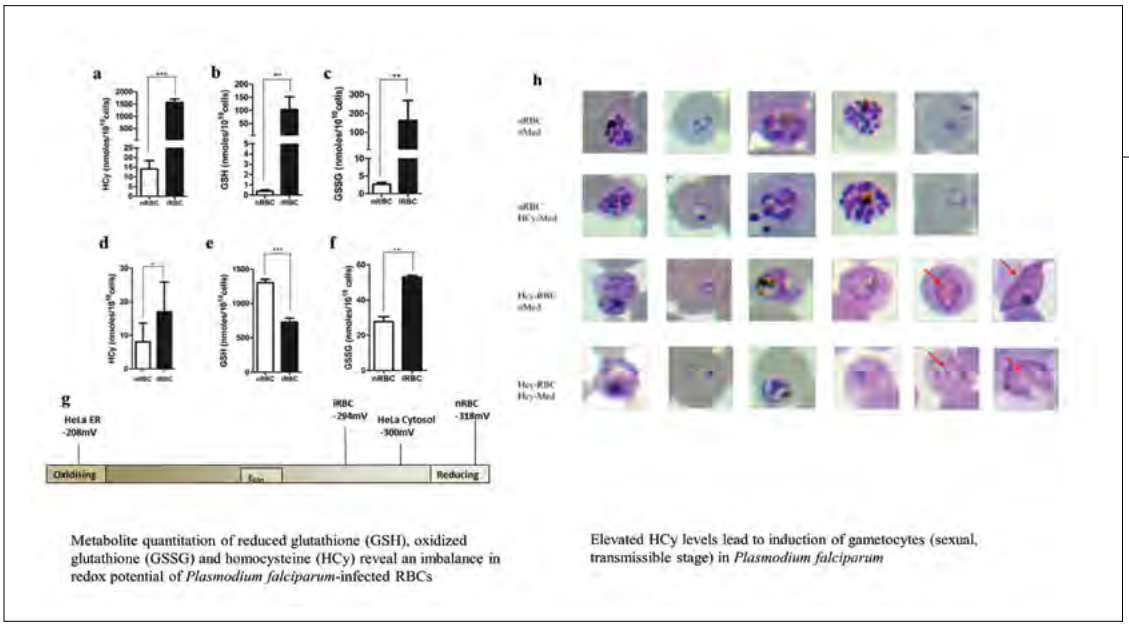
11. Utpal Nath (MCB)



Trichomes are specialized epidermal cells dispersed on plant surface (picture of the left) that can be compared to the hair cells on animal skin. Leaf trichomes in the model plant Arabidopsis typically form 3-branched structures (picture on the right), a shape that is genetically regulated. This study has identified the TCP class of transcription factors as a new class proteins that regulate trichome cell shape.

Reference: BVL Vadde, KR Challa, and U Nath (2017) The TCP4 transcription factor regulates trichome cell differentiation by directly activating GLABROUS INFLORESCENCE STEMS in *Arabidopsis thaliana. The Plant Journal.* 93(2):259-269. doi: 10.1111/tpj.13772

12. Utpal Tatu (BC)

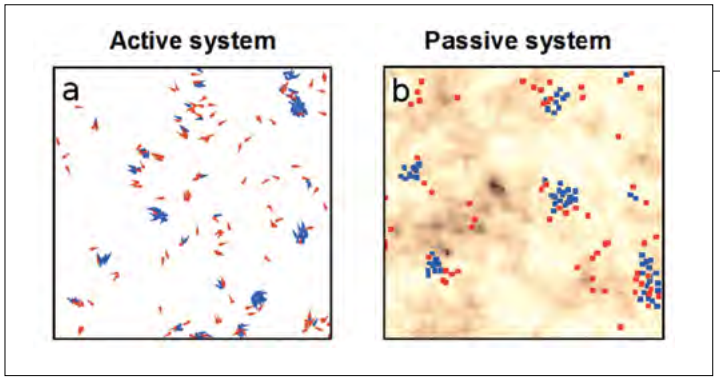


Metabolite quantitation of reduced glutathione (GSH), oxidized glutathione (GSSG) and homocysteine (HCy) reveal an imbalance in redox potential of *Plasmodium falciparum*-infected RBCs

Elevated HCy levels lead to induction of gametocytes (sexual, transmissible stage) in *Plasmodium falciparum*

Mass-spectrometric based metabolite estimation reveals a role of redox active metabolites in stage transition in the malaria parasite: (a-f) Quantitative measurements of GSH, GSSG and HCy indicate perturbed levels of these metabolites in Pf-infected RBCs and culture supernatant. (g) Change in the redox scale of RBCs upon Pf-infection. (h) HCy is the physiological metabolic cue leading to gametocytogenesis in P. falciparum.

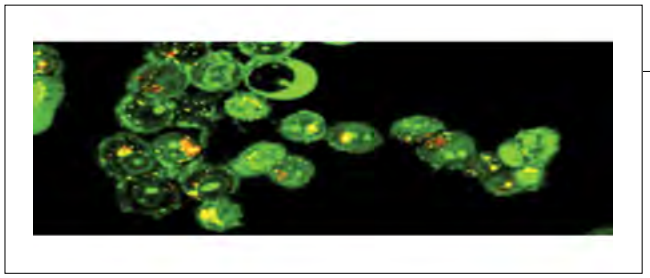
Reference: D Beri, B Balan, S Chaubey, S Subramaniam, B Surendra, and U Tatu (2017) A disrupted transsulphuration pathway results in accumulation of redox metabolites and induction of gametocytogenesis in malaria. *Nat. Sci* Rep 7:40213



13. Vishwesha Guttal (CES)

This study challenges this common perception that movement of organisms typically does not favour animals helping or cooperating each other. The image shows how mobility can promote cooperation through self-organised mobile animal groups. Blue individuals represent cooperators whereas red individuals are cheaters. Self-organisation allows cooperators to stay together and avoid cheaters.

Reference: J Joshi, ID Couzin, SA Levin and V Guttal (2017) Mobility can promote the evolution of cooperation via emergent self-assortment dynamics. *PLoS Comput Biol* 13(9): e1005732.



14. Annapoorni Rangarajan (MRDG)

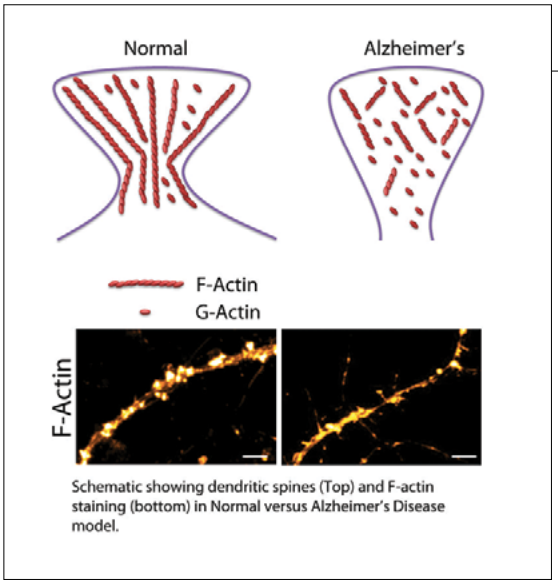
In advanced stages of cancer, cancerous cells spread to different parts of the body through our blood or lymph in a process called metastasis. In this study, researchers have made an insightful discovery on the molecular mechanisms behind the spread of cancer, which can help us better understand and treat the disease.

Reference: Saha M, Kumar S, Bukhari S, Balaji SA, Kumar P, Hindupur SK, and Rangarajan A (2018). AMPK-AKT double negative feedback loop in breast cancer cells regulates their adaptation to matrix deprivation, *Cancer Research,* (in press, but published online).

15. Raghavendra Gadagkar (CES)

Around 40% of workers of the Indian paper wasp Ropalidia marginata, that were isolated from their nests by researchers, were found to have successfully built their own nests and reproduced themselves. The researchers observed that altruistic behaviour and working hard on the parent nest did not significantly diminish a worker's chances of future reproduction.

Reference: Brahma A, Mandal S and Gadagkar R (2018). Current indirect fitness and future direct fitness are not incompatible, *Biology Letters*, 14:2.

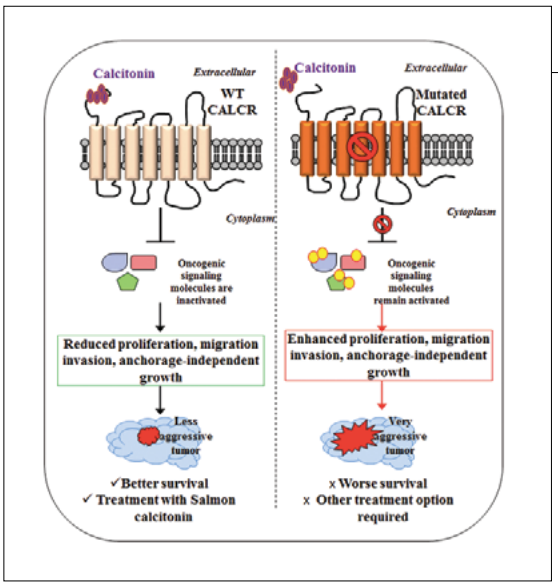


Schematic showing dendritic spines (Top) and F-actin staining (bottom) in Normal versus Alzheimer's Disease model.

16. Vijayalakshmi Ravindranath (CNS)

A key protein in the brain that is broken down early on in Alzheimer's disease has been identified, which could serve as an early biomarker. The protein, called F-actin, maintains the shape of dendritic spines on the surface of neurons, critical for synaptic communication.

Reference: Kommaddi RP, Das D, Karunakaran S, Nanguneri S, Bapat D, Ray A, Shaw E, Bennett DA, Nair D, Ravindranath V (2018). Aβ mediates F-actin disassembly in dendritic spines leading to cognitive deficits in Alzheimer's disease, *Journal of Neuroscience*, 38(5):1085-1099.



17. Kumar Somasundaram (MCBL)

A previously unknown gene mutation has been linked to a highly aggressive form of a brain tumour called glioblastoma. Patients who had mutations in a gene coding for a specific protein receptor (CALCR) were found to have more aggressive tumours and a much shorter survival time.

Reference: Pal J, Patil V, Kumar A, Kaur K, Sarkar C, and Somasundaram K (2018). Loss-of-Function mutations in calcitonin receptor (CALCR) identify highly aggressive glioblastoma with poor outcome, *Clinical Cancer Research,* 24(6):1448-1458.

3.1.1 BIOCHEMISTRY

The Department of Biochemistry started in 1921. It was recognized as Centre of Advanced study by UGC in 1965. There are 15 members of the faculty, 3 Emeritus Scientists, 80 PhD students, 30 PDF/ DST Young Scientists/UGC Kothari Fellows, 1 administrative staff, 4 permanent helpers and 40 temporary staff in the department.

Current Research

PROTEINS, NATURAL PRODUCTS AND METABOLIC ENGINEERING: Investigations of secondary metabolites with antithrombotic as well as anticancer activity from endophytic fungi of *Datura metel* and *Casia fistula,* and *Catharanthus roseus* and *Mapia foetida,* respectively, were carried out. Cloning and analysis of taxol biosynthetic pathway gene DBAT from endophytic fungus *Lasiodiploidia theobromea.* UvrD helicase from *Neisseria gonorrhoeae* (FA1090) behaves as a dimer in solution, exhibits 3′-5′ polarity on ssDNA and unwinds blunt end duplex DNA as well as different recombination intermediates. It has been observed that NgoUvrD can unwind intermolecular G quadruplex DNA (TP and OX1T) which was further elaborated by using oligonucleotides mimicking different types of G-quadruplex DNA. This particular property of NgoUvrD might explain its potential role in the pilC gene phase variation in *Neisseria gonorrhoeae.* Protein acetylation profile analysis of different strains of H. pylori using western blot demonstrated that different strains had characteristic proteins that were acetylated. PSI-BLAST against GNAT domain of known protein acetyltransferase identified Hp0935 as one of the putative N-acetyltransferase, which was cloned, overexpressed, purified to near homogeneity and crystallized. The 3D structure is being determined and the biochemical characterization is in progress. The transcription factor Mxr1p functions as a global regulator of multiple metabolic pathways in the yeast, Pichia pastoris. Methionine synthase localizes to nucleus in P. pastoris and performs novel functions.

DNA REPAIR, RNA TRANSACTIONS AND GENOMIC STABILITY: The meiotic "recombination hotspots" of Saccharomyces cerevisiae were found to fold into G-quadruplex and i-motif structures and play important roles in DNA/DNA pairing, DNA replication and gene expression. S. cerevisiae Red1 lacks the ability to promote intra- and intermolecular DNA/DNA pairing, but can promote bridging of non-contiguous segments of double-stranded DNA and non-homologous DNA end joining, thus implicating an unexpected and novel role for Red1 in recombination-based DNA repair. Genetic and functional analyses of M. tuberculosis IHF revealed specific amino acid

Core Research

Proteins, Natural products and metabolic engineering; DNA repair, RNA transactions and genomic stability; Biology of chaperones; Immunobiology

residues that are essential for genome stability, DNA binding and integrative recombination. The role of non-SMC subunits, Nse1 and Mms21, of the Smc5/6 complex in maintenance of chromosome stability was investigated. Nse1 was found to be important for completion of DNA replication and for stable maintenance of chromosomes. A novel small molecule inhibitor, Disarib, targeting BCL2 with a potential in cancer therapeutic was discovered. Mechanism of double-strand break repair in shrimp and mammalian mitochondria was identified. Result showed that a known HIV integrase inhibitor, Elvitegravir, inhibits RAG functions and impairs immunity of host organism. It was demonstrated that FANCJ helicase participates in DSB repair and RAD51 paralogs participate in mitochondrial DNA replication. It was also shown that *E. coli* UvrD helicase unwinds G4 DNA structures. The role of arginine methylation in regulation of repression activity of RGG-motif containing proteins Scd6 and Sbp1 was established. Four mammalian genes whose transcripts exhibit translational readthrough have been identified and the functional significance of these events is being studied.

BIOLOGY OF CHAPERONES: Neglected infectious diseases are being studied to improve diagnosis and treatment strategies. The mechanisms regulating gametocytogenesis in malaria are being investigated. Also, the diagnostic methods for MDR and fatal cause of Candidiasis are being developed. Understanding the ROS-sensing mechanisms, antioxidant nanozymes, heat shock protein based therapeutics, structure and function of heat shock proteins; protein folding in cell; protein transport across mammalian mitochondria; iron-sulphur protein biogenesis and genetic disorders.

IMMUNOBIOLOGY: A specific monoclonal antibody was shown to rescue cells from cytotoxicity induced by the cytokine TNFα. The epitope corresponding to the antibody was identified and the molecular mechanism of neutralization was delineated. Glycodelin, a progesterone-induced endometrial protein was shown to induce apoptosis in natural killer cells and suppress their cytotoxicity, thus protecting the fetus from the process of allo-graft rejection. The study also highlights the direct interaction of Gd with its receptor CD7 in NK and T cell lines. The thymus is important for the generation of T cells, which play a critical role in cellular immunity. The thymus is known to atrophy during ageing, stress, infections, etc. The changes in sub-populations of thymocytes during infection-induced thymic atrophy have been investigated. Strikingly, the DN2-4 and DP1 and DP2 populations were greatly affected during this process. The roles of cortisol and interferon-gamma which are induced during infections were investigated. Using an integrated systems biology approach, host response to tuberculosis was investigated, from which a multi-gene host biomarker signature was identified for detecting pulmonary tuberculosis from patient blood samples. In a separate project, using structural bioinformatics approaches, a PDB-scale analysis of ATP binding proteins was carried out that identified that diverse ATP binding proteins group into only a few site-types, which have characteristic structural

FACT FILE

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URL **biochem.iisc.ac.in**

Degree Programs offered **PhD and Int PhD**

IN NUMBERS

14 Academic Staff

68 PhD students

12 Int PhD Students

66 Publications

2 Int PhD Conferments

13 PhD Conferments

Chairperson: C JAYABASKARAN

and in some cases sequence motifs. Using this knowledge, a genome-wide scan was carried out in M. tuberculosis, from which more than a thousand ATP binding proteins were identified. Several of these were validated experimentally using a chemical proteomics approach in a collaborator's laboratory.

Faculty & Staff

NAGASUMA CHANDRA | PhD (Bristol), Associate Professor

PATRICK D'SILVA | PhD (IIT Bombay), Associate Professor

SANDEEP M ESWARAPPA | PhD (IISc), Assistant Professor

C JAYABASKARAN | PhD (IISc), MNASc, Professor

ANJALI ANOOP KARANDE | PhD (Bombay), Professor

SHIKHA LALORAYA | PhD (Wisconsin), Associate Professor

K MUNIYAPPA | PhD (IISc), FASc, FNASc, FNA, FTWAS, Professor

GANESH NAGARAJU | PhD (IISc), Assistant Professor

DIPANKAR NANDI | PhD (California-Berkeley), Professor PhD

SATHEES C RAGHAVAN | PhD (BHU), Associate Professor

PURUSHARTH RAJYAGURU | PhD (CCMB), Assistant Professor

PN RANGARAJAN | PhD (IISc), FASc, FNASc, Professor

D NARASIMHA RAO | PhD (IISc), FASc, FNASc, FNA, Professor

UTPAL S TATU | PhD (IISc), FASc, Professor

Emeritus Professors

G PADMANABAN | PhD (IISc), Emeritus Professor

AJ RAO | PhD (IISc), Emeritus Professor

H S SAVITHRI | PhD (IISc), Emeritus Professor

3.1.2 CENTRAL ANIMAL FACILITY

The Central Animal Facility (CAF) breeds, maintains and supplies pure and inbred strains of experimental animals for biomedical research activities at the Institute. 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.).

Core Research

The experimental animals are provided to several investigators who are using animals for research activities in the Division of Biological Sciences (Biochemistry, Microbiology and Cell Biology, Molecular Reproduction, Development and Genetics, Molecular Biophysics Unit, Centre for Neuro Sciences) and other Departments such as Department of Mechanical Engineering, Materials Research Centre, Materials Engineering, Inorganic and Physical Chemistry and Centre for Nano Science and Engineering

Faculty & Staff

RAVINDRANATH H ALADAKATTI | PhD (Karnatak University) Senior Scientific Officer

KN BALAJI | PhD (IISc), Professor

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Degree Programs offered **PhD and Int. PhD**

3.1.3 CENTRE FOR ECOLOGICAL SCIENCES

Centre for Ecological Sciences (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 modelling of ecosystems.

Current Research

CES has continued its tradition of cutting-edge research in the field of ecology and evolution. How individuals of the primitively eusocial wasp Ropalidia marginata find their way back home was investigated. The lesser false vampire bat Megaderma spasma was found to forage in natural vegetation within human-dominated landscapes. In a tree katydid, the ecological context of a multimodal acoustic-vibrational communication system was studied at two spatial scales. In a tree cricket negative fitness consequences of predation were largely due to mortality rather than behavioural changes. In other research on animal behaviour, endocrinological analyses indicated hormonal correlates of the costly lekking behaviour in the endemic blackbuck antelope, Antelope cervicapra. How visual body condition

Core Research

Animal Behaviour, Behavioural Ecology, Bioacoustics, Chemical Ecology, Climate Change, Community Ecology, Ecosystem Ecology, Evolution, Fire Ecology, Forest Dynamics, Grassland Ecology, Marine and Coastal Ecology, Mathematical Ecology and Modelling, Molecular Ecology, Movement Ecology, Nutrient Cycling, Phylogenetics, Phylogeography, Plant–Animal Interactions, Predator–Prey Interactions, Sensory Ecology, Stress Physiology

scores were related to levels of faecal glucocorticoid metabolites in free-ranging Asian elephants in the seasonally dry tropical forests of southern India was examined. Applied research suggested the usefulness of a functional trait approach to predict the response of butterflies to internal forest fragmentation caused by roads and an invasive plant. Also, identification of tipping points in transitions between grassland and savannah ecosystems were investigated. In molecular ecology and phylogenetic studies, research was conducted on the biogeography of blindsnakes, phylogeography of blackbuck, species status of Himalayan langurs, freshwater snail biogeography and evolution, and the phylogenetic diversity of Western Ghats forests. Significant contributions were made to our understanding of how fire regulates forest dynamics in the seasonally dry tropical forests of the Western Ghats. The urban ecology of lizards was investigated as was the effect of wind turbines on lizard behaviour and community structure in the Western Ghats. Grassland ecosystems in Karnataka were surveyed for setting up long-term research. The nexus between life-history traits and resource availability in governing dispersal propensities were examined, and the dichotomy between slow- and fast-paced insect life histories was clearly established.

Faculty & Staff

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ROHINI BALAKRISHNAN | PhD (TIFR), Professor

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11 Academic Staff
11 Scientific Staff
42 PhD students
7 Int PhD Students
84 Publications
1 Int PhD Conferments
9 PhD Conferments

Chairperson: RENEE M BORGES

3.1.4 CENTRE FOR INFECTIOUS DISEASE RESEARCH

The main goal of Centre for Infectious Disease Research (CIDR) is to integrate research activities in the area of infectious diseases with interactions and collaborations and provide avenues for multidisciplinary activities with translational outcomes. CIDR hosts fellows with a fully equipped and functional laboratory and a state of the art BSL-3 facility to carry out their research. Research activities in CIDR are spearheaded by senior level fellowships, e.g., Ramalingaswami, DBT-Wellcome, Ramanujan etc., through which competitive grants have been procured for studies related to infectious disease research.

Core Research

On-going work is directed towards understanding and targeting drug tolerance in Mycobacterium tuberculosis and application of network biology to identify new drug combinations. Another area of research is focussed on the principal immune mechanisms that contribute to reactivation of tuberculosis in the context of HIV infection

Current Research

Whole genome sequencing of HIV isolates from clinical samples was performed in a south Indian cohort. Phylogenetic analysis revealed that the majority of the samples belonged to the HIV1 subtype C category. This study will help in better understanding of HIV prevalence and possible treatment strategies geared towards the local population. The second area of investigation was the identification of CD4+ T cell responses to latent, pulmonary and extra-pulmonary tuberculosis. Interestingly, the CD4+ T cell response specific to dormancy related (DosR) proteins was found to be higher in latent compared to extra pulmonary or pulmonary tuberculosis. Identification of T cell subtypes that distinguish between different types of tuberculosis is the highlight of this study. The third area of investigation was the roles of intracellular redox sensor, WhiB4, in modulating sensitivity of Mycobacterium tuberculosis to Augmentin, a beta-lactamase inhibitor. The loss in WhiB4 expression increases tolerance to Augmentin whereas higher expression of WhiB4 increases the effect of Augmentin. This study points to the critical roles of redox in lowering drug resistance in Mycobacterium tuberculosis.

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IN NUMBERS

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Convener: DIPANKAR NANDI

3.1.5 CENTRE FOR NEUROSCIENCE

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, are the main focus areas of the Centre for Neuroscience (CNS). It recruits faculty across wide-ranging disciplines to establish a strong program in basic neuroscience and builds links to existing expertise in IISc as well as with clinical centres to develop translational research.

Current Research

CNS is a multidisciplinary department with the common goal of understanding brain functions in health and diseases. The department currently has eight faculty members, one Wellcome-DBT India Alliance Intermediate Fellow, two Ramalingaswami Fellows and one INSPIRE faculty fellow.

In the context of motor control, the neuronal and computational architecture of sequential saccade planning was investigated by having subjects perform a sequential-saccade task. Midway saccades that are directed at an intermediate location between two sequentially presented targets, as a probe to address whether such parallel programming only

Core Research

Motor Control, Neurobiology of Disease, Neural mechanisms of attention, Neuronal differentiation and development, Astrocyte biology, Neurobiology of Learning and Memory, Molecular organization of synapse, Neuronal receptor biology, Visual perception and recognition, Neural mechanisms of selective attention, Neurobiology of Stress and Depression

reflects concurrent processing of goals or whether multiple motor plans coexist, unfolding subsequently during the execution. A shift in the distribution of midway saccades towards the jumped location of the second target following adaptation indicated that the brain can make use of prospective motor plans to guide sequential eye movements. In addition, it was observed that the spatiotemporal pattern of the endpoints of midway saccades can be well explained by a motor addition model. These results together provide strong evidence of parallel activation of prospective motor plans during sequential saccades. The same was confirmed in neuro-physiological investigations by recording from single cells in the frontal cortex where evidence of concurrent planning was revealed.

In the context of sensory information processing, several insights into how the brain performs object recognition: (1) Symmetric objects are special in perception despite being governed by generic computations in single neurons; (2) There is a temporal hierarchy of object invariances in single IT neurons whereby size and position invariance develop earliest, followed by viewpoint invariance; (3) Humans use targets, non-targets and scene context to guide object detection in natural scenes, were reported.

In the context of cognitive processing, a model for analysis of behaviour that enables distinguishing two distinct neural mechanisms - perceptual and decisional, that operate during attention, was developed. EEG signatures by which multiple stimuli compete for attention in the brain and developing and applying novel algorithms for identifying "hub-nodes" in the brain with functional and diffusion magnetic resonance imaging (fMRI/dMRI) are also being identified. In the context of neural oscillations, it was found that large visual stimuli generated two gamma oscillations in the visual cortex of monkeys and humans, and these gamma oscillations were highly tuned to reddish colours.

In the area of Molecular, Cellular and Developmental Neuroscience, the laboratory studied the molecular mechanisms regulating reactive astrogliosis in the mouse brain. It was found that the transcription factor, SRF, may regulate generation of protective reactive astrogliosis. Lipid metabolism has been shown to hold the key to major fundamental processes including neuronal differentiation. Work on delineating the role played by astrocytes in modulating mood-related behaviour is also being carried out. Molecular, behavioural and histological techniques and transgenic mouse models are used to understand the signalling pathways responsible for astrocyte-neuron communication and subsequent modulation of behaviour. Another aspect of work focuses on unravelling the molecular mechanisms underlying neuronal polarity and how it contributes to neuronal differentiation and development. Towards deeper understanding of the molecular architecture of the synapse, the functional units of neuronal communication, the Nano Organization laboratory utilizes ultra-high resolution imaging approaches to investigate assembly and regulation of synaptic transmission machinery. Novel imaging paradigms like nanoscale imaging combined with optical and

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IN NUMBERS

8 Academic Staff

33 PhD students

32 Publications

3 Int PhD Students

2 MS (Science)

6 PhD Conferments

Chairperson: ADITYA MURTHY

chemical stimulations is used to observe real-time organization of a chemical synapse.

In the area of disorders of the nervous system, the research is focused on elucidating the early pathogenic mechanisms leading to Alzheimer's disease (AD), a progressive neurodegenerative disorder often seen in the elderly and manifests clinically as memory loss and cognitive impairment. It has been shown that synaptic dysfunction including loss of activity-dependent protein translation and cytoskeletal F-actin occurs in AD long before the manifestation of disease pathology. Loss of synaptosomal F-actin is associated with impaired recall upon fear conditioning and can be reversed by actin polymerizing agents. Studies are being carried out on how ubiquitination and deubiquitination of metabolic G-protein coupled receptors and their adaptor protein, Ð-arrestin2 contribute to the agonist induced synaptic functions in cellular models and mouse models of Alzheimer's disease. These findings may provide new avenues for therapeutic intervention and prevention of AD progression.

In the context of learning and memory, researchers are actively working towards understanding remote memories (memories of past lifetime events) that are vital for shaping behaviour. The technical impediment to image synaptic architecture of neuronal networks in deep brain regions limits our ability to understand the neuronal underpinnings of remote memories (past lifetime events). This limitation has been overcome by using a novel contrast that is generated without the use of any additional agents but by utilizing the photophysical properties of fluorophores present within neurons. It has also been shown that the nature and specificity of memory recall of past events is highly modulated by the interaction between multiple instances of encoding occurring in different brain regions. In a related but distinct area of research, the Centre is studying how hippocampal network creates a coherent representation of events within their spatial context. Specifically, the studies focus on the interplay between sensory-derived spatial and non-spatial information brought in by the lateral entorhinal cortex (LEC) and the internally generated, path-integration-based spatial representation in the medial entorhinal cortex (MEC).

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3.1.6 MOLECULAR BIOPHYSICS UNIT

The Molecular Biophysics Unit (MBU) is currently engaged in frontline research in contemporary Biophysics, Structural Biology and Physiology. Research activities in the Unit focus on the structure, conformation and interactions of biomolecules and their functions, with the main objective of explaining biological activity in molecular terms.

Current Research

The projects handled in the unit include biophysical and crystallographic studies of integral membrane protein transporters that selectively gate substrates and active compounds across the membrane. Specific projects focus on structure function studies of ion-coupled neurotransmitter transporters and on structural functional and pharmacological studies of multi drug efflux proteins from pathogens.

The crystal structure of bacterial mercuric reductase evolved to resist the widespread presence of Hg in the environment has been determined. The study confirmed the homodimeric structure of the enzyme and provided insights into its catalytic activity.

In the first structural and related study of mycobacterial sanitization enzymes, the mode of action of Mycobacterium smegmatis MutT1, an

Core Research

Protein folding and dynamics, Lectins and lectin-carbohydrate interaction, Peptide synthesis and design, X-ray crystallography of proteins and viruses, Computer modelling and dynamics of biological molecules, Theoretical studies on the conformation of peptides and proteins, Conformational analysis of nucleic acids, DNA-protein interactions, Unusual DNA structures and control of transcription, Ionophores and drugs and their interaction with membranes, Genome organization, Synthetic protein design and protein engineering, Ion channels and electrophysiology, Neurophysiology and computational neuroscience, Membrane channel forming peptides

enzyme with unusual modes of association has been elucidated. It has also been demonstrated that the enzyme hydrolyses diadenosine polyphosphates, an observation of considerable biological significance. Also elucidated is the concerted movement of dimer interface and ligand binding region of Mycobacterium tuberculosis pantothenate kinase, on the disruption of the CoA binding site. In the work on lectins, distortion of ligand molecule as a strategy for modulating binding affinity was further explored. In a first study of its kind, an archeal lectin has been biochemically characterized and crystallized.

Studies from the unit had earlier predicted, using computational analyses, that the spike-triggered average (STA) of hippocampal neurons would exhibit theta-frequency (4-10 Hz) spectral selectivity and would manifest coincidence detection capabilities for inputs in the gamma-frequency band (25-150 Hz). These predictions were confirmed through direct electrophysiological recordings of STA from rat CA1 pyramidal neurons and demonstrate that blocking HCN channels reduces the frequency of STA spectral selectivity to the delta-frequency range (0.5-4 Hz).

A new biophysically rooted, physiologically constrained conductance-based synaptic model was developed to mechanistically account for short-term facilitation and depression, respectively through residual calcium and transmitter depletion kinetics.

Employing global sensitivity analyses, it was demonstrated that near-identical synaptic filters and short-term plasticity profiles could emerge from disparate parametric combinations. These conclusions strengthen the argument that parametric and interactional complexity in biological systems should not be viewed from the limited curse-of-dimensionality standpoint, but from the evolutionarily advantageous perspective of providing functional robustness through degeneracy.

It was found that Coccinia indica agglutinin 1 forms filaments for its function in phloem bundles in plants.

Distortion of ligand and the plasticity of the combining site to modulate sugar specificity for the lectins were uncovered.

Proteomics and glycoproteomics of lectins and carboxypeptidase were studied.

Down regulation of Th17 cell response by Toll/ILR-1 Domain relieved arthritis in mice. Disruption of BCL2-BAK interaction by Disarib as a consequence of its binding to BH1 domain of BCL2 triggered apoptosis and promoted the killing of cancer cells. Bone Morphogenetic protein-7 augments insulin sensitivity by potentiating PI3K/AKT pathway in type II diabetic mice. Heat shock Proteins HSP70-2, is shown to promote ovarian cancer growth.

Commonly used protein staining dyes was shown to inhibit the aggregation of Parkinson's peptide - α synuclein.

Arginsuccinate lyase of M. tuberculosis is negatively regulated by succinylation of its c- terminal cysteine by its product fumaric acid.

The interaction of lactate with TREK1 potassium ion channels that regulates the flow of potassium ions out of the neurons was studied by recording the activity of single TREK1 channels and measuring whole-cell TREK1 currents in astrocytes using patch clamp technique which measures currents across cell membranes. The studies confirmed that increased concentrations of lactate increased the activity of TREK1 channels through interaction with a critical histidine residue in the channel protein. Lactate also caused increased expression of the TREK1 channel protein and reduced neuronal death in the hippocampus in an in vitro model of brain ischemia confirming the neuroprotective role of lactate.

Comparative analysis of proteins encoded in the genomes of pathogenic and non-pathogenic variants of Leptospora led us to identify critical pathogen proteins. Integrating this information with protein-protein interaction databases enabled us to predict interactions of many of these proteins with human proteins. We have explored repurposing FDA-approved drugs against the malaria parasite, Plasmodium falciparum. A number of FDA-approved drugs which were originally intended to target proteins of other pathogens are postulated to be anti-malarial as well. Using sensitive sequence analysis and fold recognition techniques we identified a new domain family which is predicted to interact with RWD domains present in various signalling proteins.

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ASHOK SEKHAR | PhD (Wisconsin-Madison), Assistant Professor

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K SUGUNA | PhD (IISc), Professor

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A SUROLIA | PhD (Madras), FASc, FNASc, FNA, FTWAS, M-IMBN, Bhatnagar Fellow, Honorary Professor

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73 PhD Students
12 Int PhD Students
73 Publications
5 Int PhD Conferments
14 PhD Conferments

Chairperson: **RAGHAVAN VARADARAJAN**

3.1.7 MICROBIOLOGY AND CELL BIOLOGY

The Microbiology and Cell Biology (MCB) department has 15 faculty members: 8 Professors, 3 Associate Professors and 4 Assistant Professors. The major research activities include investigations on microbial pathogenesis and eukaryotic cellular processes.

Current Research

The Department of Microbiology and Cell Biology is a leading centre performing front-line research in disease biology (bacterial, viral and fungal) and in basic cellular processes. The key findings for the past one year are summarized below.

(A) BACTERIAL PATHOGENESIS OF MAJOR DISEASES

The continuing investigations on the tuberculosis-causing organism Mycobacterium tuberculosis (Mtb) revealed that the resistance against antibiotics (such as ampicillin) is linked to the intra-cellular redox physiology, which is mediated by the WhiB4 gene product. In Mtb genome biology research, aspects of topology modulation and genomic landscape of DNA-modifying enzymes such as gyrase, topoisomerase and RNA polymerase have been studied. The chemical modifications of nucleoid-associated proteins and their role in programmed cell death were also studied. By probing protein synthesis mechanisms in prokaryotes, it was shown that the conserved feature of 3GC pairs in the anticodon stem of $tRNA^{fMet}$ licences its transition from 30S

Core Research

Regulatory processes in gene expression, protein synthesis; DNA repair and stress responses in prokaryotes and eukaryotes; Control of cell division, cell fate, differentiation, morphogenesis and protein trafficking; Translational control of viral and cellular mRNAs; Pathogenesis of *Mycobacterium, Salmonella,* Enteroviruses, Flavivirus, Coxsackie virus, HIV Genetics of Glioma, diabetes and cardiovascular diseases

to 70S initiation complex and then to elongation-competent 70S by releasing IF3. It was also found that the feature of formylation permits targeting of $tRNA^{fMet}$ to 30S ribosome. In an independent study, it was identified that a fraction of small size Mtb cells, in a population, is more susceptible to antibiotics, offering an opportunity to study some antibiotic-resistance mechanisms. Besides, it was shown that some key Mycobacterial glycoproteins subvert host innate immunity. Molecular mechanisms that govern immune evasion strategies, intracellular survival and pathogenesis of *Mycobacteria, Shigella, Listeria, Staphylococcus, Candida albicans, Cryptococcus* and *Salmonella* are being studied using cell culture, mouse, *C. elegans* and plants as models.

(B) VIRAL PATHOGENESIS AND VACCINE DESIGN

The virology groups have recently identified a unique strategy employed by Coxsackievirus B3 to up-regulate the IRES-containing host factor PSF for its own replication, thus identifying a new target for containing this virus. It has been shown that the natural compound corilagin from *Phyllanthusamarus* is effective for in blocking HCV replication. The work of another group has unraveled the molecular basis of attenuation of live Japanese encephalitis (JE) vaccine SA14-14-2. Work on the HIV virus, examined the role of redox signaling mechanisms and relevance to latency during AIDS disease.

(C) CELLULAR PROCESSES AND CANCER BIOLOGY

On the before cancer biology front, it has been demonstrated that the Calcitonin-Calcitonin receptor (CT-CALCR)-signaling is an important tumor suppressor pathway in the brain cancer glioma and established CALCR as a novel therapeutic target. The importance of m6A-modification in glioma stem-like cells and the role of RNA methyltransferase-like 3 as a potential therapy target is a recent discovery from our research. On the cell biology front one of our groups investigated pigment cell (melanosomes) formation. Multiple small G-proteins were seen to regulate protein trafficking to control melanosome biogenesis. The metabolism of microRNAs (miRNAs) is linked to basic cellular processes and these molecules were investigated in Caenorhabditis elegans. By employing both *in vivo* and *in vitro* approaches, a 260 kDa multi-subunit miRNA turnover complex named 'miRNasome-1', was characterized. This complex is potentially a core constituent in the miRNA turnover pathway. To study the process of eukaryotic cell division in finer details, *C. elegans* embryos as well as human cells are being used as models. Recently, it was uncovered that a major mitotic kinase complex CDK1/cyclinB counteracts PP2A phosphatase in regulating proper spindle behaviour in human cells.

(D) GENE REGULATION, DEVELOPMENT AND LIFESTYLE DISEASES

Fission yeast is a model organism to understand

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IN NUMBERS

15 Academic Staff

1 Scientific Staff

83 PhD Students

8 Int PhD Students

55 Publications

4 Int PhD Conferments

13 PhD Conferments

Chairperson: **USHA VIJAYRAGHAVAN**

splice-site recognition mechanisms relevant to many other multicellular eukaryotes. The role of two fission yeast splicing factors in influencing choice of splicing patterns under conditions of normal or stress growth was shown. In mammals, studies are focused on a family of histone deacetylases called Sirtuin isoforms (SIRT1-SIRT7) that regulate the pathophysiology of heart failure using mouse as a model system. In the area of plant developmental biology, two temporal gene regulatory networks in rice that provide leads to the molecular pathways controlling floral formation and patterning of organs have been deciphered. Change in cell shape during organ organogenesis is a key developmental process and its genetic regulation is an active area of research. Using Arabidopsis, a model plant, it has been shown that a TCP transcription factor regulates the epidermal cell shape by directly promoting the transcription of Glabrous Inflorescence Stems.

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SAUMITRA DAS | PhD (Calcutta), FNA, FASc, FNASc, Professor

SACHIN KOTAK | PhD (Frankfurt), Assistant Professor

V NAGARAJA | PhD (IISc), Professor (On-lien)

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G SUBBA RAO | PhD (JNU), Assistant ProfessorAmit Singh | PhD (Delhi), Assistant Professor

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3.1.8 MOLECULAR REPRODUCTION, DEVELOPMENT AND GENETICS

Research in the Department of Molecular Reproduction, Development and Genetics (MRDG) is diverse, ranging from bacterial and human genetics to signal transduction, mammalian reproduction, endocrinology, developmental biology and aging, biology of oral, breast and brain cancers, morphogenesis, stem cells and use of cryo-EM to determine 3D structures of large macromolecular complexes.

Current Research

Following are the important on-going research projects in the Department:

(A) BREAST CANCER: The role of cancer associated fibroblasts in the progression of breast cancer is being studied. The mammary fibroblasts engineered to express Transforming Growth Factor-beta and knock down of type II TGF-beta receptor are orthotopically co-implanted along with breast cancer cells in immunocompromised mice. The progression of tumours with various controls with respect to growth, metastasis will be analysed. The other important project is on the mechanism of IGFBP2 mediated progression of glioma and developing recombinant antibodies against it.

(B)MOLECULAR GENETICS OF ANENCEPHALY: Anencephaly is characterized by the absence of brain tissues. It shows a heterogeneous etiology, ranging from environmental to genetic causes. We employed whole-exome sequencing and discovered the TRIM36 gene as the cause of autosomal recessive anencephaly in 1/37 Indian families. The work is in progress to discover additional causative genes for anencephaly.

(C) UTILIZATION OF BETA-GLUCOSIDES BY BACTERIA: On-going studies on aromatic beta-glucosides utilization by bacteria have revealed that aglycones such as salgenin generated by the hydrolysis of beta-glucosides such as salicin can confer resistance against specific classes of antibiotics by activating efflux pumps. Therefore, the ability to hydrolyse aromatic glucosides in the natural environment offers an additional survival capability in the presence of antibiotics.

(D) DROSOPHILA MUSCLE REMODELLING AND PROTEIN DEGRADATION: Transcriptional changes responsible for muscle remodelling and protein degradation are being identified using Drosophila flight muscles. Using Drosophila genetics very elegantly, our group was able to establish that miRNA-9 is involved in cardiomyopathy/hypertrophy through translational repression of the Troponin-T.

(E) CALCIUM MOBILIZATION DURING LACTATION: Research is being carried out to examine the mechanism of calcium mobilization during lactation in rodents and cows. The data

suggest that the bone resorption markers parallel the increased availability of calcium in lactating rats, but this is not observed in cows.

The role of a receptor guanylyl cyclase in gut physiology is being investigated following the identification of mutations in this receptor that cause congenital secretory diarrhoea. Novel transgenic mice have been generated and aspects of their gut physiology are being investigated to understand the molecular basis of human diseases. Novel proteins involved in cAMP metabolism have been identified and their role in regulating mycobacterial cell wall synthesis, protein acylation and regulation of central carbon metabolism have been discovered.

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Core Research

The core research areas of the department are as follows: Gene regulation in prokaryotes & eukaryotes, Host- Pathogen Interactions, Human Genetics, X-inactivation, Signal Transduction, Developmental Biology and Ageing, Morphogenesis, Mouse Embryo Development, Stem Cells and Differentiation, Reproductive Biology, Endocrinology, Cancer Biology and Cancer Stem Cells, and protein translation and its regulation

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Degree Programs offered **PhD and Int PhD**

IN NUMBERS

13 Academic Staff
44 PhD students
12 Int PhD Students
38 Publications
2 Int PhD Conferments
7 PhD Conferments

Chairperson: **PATURU KONDAIAH**

3.2 DIVISION OF CHEMICAL SCIENCES

The faculty members of the Division work on all contemporary topics in chemistry, ranging from Chemical Synthesis, Drug Design, Chemical Biology, Materials Chemistry, Surface and interface Science, Nanochemistry, Molecular Spectroscopy, Ultrafast Chemical Dynamics, Computational and Theoretical Chemistry, Solid State Chemistry and Nuclear Magnetic Resonance spectroscopy.

Themes

The Division of Chemical Sciences has consistently maintained its position among the top 50 chemistry departments in world rankings over the past decade. It is a globally competitive Division with clear focus on top quality research in specific current areas such as bio-inorganic chemistry and chemical biology of drugs with a particular aim on disease control and cure, ultrafast spectroscopy and dynamics of molecules towards

Research Highlights

The Division of Chemical Sciences comprises the Department of Inorganic and Physical Chemistry, Department of Organic Chemistry, Solid State & Structural Chemistry Unit, Materials Research Centre and NMR Research Centre

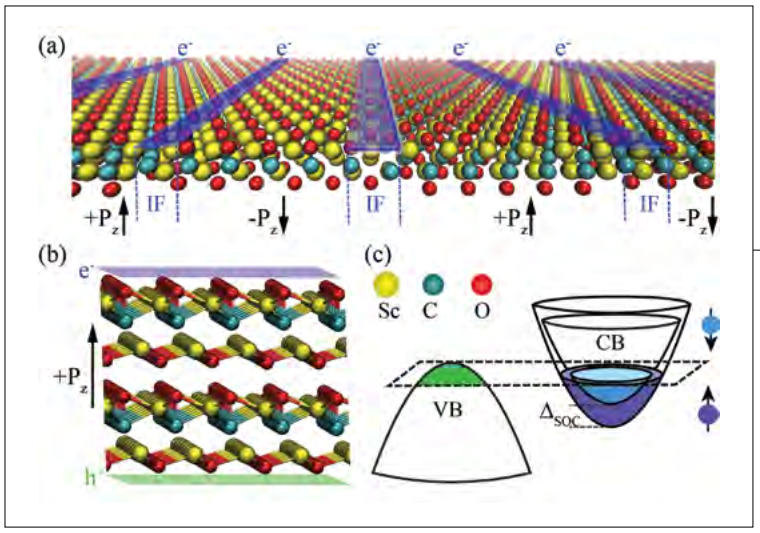
DEPARTMENTS | CENTRES | UNITS

- INORGANIC AND PHYSICAL CHEMISTRY
- MATERIALS RESEARCH CENTRE
- NMR RESEARCH CENTRE
- ORGANIC CHEMISTRY
- SOLID STATE AND STRUCTURAL CHEMISTRY UNIT

IN NUMBERS

- 62 FACULTY MEMBERS
- 276 PhD STUDENTS
- 61 INT PhD STUDENTS

RESEARCH SNAPSHOTS 2017-18



1. Abhishek Kumar Singh (MRC)

The study reported the highest ever out of plane polarisation and simultaneous existence of 2D electron and hole gas in Sc^2CO^2 MXene, which could accelerate the design of nanoelectronic devices. The figure shows (a) One-dimensional metallic interface (shaded blue area labelled IF) in Sc^2CO^2 MXene separating (+Pz) and (+Pz) polarized domains. (b) Bilayer Sc^2CO^2 MXene, the direction of the out-of-plane polarization is shown by the black arrow (c) electron-hole gap formation in the conduction band (CB) valance band (VB), respectively.

Reference: A Chandrasekaran, A Mishra, and AK Singh (2017) Ferroelectricity, Antiferroelectricity, and Ultrathin 2D Electron/Hole Gas in Multifunctional Monolayer MXene. *Nano Lett.* 17: 3290+3296

2. Anshu Pandey (SSCU)

Copper-iron sulphide (CuFeS2) is one of the few solution-processable semiconductors that has both a benign composition and a near-infrared band gap. This work attempts to explain the many peculiar properties of CuFeS2, most notably its uncanny resemblance to gold. The photograph shows the reflection of one rupee coin on a high-quality one square-inch solution processed film of CuFeS2 nanocrystals.

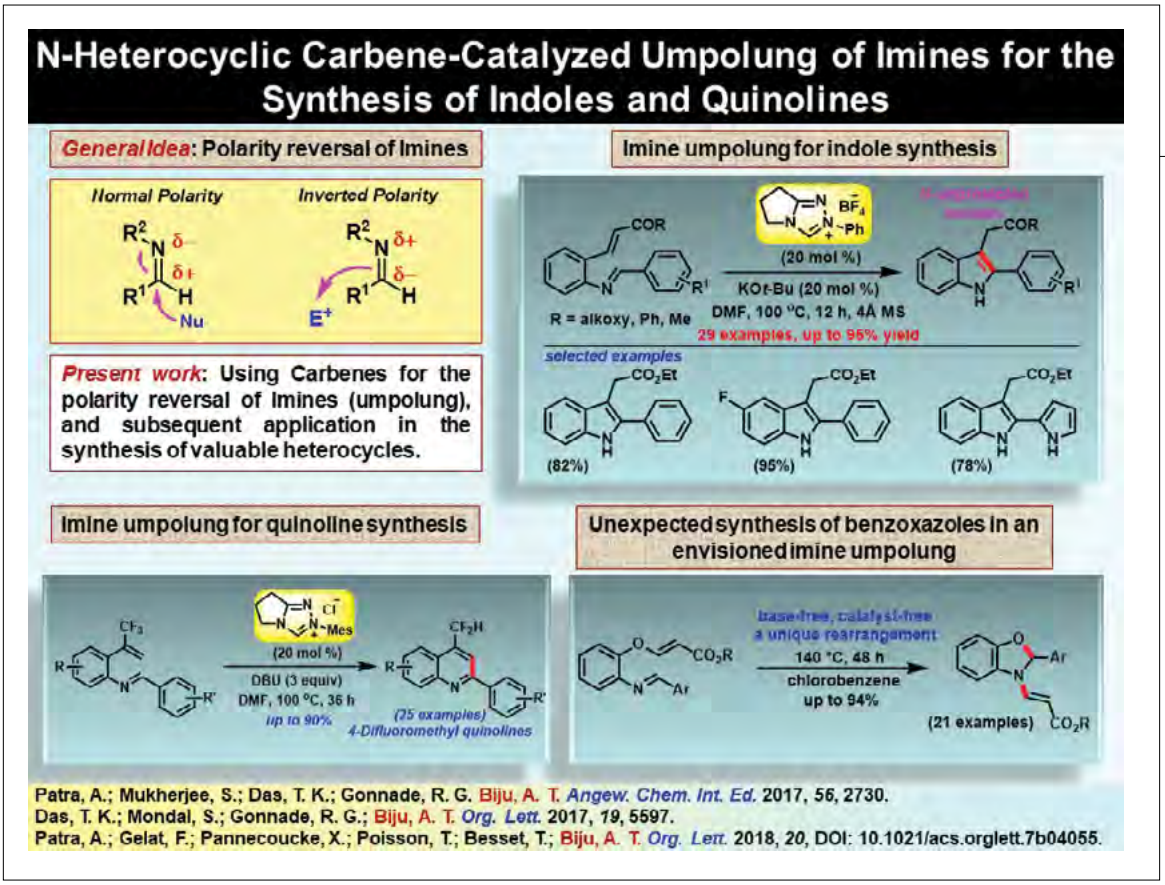
Reference: S Anumol, B Bhattacharyya, VVR Kishore, A Kumar, GP Rajasekar, DD Sarma, and A Pandey (2018) Why Does CuFeS2 Resemble Gold? *J. Phys. Chem. Lett.* 9: 696-701. DOI: 10.1021/acs.jpclett.7b03190

3. Arunan E (IPC)

Arunan's group used a home-built spectrometer (left) to prove that HS dimer is hydrogen bonded (top right) though the solid H2S is bound by 'Van der Waals interaction' (bottom right). This confirms the new definition of hydrogen bond proposed by an IUPAC task group chaired by him in 2011.

Reference: E Arunan (2017) Plenary Talk given at the 22nd Horizons in Hydrogen Bond Research Conference held in Finland, September 2017.

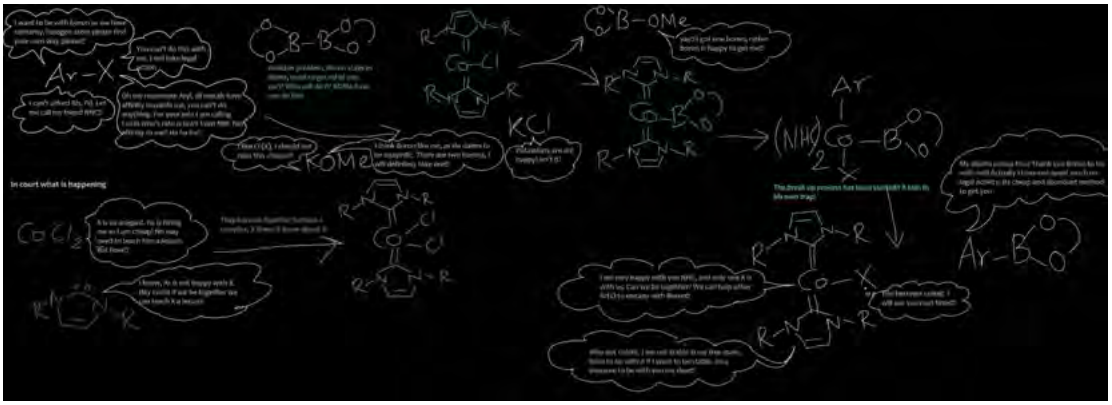
4. Akkattu T Biju (OC)



Imines are electrophilic reagents in organic synthesis. The researchers observed that the inherent electrophilicity of imines can be inverted by using N-heterocyclic carbenes (NHC) as catalysts. Based on this concept, they have uncovered the NHC-catalysed umpolung (polarity inversion) of imines for the synthesis of biologically important functionalised indoles. They also extended the imine umpolung concept to the synthesis of difluoromethylated quinolines. Notably, they synthesised benzoxazoles by attempting imine umpolung on a vinylogous carbonate under hot conditions in the absence of NHC.

Reference: A Patra A, F Gelat, X Pannecoucke, T Poisson, T Besset, and AT Biju (2018) Synthesis of 4-Difluoromethylquinolines by NHC-Catalyzed Umpolung of Imines. *Org. Lett.* In Press. DOI: 10.1021/acs.orglett.7b04055

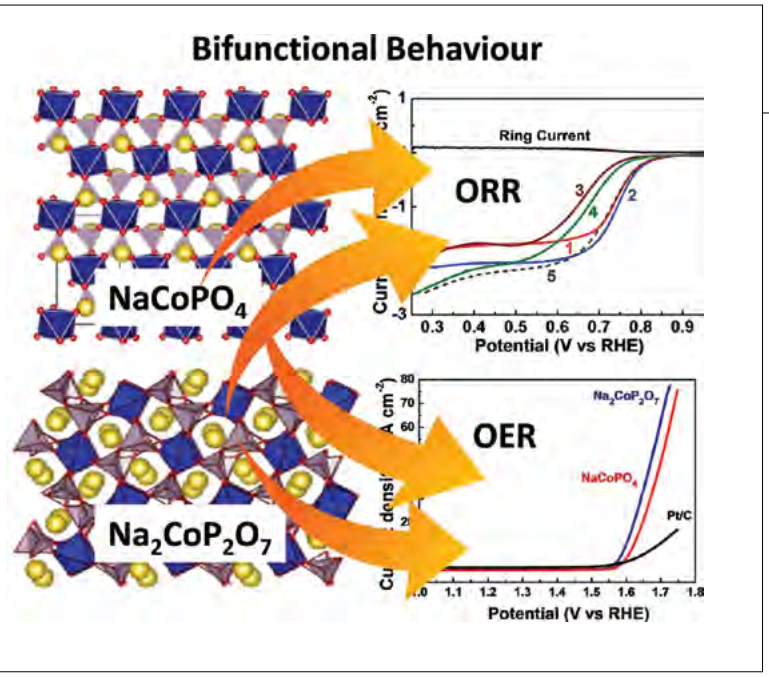
5. Geetharani K (IPC)



The primary aim of our research is to develop non precious transition-metal-catalysts for the syntheses of organoboranes which are important intermediates in c-c coupling reactions, medicinal chemistry, agrochemical industry and the like. We have developed an efficient synthetic route to organoboranes using inexpensive, less toxic Fe and Co based catalyst.

Reference: Communicated (unpublished)

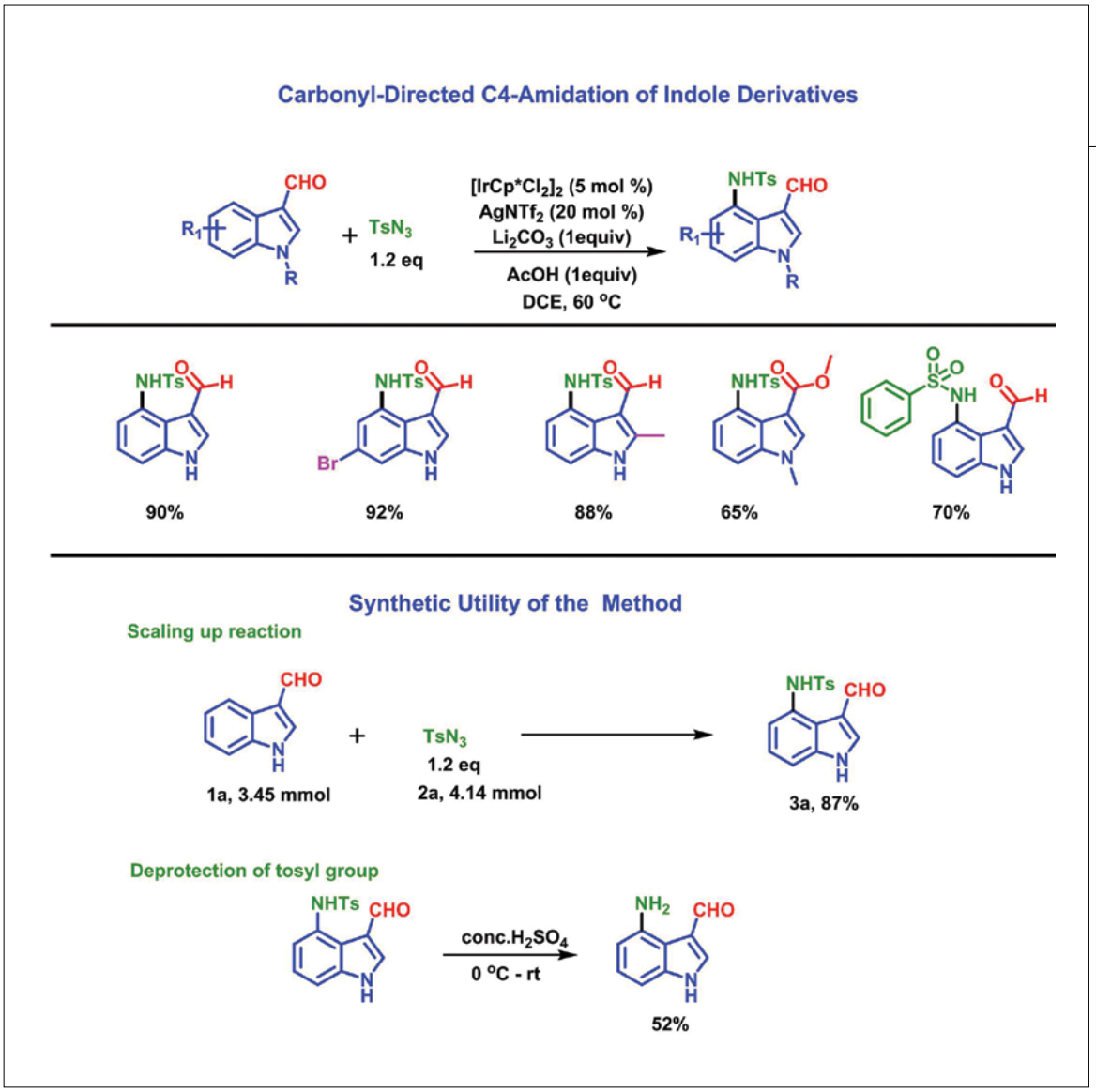
6. Prabeer Barpanda (MRC)



To produce cost-effective catalytic materials and replace the expensive Pt and Rh systems, researchers have explored various metallic and oxide compounds. This study demonstrates sodium battery insertion materials like $NaCoPO_4$ and $Na_2CoP_2O_7$ with promising oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) bi-functional electrocatalytic activities. They offer an economic option to design efficient electrocatalytic materials.

Reference: R Gond, K Sada, B Senthilkumar, and P Barpanda (2018) Bifunctional electrocatalytic behavior of sodium cobalt phosphates in alkaline solution. *ChemElectroChem.* 5, 153.

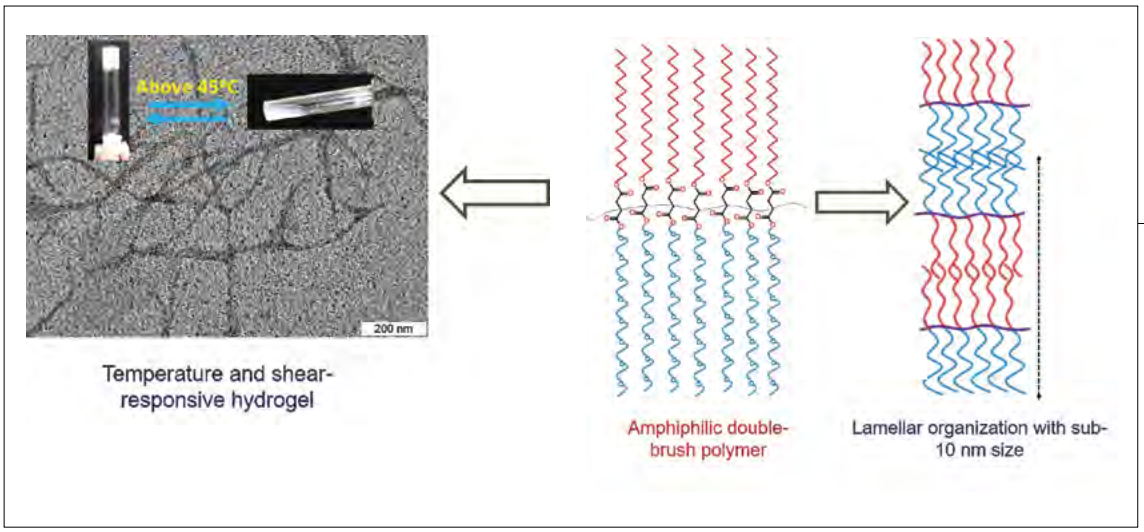
7. KR Prabhu (OC)



C4-Decorated indole scaffold features in a plethora of bioactive molecules, natural products, and functional materials. While their syntheses traditionally involved largely harsh stoichiometric reaction conditions, Prabhu and co-workers accomplished an unprecedented CĐH activation strategy, for the formation of C-N bond of indoles at the C4—position as illustrated in the scheme.

Reference: V Lanke and KR Prabhu (2017) Iridium(III) catalysed regioselective amidation of indoles at the C4-position using weak coordinating groups. *Chem. Commun.* 53, 5117.

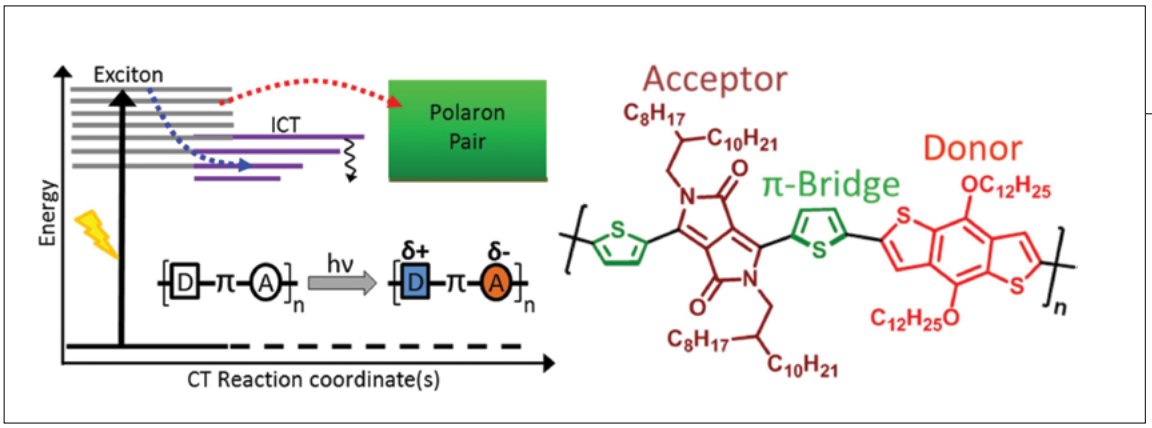
8. S Ramakrishnan (IPC)



Immiscibility between two closely spaced pendant segments along a polymer backbone drives the chain to adopt a conformation that segregates the segments on either side of the chain. When one of the pendant segments is water-soluble, it then leads to their self-assembly to form a hydrogel; remarkably, this hydrogel transforms to a sol upon application of either shear or heat.

Reference: S Chakraborty, SG Ramkumar and S Ramakrishnan (2017) Amphiphilic Double-Brush Polymers Based on Itaconate Diesters. *Macromolecules,* 50, 5004

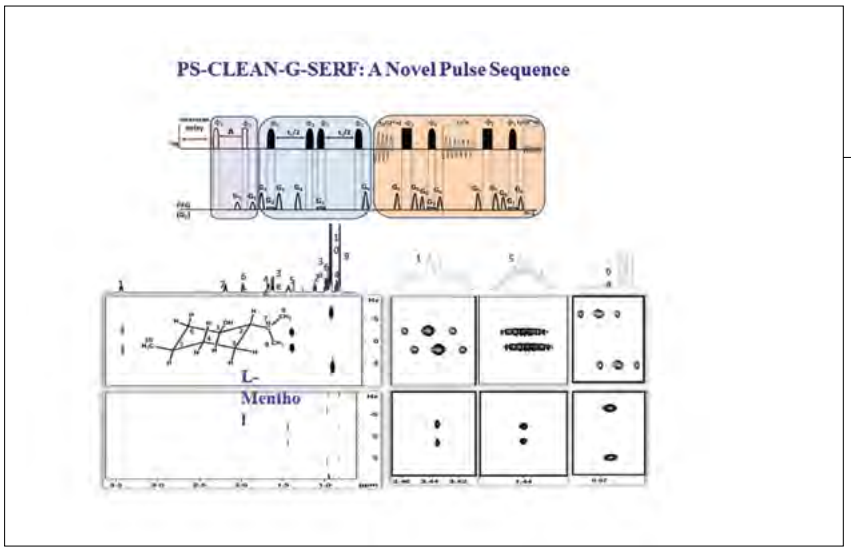
9. Satish Patil (SSCU)



The study probed the transient structural evolution of the polymer backbone during the generation of the intramolecular charge transfer state. In order to optimise the performance of organic photovoltaic devices, the authors investigated the complex interplay between ultrafast polaron pair generation and exciton relaxation pathways (see Figure) via elucidation of the charge transfer reaction coordinate.

Reference: P Roy, A Jha, VB Yasarapudi, T Ram, B Puttaraju, S Patil & J Dasgupta (2017) Ultrafast bridge planarization in donor-℗-acceptor copolymers drives intramolecular charge transfer. *Nature Comm.* 8, 1716. DOI:10.1038/s41467-017-01928-z

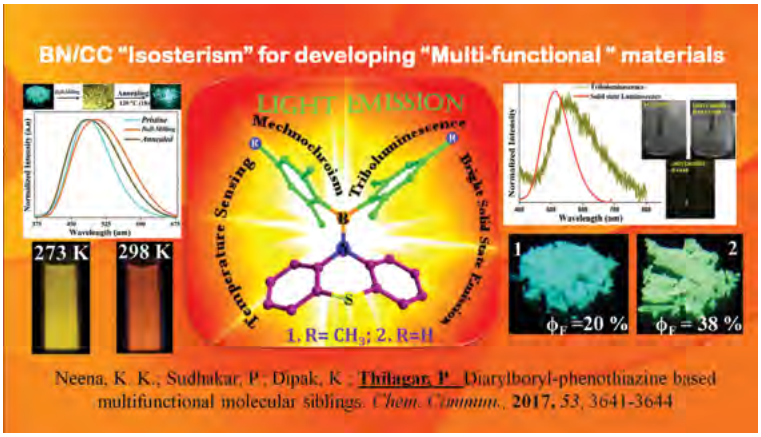
10. N Suryaprakash (NMR Research Centre)



The study report a novel PS-Clean-G-SERF NMR experiment that completely eradicates the axial peaks while also preventing the evolution of undesired couplings from the complex NMR spectrum. The resultant two dimensional spectrum of a selectively excited proton yields pure shift spectrum devoid of any couplings with ultra-high resolution in the direct dimension and the scalar coupling information in the indirect dimension.

Reference: SK Mishra and N Suryaprakash (2017) Pure shift Edited Ultra High Resolution NMR Spectrum with Complete Eradication of Axial Peaks and Unwanted Couplings. *J. Magn. Reson.* 279, 74-80

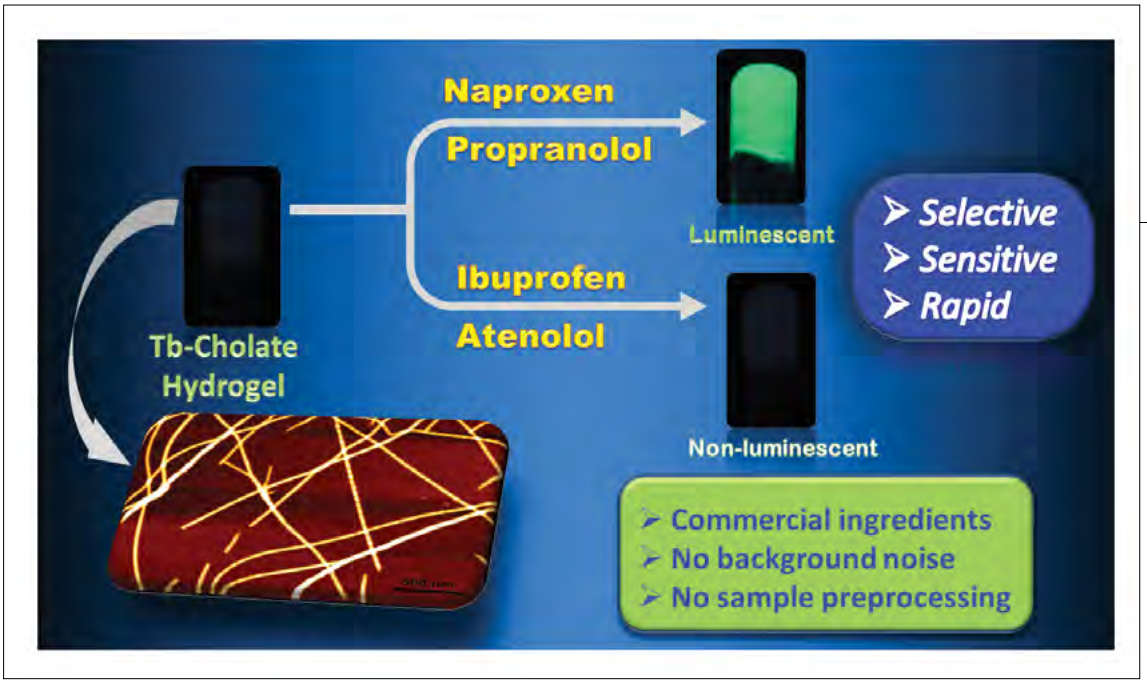
11. P Thilagar (IPC)



After having pioneered the concept of controlling the optical characteristics of luminescent compounds in solid state and solution by constraining the molecular conformations, we designed and developed tetraarylaminoboranes, the isoelectronic analogues of tetraarylethenes. We observed that the triboluminescence characteristics of 2 are rare and they may find potential applications in light emitting devices, security markers and as damage detectors in civil structures and polymer objects.

Reference: KK Neena, P Sudhakar, K Dipak, and P Thilagar P (2017) Diarylboryl-phenothiazine based multifunctional molecular siblings. Chem Commun. 53, 3641-3644

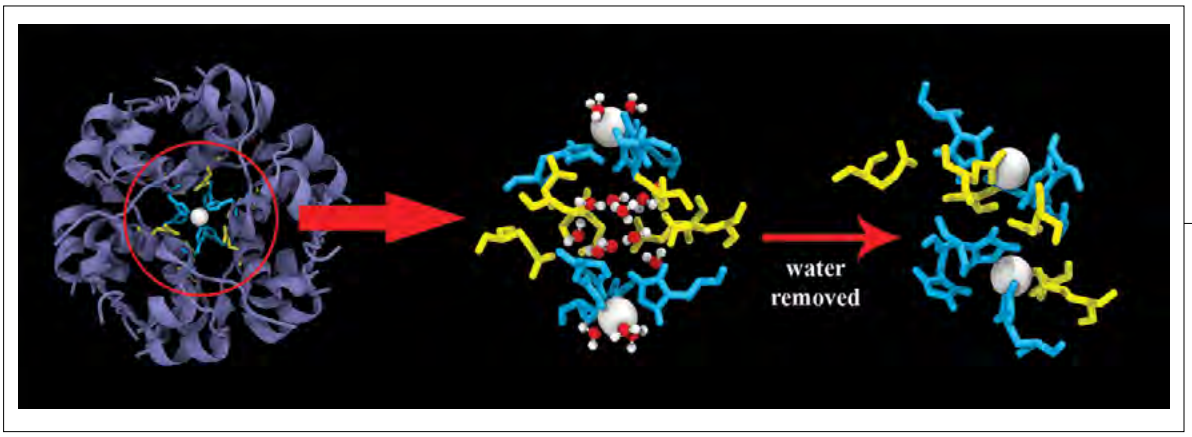
12. Uday Maitra (OC)



Maitra's team has developed a simple method in which two common drugs, naproxen (painkiller) and propranolol (CNS active drug) could be detected selectively at sub-ppb levels in less than 2 minutes by 'turn-on' photoluminescence of a Terbium-cholate hydrogel. Closely related drugs such as ibuprofen (painkiller) and atenolol (CNS active) did not exhibit photoluminescence enhancement.

Reference: R Laishram and U Maitra (2017) Rapid Sensing of Specific Drugs at Sub-Ppb Levels by Using a Hybrid Organic–Inorganic Photoluminescent Soft Material. *Asian J. Org. Chem.* 6, 1235.

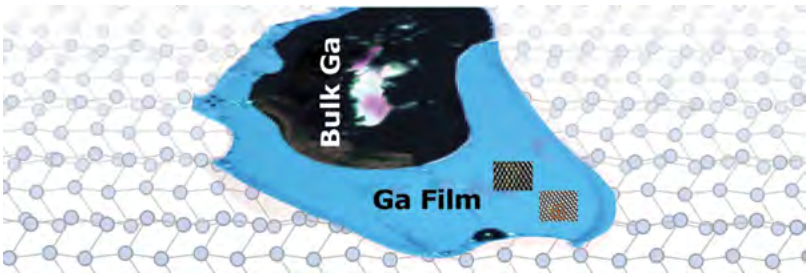
13. Biman Bagchi (SSCU)



Insulin is the most potent drug for treatment of diabetes and the study of the structural integrity of this drug molecule is crucial. This study investigates the role of water molecules in stabilizing the hexameric form of insulin, which acts as the storage unit of the biologically active monomers.

Reference: Mukherjee S Mondal S, Deshmukh AA, Gopal B, and Bagchi B (2018). What gives insulin hexamer its unique shape and stability? Role of ten confined water molecules. *Phys. Chem. B,* 122, 1631-1637).

14. Abhishek Singh (MRC)



The study uses exfoliation technique of surface solid layers from the molten phase of gallium to synthesize these 2D metallic sheets. This achievement is in an important step in realising its potential in various applications.

Reference: Kochat A, Samanta Y, Zhang S, Bhowmick P, Manimunda P, Asif SAS, Stender A, Vajtai R, Singh AK, Tiwary CS, and Ajayan PM (2018). "Atomically thin gallium layers from solid-melt exfoliation", Science Advances, 4(3): e1701373.

3.2.1 INORGANIC AND PHYSICAL CHEMISTRY

Established more than a century ago in 1909, when the Institute was founded, the Inorganic and Physical Chemistry Department (IPC) has excelled in both fundamental and applied research.

Current Research

A) BIO AND MEDICINAL INORGANIC CHEMISTRY: On this topic the following contributions have been made by the department faculty.

• Curcumin-based metal complexes as photo-chemotherapeutic agents have been developed and the compounds show significant photo-induced cytotoxicity in visible light while being minimally toxic in dark. BODIPY – Copper(11) conjugates are reported to show mitochondrial localization with single t oxygen mediated visible light-induced apoptotic cell death.

• Metal oxide nanomaterials that are capable of mimicking all the three majorcellular metalloenzymes have been shown for, controlling the level of reactive oxygen species (ROS) inside cells. The nanomaterials appear promising candidates for therapeutic applications against oxidative stress-induced neurological disorders, particularly Parkinson's.

Core Research

Currently, the department has 19 faculty members working in rich and diverse areas of chemistry including molecular spectroscopy, chemical dynamics, bio photonics, analytical and computational theory, electrochemistry, polymer chemistry, transition metal and non-metal chemistry, bioinorganic and biophysical chemistry, and functional materials

(B) CHEMICAL DYNAMICS AND SPECTROSCOPY

Several faculty members of the department work in this area.

• A combination of experiment and theory is being used to advance the understanding of intra- and intermolecular bonding and structure, including H-bonding. Two key experimental approaches employed are microwave spectroscopy and shock wave studies, that are both used toward this end. Studies related to astrochemistry are also being pursued.

• Protein-protein and nanoparticle-protein interactions have been investigated using several techniques, including second harmonic light scattering from solution. Binding constants, free energy of adsorption, number of proteins adsorbed on the nanoparticle surface are obtained to characterize the interaction between the surface and the macromolecules.

• Ultrafast surface reactions are being studied, including catalytic oxidation of CO monoxide, desorption of CO and CO2 on transition metal and metal oxide nanoparticle surfaces. Ultrafast initial steps in the laser ignition of energetic molecules like propellants and plasticizes are also being investigated. Steps are being taken towards development of X-Ray spectroscopy. Theoretical studies in attochemistry are also done.

• Research in condensed matter theory, including the statistical mechanics of complex fluids, polymer physics and stochastic processes is actively pursued in the department. Recent efforts have been to understand the role of noise on processes operating at the level of single molecules, where analytical models of fluctuating nanoscale systems have been developed.

• An understanding of vibronic dynamics in the gas and solution phases via theory is being developed. Most recent studies were on molecular dynamics simulations of H-atom abstraction reaction by CN radical from ethanol, and also the topology and mode involvement in the low-lying conical intersections of aniline involving the first pi-sigma* state.

(C) ORGANOMETALLIC CHEMISTRY:
In this sub-discipline, the departmental faculty members have contributed to the following.

• The hetereogeneous nature of catalysts involved in the transfer hydrogenation of unsaturated substrates by Ruthenium half-sandwich complexes with three different ligand systems has been discovered. Chiral N-heterocyclic carbenes have been made and converted to tethered half-sandwich complexes using amino acid chiral pool.

• A new and novel route for the synthesis of sigma complexes of H2, R3SiH, and H3N•BH3 via displacement of agostic interactions in a series of ruthenium complexes bearing PNP pincer complexes has been developed. In addition, a series of certain unusual homobimetallic ruthenium dihydrogen complexes bearing N-heterocyclic carbene ligand has been synthesized and characterized. A simple

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Degree Programs offered **PhD and Int PhD**

IN NUMBERS

19 Academic Staff
3 Scientific Staff
106 PhD Students
29 Int PhD Students
106 Publications
4 Int PhD Conferments
8 PhD Conferments

Chairperson: S UMAPATHY

synthetic strategy for iridium nanosponge has been developed via dissolution of capping agent in Ir@BNHx composite.

(D) POLYMER CHEMISTRY: A double amphiphilic comb polymer was prepared by micellar polymerization of an itaconate-based nonionic amphiphile carrying cetyl and PEG segments; at concentrations above 2.5 wt % in water, these form hydrogels upon polymerization. These hydrogels exhibited reversible temperature and shear responsive transformation to a sol. The benign nature of these polymers makes the hydrogels potentially useful as scaffolds for drug delivery and tissue engineering.

(E) MATERIAL CHEMISTRY: Studies have been carried out on surfaces and interfaces, including single and few layer ternary phosphochalcogenides of formula, MPX3, which have been investigatd for catalysis, as field effect transistors and for sensing. Rechargeable metal-air batteries based on zinc-air, lithium-air chemistries have been developed as well.

(F) MAIN GROUP CHEMISTRY: In this area, the following contributions have been made.

• Molecules with controlled optical characteristics based on tetraarylaminoboranes have been prepared and analysed. To this end, molecular siblings composed of electron deficient boryl and electron rich phenothiazine moieties have been designed and synthesized. These molecules exhibit multifunctional external stimuli responsive properties; in particular, their mechanoluminescence property has been exploited for rewritable data storage.

• The development of new transition metal catalysts for catalytic borylation reactions has been undertaken. The focus is on non-precious metal system based on Fe and Co for the cross-coupling reaction of aryl halides with diboron reagents. It was found that Co(IMes)2Cl2 in the presence of base KOMe is a good catalyst. A low coordinate iron(II) amide (Fe[N{SiMe3}2]2) catalyzed hydroboration of aldehydes and ketones with pinacolborane at room temperature has been developed.

(G) SUPRAMOLECULAR CHEMISTRY: The design of several molecular barrels and use their confined nanospace for catalytic organic transformations have been undertaken. In some case, regioselective organic transformations using molecular cages as reactors have been achieved. A series of proton conductive discrete heterometallic molecular cages have been studied.

Faculty & Staff

ARUNAN E | PhD (Kansas), FASc, Professor

ATANU BHATTACHARYA | PhD (Colorado), Assistant Professor

AR CHAKRAVARTY | PhD (Calcutta), FASc, FNA, Professor

BINNY J CHERAYIL | PhD (Chicago), Professor

P K DAS | PhD (Columbia), FASc, Professor

K GEETHARANI | PhD (Madras), Assistant Professor

UPENDRA HARBOLA | PhD (JNU), Associate Professor

BALAJI R JAGIRDAR | PhD (Kansas), FASc, Professor

G MUGESH | PhD (IIT Bombay), FASc, FNASc, FNA, Professor

PARTHA SARATHI MUKHERJEE | PhD (Jadavpur), Associate Professor

M NETHAJI | PhD (Madras), Chief Research Scientist

SANJAY PRASAD | MTech (Anna), Scientific Officer

S RAMAKRISHNAN | PhD (U Mass, Amherst), FASc, Professor

SAI G RAMESH | PhD (Wisconsin), Assistant Professor

C RANJAN | PhD (Muelheim Ruhr), Assistant Professor

S SAMPATH | PhD (IIT Madras), FASc, FNA, Professor

AG SAMUELSON | PhD (Cornell), Professor

S SANDYA | PhD (Kerala), Scientific Officer

P THILAGAR | PhD (IIT Kanpur), Associate Professor

S UMAPATHY | PhD (Otago), FASc, Professor

S VASUDEVAN | PhD (IIT Kanpur), FASc, FNA, Professor

Honorary Professor

ED JEMMIS | PhD (Princeton), FASc, FNA, Honorary Professor

KL SEBASTIAN | PhD (IISc), FASc, FNA, Honorary Professor

3.2.2 MATERIALS RESEARCH CENTRE

The Materials Research Centre (MRC) was established in 1978, to foster interdisciplinary research in different areas of materials science and technology with an emphasis on electronic and functional materials. Recently the centre has diversified in to biomaterials, multiscale simulation and properties of nanomaterials. The slogan of the centre, "From basic science to device prototypes," would aptly sum up its research efforts.

Current Research

A) ENERGY HARVESTING MATERIALS: Faculty members of the centre are involved in addressing the challenges associated with development of efficient energy harvesting materials using state-of-the-art density functional theory based methods. An extensive study is in progress to develop guidelines for designing high ZT thermoelectric materials and ambient condition efficient hydrogen and Li storage materials. Nanostructurization of transition metal silicides is carried out for high temperature thermoelectric application.

Core Research

The efforts of the faculty of the centre covers the following broad areas of research:

Semiconducting materials for blue LEDs, phosphors for white light applications, absorber for photovoltaic applications, infra-red and UV detection, gas sensing, etc. Biomaterials for musculoskeletal applications, catalytic materials for water splitting, water purification, energy harvesting and storage materials for thermoelectric, Li-ion/ Na-ion battery, and hydrogen storage, fuel cells, etc and thermoelectrics and meta-materials are pursued in the centre

(B) 2D MATERIALS AND META MATERIALS: Faculty members of the centre are working on 2D materials as they are considered as materials for next generation devices. In order to use 2D materials as building blocks in electronic, optical, and sensing applications, their electronic properties need to be modified. A focussed effort aiming towards gaining the ability to modify the band gaps of these materials in a controlled and non-invasive way is currently underway. Meta-structure based on vanadium oxide phase change materials for perfect absorbers of IR and microwave frequencies have been demonstrated.

(C) WHITE LIGHT-EMITTING-DIODES FOR GREEN ENERGY: The LED project evolved for this initiative dealt with "White" LEDs, typically blue LEDs working in conjunction with yttrium aluminium garnet (YAG) phosphor, used for lighting applications. A commercial white LED produces 110 lm/W at an injection current of 700 mA, exemplifies the state-of-the-art in solid-state lighting. The work at MRC developed highly efficient white LEDs higher than commercially available LEDs in three phases over the last 6 years in collaboration with an industry.

(D) BIOMATERIALS FOR MUSCULOSKELETAL: Applications: Researchers of MRC have made pioneering contributions towards innovative research on multifunctional ceramics, impacting healthcare, renewable energy and aerospace applications. They have been constantly pursuing the mission to conduct transformative research, leading to development of new materials and technologies through collaborative efforts of academia and national laboratories with intensive – interactive inputs from clinicians and industries. A common thread in the research programs is the ability to design new materials, to manipulate processing approaches (spark-plasma sintering, 3D inkjet powder printing, magnetron sputtering, etc) and to combine computational analysis with performance qualifying assays, while establishing the translational potential through technology licensing to companies. Employing quantitative experiments together with computational and pre-clinical studies in animal models, the Laboratory for Biomaterials at MRC has developed new multifunctional biomaterials ('piezobiocomposites' with bone mimicking functional properties), a new processing approach (spark plasma sintering or 3D inkjet powder printing) and new culture protocols to understand biophysical stimulation (electric, magnetic, fluid shear) mediated modulation of cell functionality. The research encompassing experiments and theory, added a new dimension to establish synergistic, interaction between external field (pulsed/steady electric-field/ static magnetic field) stimulation and substrate properties (electrical conductivity / magnetisation) for guiding Osteogensis/neurogenesis/ cardiomyogenesis of stem cells, in vitro. The secret work at the Laboratory for Biomaterials validated such observations under controlled fluid shear in custom designed PMMA micro fluidic devices. The research group at MRC in collaboration with a group of orthopaedic surgeons and prosthodontists, invented new manufacturing technologies for a patient-specific ceramic femoral head and polymer – ceramic hybrid acetabular socket prototypes for total

FACT FILE

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Degree Programs offered **PhD and Int PhD**

IN NUMBERS

7 Academic Staff

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5 Int PhD Students

99 Publications

1 Int PhD Conferments

10 PhD Conferments

Chairperson: **ARUN M UMARJI**

hip-joint replacement surgery as well as a three-piece dental implant system with pentagonal anti-rotational features. These technologies are licensed to micro, small and medium enterprises (MSME). The secret research with 3D printing to fabricate cranioplasts to treat craniectomy defects has advanced to human clinical studies.

(E) Nanostructured Materials for Energy and Environment Applications: Faculty of our centre are involved in designing nanostructured based catalysts for water splitting, water purification and fuel cells. Some faculty members are associated with the development of materials for gas sensing applications at room temperature, infra-red and UV detection.

Faculty & Staff

BIKRAMJIT BASU | PhD (Kuleuven, Belgium), Professor

PRABEER BARPANDA | PhD (Rutgers), Assistant Professor

KARUNA KAR NANDA | PhD (IOP), Professor

N RAVISHANKAR | PhD (IISc), Professor

BALARAM SAHOO | PhD (Duisberg), Assistant Professor

ABISHEK K SINGH | PhD (Tohoku), Associate Professor

ARUN M UMARJI | PhD (IIT Madras), Professor

EMERITUS PROFESSOR

G ANANTHAKRISHNA | PhD (Texas), INSA Senior Scientist

S B KRUPANIDHI | PhD (University of Delhi), INSA Senior Scientist

SANGRAM K SAMAL | PhD (University of Pisa), Ramalingam Fellow

3.2.3 NMR RESEARCH CENTRE

The NMR Research Centre began with the installation of the first superconducting magnet based high field NMR spectrometer in the country in the year 1977. Today the Centre has grown to be a nodal centre for research in the area of magnetic resonance in the country and has retained its leadership in the areas of spectral service, in-house research and developmental work. The Centre has been at the forefront of research in the area of magnetic resonance and has been leading the country in this area.

Current Research

During the last year several novel NMR spectroscopic methods have been developed. Some of the important findings/work initiated during this period include:

Development of a pattern recognition based approach for identifying metabolites in NMR based metabolomics, establishing the dynamic nature of protein-nano-particle interactions by NMR spectroscopy, development of a facile approach for accurate determination of magnitudes and relative signs of J couplings involving fluorine, sensitivity enhancement in slice-selective NMR experiments through polarization sharing and solution and solid-state NMR investigations of amyloid proteins and designed and bioactive peptides.

FACT FILE

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IN NUMBERS

7 Academic Staff
10 Publications

Chairperson: **S VASUDEVAN**

Faculty & Staff

HANUDATTA S ATREYA | PHD (BOMBAY), ASSOCIATE PROFESSOR

N SURYAPRAKASH | PHD (BANGALORE), FNASC, PROFESSOR

Emeritus Professor

JAYANTHA CHATTERJEE | PHD (MUNICH), ASSISTANT PROFESSOR

BALAJI R JAGIRDAR | PHD (KANSAS STATE), PROFESSOR

KP RAMESH | PHD (BANGALORE), ASSOCIATE PROFESSOR

SIDDHARTHA SARMA | PHD (MARYLAND), PROFESSOR

MAHAVIR SINGH | PHD (MUNICH), ASSISTANT PROFESSOR

S VASUDEVAN | PHD (IIT KANPUR), PROFESSOR

Core Research

The primary focus of the NMR Research Centre is the development of new NMR spectroscopic methods and their application to important and challenging problems in Chemistry and Biology

3.2.4 ORGANIC CHEMISTRY

The Department of Organic Chemistry (OC) is one of the oldest departments in IISc, which started in the year 1911. Current research in the department covers contemporary organic chemistry, as well as interdisciplinary subjects.

Current Research

• Catalytic enantioselective formal umpolung alkenylation of beta-ketoesters, vinylogous allylic alkylation of coumarins and sulfenylation of deconjugated butyrolactams and enantioselective synthesis of 3,4-unsubstituted thiochromenes through catalytic sulfa-Michael/Julia+Kocienski olefination have been accomplished.

•Total Synthesis of macrolactone aetheramide possessing in vitro anti-HIV activity is conducted. Use of sulfinimines in the direct addition of ketones, synthesis of sedamine and lasubine alkaloids has been demonstrated.

• Peptidomimics: Synthesis, conformational analyses, energetics of: (i) van der Waals and CH/pi interactions in proteins; (ii) H-bond surrogate constrained Đ-, 310-helices and (iii) high throughput molecular sensors, are accomplished.

• Strategies involving metallic, metal-free, organometallic, and organocatalysts for synthesizing

FACT FILE

Established **1911**
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Fax **+91-80-2360 0529**
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URL **orgchem.iisc.ac.in/**
Degree Programs offered **PhD and Int PhD**

IN NUMBERS

10 Academic Staff
53 PhD Students
10 Int PhD Students
70 Publications
2 Int PhD Conferments
8 PhD Conferments

Chairperson: N JAYARAMAN

biologically active compounds under environmentally benign conditions using C-H activation and cross dehydrogenative coupling strategies are developed.

• AgOTf-catalyzed synthesis of benzoindolines, and TfOH-catalyzed synthesis of napthofurans has been achieved. Enantioselective synthesis of b-lactones (NHC catalysis) and spiroheterocycles (using secondary amine catalysis) have been done.

• Cascade energy transfer from a sensitizer to Tb(III), and then to fluorescent dyes was observed for the first time in a self-assembled hydrogel derived from commercially available ingredients.

• Preparation and application of 2D-nanomaterials in antibacterial activity, biomolecular recognition and catalytic effect in organic synthesis have been accomplished.

• Concentration dependent self-assembly of TrK-NGF receptor derived tripeptide and utilization of red-light-emitting CdTe nanoparticles for the trace-level detection of harmful herbicides in adulterated food and agricultural crops have been done.

• Sugar amino acid based antimicrobial and antileishmanial peptides, amide-linked cyclic oligonucleotide analogs and total synthesis of naturally occurring asperaculin A, using a radical-mediated method to build its central chiral quaternary centre, have been carried out.

• Synthetic glycolipids as new class of inhibitors of mycobacterial metabolic and phenotype functions; dendron-appended one-dimensional polydiacetylene polymers, their biosensing and structure-function relationship in dendritic liquid crystals have been demonstrated.

Faculty & Staff

SANTANU BHATTACHARYA | PhD (Rutgers), FASc, FNA, FTWAS, Professor

TUSHAR KANTI CHAKRABORTY | PhD (IIT Kanpur), FNA, FASc, FNASc, Professor

MRINMOY DE | PhD (Massachusetts), Assistant Professor

N JAYARAMAN | PhD (IIT Kanpur), FASc, Professor

UDAY MAITRA | PhD (Columbia), FASc, FNA, Professor

SANTANU MUKHERJEE | PhD (Cologne), Assistant Professor

EN PRABHAKARAN | PhD (IIT Kanpur), Associate Professor

KR PRABHU | PhD (IISc), Associate Professor

KAVIRAYANI R PRASAD | PhD (Pune), Professor

Core Research

The core interest of the department covers areas including design, synthesis, characterization and analyses of physical and biological properties. The areas pursued are organic synthesis, molecular design, physical organic chemistry, chemistry of new materials, bioorganic chemistry/chemical biology, methodology development and asymmetric catalysis

3.2.5 SOLID STATE AND STRUCTURAL CHEMISTRY UNIT

The Solid State and Structural Chemistry Unit (SSCU) was founded in November, 1976. The unit has provided major thrust to frontier areas of Chemistry. Besides developing its own research and teaching programs, unit members interact closely with other departments of the institute. The unit is a premier research center of global repute in the areas of solid state and physical chemistry. Our faculty and students work in inter-disciplinary areas at the intersection of chemistry, physics and materials science.

Current Research

Experimental and theoretical research pursued in the unit aims at understanding diverse phenomena associated with solids and condensed phases as well as liquids at the fundamental level. There is also significant emphasis on research activities aimed at development of prototypes for commercialization. Some on-going cutting-edge research areas pursued in the Unit are as follows:

(A) SYNTHESIS, STRUCTURE, ELECTRONIC AND MAGNETIC PROPERTIES OF OXIDES: Inorganic-organic hybrid framework compounds have been studied over the years with primary focus on understanding the structure and properties. In the course of this study, it has been found that new anions such as sulfates, thiosulfates, borates can be incorporated as part of the framework leading to interesting new families of compounds. The use of organic acids along with nitrogen containing ligands led to new compounds that exhibit proton conductivity, (photo)catalysis, heterogeneous catalysis. Some of the framework solids have shown great potential in alkali-metal-ion battery chemistries and hydrogen storage.

(B) CRYSTAL ENGINEERING, CHARGE DENSITY AND RELATED ASPECTS: Application of crystal engineering in the development of pharmaceutical solids

The main objective of crystal engineering is to design functional molecular solids with tunable properties based on intermolecular interactions. The concept of supramolecular synthon or the recognition of molecules through intermolecular interactions plays a crucial role to correlate the structure and property of crystalline solids. A wide variety of weak interactions including hydrogen bonding, Ⓟ···Ⓟ, halogen···halogen interactions present in single component as well as multi-component molecular crystals or cocrystals have been studied. The understanding of molecular interactions aids in the design of pharmaceutical cocrystal with improved physicochemical properties.

(C) ORGANIC PHOTOVOLTAIC MATERIALS: Synthesis of new class of Ⓟ-conjugated polymers and correlating their structure and properties have been pursued in great details. New class of conjugated polymers by various chemical routes, which control the polymer chain conformations, intermolecular interactions and disorder by rational design were initiated and utilized to fabricate optoelectronic

devices. The synthetic design principles helped in developing new class of n-type conjugated polymers, which exhibit enhancement of electron charge-carrier mobility. Examples of this type are rare in the literature. The conjugated polymers exhibit band-like transport, which demonstrates the effectiveness of the rational molecular design and generate potential for new class of optoelectronic devices. Understanding the photophysical properties of such systems would lead to new and efficient photovoltaic materials.

(D) SYNTHESIS, STRUCTURE AND ELECTRONICS PROPERTIES OF MOLECULAR SEMICONDUCTORS: The main activity centers on exploring novel properties of a range of materials with an emphasis on their electronic, magnetic, dielectric and optical properties. Besides seeking new materials and properties, a major thrust is in trying to understand the origin of such novel and interesting properties, based on advanced experimental techniques and state-of-the-art theoretical approaches. Some specific highlights of the research in such directions are (a) crystal structure engineering by fine tuning the surface energy in II-VI nanocrystals e.g. /CdSe, (b) tuning of dielectric properties and magnetism of oxide materials (c) discovery of multiglass properties in partially-disordered La2NiMnO6 (d) Magnetism in Fe/Cu co-doped ZnO nanocrystals (e) Discovery of effective Mass Driven Structural Transition in Mn-doped ZnS Nanoplatelet (f) The very first demonstration of Ultra-narrow and widely tunable Mn2+ Emission from Single Nanocrystals of ZnS-CdS alloy (g) Resolving the age-old controversy regarding NiS and proving it to be an unusual self-doped, nearly compensated antiferromagnetic metal (h) The pioneering work to demonstrate the feasibility of obtaining emission across the entire visible range from an atomic transition in doped quantum dots by strain engineering and (i) A microscopic description of how the local structure, distinct from the global average structure determined by XRD, evolves in to the global structure with an increasing length-scale of the description and its consequence on the widely used concept of a chemical pressure in solid solutions.

Other studies on this front have demonstrated the occurrence of ground state charge transfer between quantum dots. This leads to the emergence of strong electrostatic forces between quantum dots, leading to the formation of a quantum dot solid. These solids exhibit chemical properties such as stoichiometry, and bear a strong resemblance to ionic compounds except that the building blocks are hundreds of times larger. In another study, possible routes to low threshold quantum dot lasers have been proposed, and novel, low threshold continuous wave quantum dot based lasers have been developed. Other studies include the development of novel synthetic methods that enable copying the morphology of a nanostructure as well as the synthesis and spectroscopy of solar energy relevant quantum dots composed entirely of earth abundant, non-toxic elements.

(E) MATERIALS ELECTROCHEMISTRY FOR RENEWABLE ENERGY: In this area, research of the unit faculty members focuses on the synthesis of electrode and electrolyte materials for various battery chemistries and supercapacitors. Critical understanding of materials properties, their correlation with structure and function is the primary focus. Many of these studies have also involved utilization of synchrotron facilities. Synthesis involved development of multifunctional high performance soft materials, inorganic nanomaterials along with networked gel polymer electrolytes based on organic materials have been investigated as potential candidates for various rechargeable battery chemistries.

(F) THEORETICAL STUDIES OF ELECTRONIC AND MAGNETIC PROPERTIES OF ORGANIC MATERIALS: Studies on the electronic and magnetic properties of strongly correlated low-dimensional systems and conjugated organic molecules have been carried out. During the course of this study, new time dependent density matrix renormalization group (DMRG) algorithm was developed to study the effect of long-range correlations on spin charge separation in polyene chains. The studies, shown through entanglement entropy studies, reveal why the DMRG method is accurate for models with long-range interactions. The DMRG method was extended to study Bethe lattices and dendrimers. On the exact diagonalization (ED) front, for the first time how to exploit both spatial and spin symmetries of systems belonging to non-Abelian point groups was shown. Entanglement entropy as a handle to study quantum phase transitions in frustrated spin chains was established. The scope of valence Bond (VB) method by using new symmetries of symmetrically substituted donor acceptor systems in polyenes and polyacenes to carry out ED studies on systems spanning nearly a billion dimensional Hilbert space was extended. This method was employed to study excited state tuning in substitute polyenes and Tetracene. In addition, systems such as fused azulenes can be in magnetic ground states due to intrinsic bond frustration in electron delocalization were also established.

(G) STATISTICAL MECHANICS CONDENSED MATTER AND BIOLOGICAL SYSTEMS: The problems of protein folding and aggregation have important implications in several neurodegenerative diseases such as Alzheimer and Parkinson's. Our

faculty have recently addressed a fundamental problem in the area of protein collapse. Single domain proteins are finite-sized heteropolymers and behave like random coils at high denaturant concentrations, and fold into specific three-dimensional structures at low denaturant concentrations to perform their functions. An interesting fundamental question is whether proteins akin to polymers undergo a coil-to-globule collapse transition during the initial stages of folding (burst-phase) as the conditions are made conducive for folding. The collapse transition in proteins is generally studied using single molecule fluorescence resonance energy transfer (FRET), and small angle X-ray scattering (SAXS) experiments. The FRET and SAXS experiments disagreed on whether Protein L, a model protein used to study protein folding, collapses during the burst-phase of folding. We studied the burst-phase of folding for Protein L using a coarse-grained protein model and molecular dynamics simulations to understand the impact of various approximations used in these methods to resolve the controversy between the FRET and SAXS experiments. We found that FRET experiments overestimated Rg of the protein due to the application of Gaussian polymer chain end-to-end distribution to extract Rg from the FRET efficiency and thereby suggesting pronounced compaction in the protein dimensions in the burst-phase. We further found that the decrease in Rg is close to the statistical uncertainties of the Rg data measured from SAXS experiments, which suggested no compaction, leading to a disagreement with the FRET experiments.

(H) MOLECULAR SIMULATION AND THEORETICAL MODEL STUDIES: A detailed theory of the effects of intermediate metastable phases on the nucleation and growth of the thermodynamically stable phase has been developed. This theory explains such novel phenomena like the role of LDL phase in the nucleation of ice from supercooled water. A theory of surface tension under the same free energy conditions was developed. Studies on protein unfolding dynamics in aqueous binary mixtures demonstrated that while DMSO preferentially melts alpha helices, urea does the same to beta sheets. The former was not known before this work. A theory of pair hydrophobicity in mixed solvents was developed. Studies on the origin of hydrophobic force law between two hydrophobic surfaces were initiated. In another front, the first theory of the role of vitamin D in human immune response is being developed.

(I) SHOCK WAVE STUDIES ON MATERIALS: Design and fabrication of Free Piston driven Shock Tube/Tunnel (FPST- HST3) for the study of high temperature materials has been accomplished. The facility would be used to produce flow enthalpy which corresponds to extreme temperatures of Ð15,000 K and maximum pressures of Ð200 bars for 1-5 ms duration. Materials like nano solid particles, low vapour liquids, thin films and solid materials are studied under extreme thermodynamic conditions. Ultra-High-Temperature Ceramics (UHTC), Thermal Barrier Coating (TBC) and Thermal Protection System (TPS) materials are synthesized and subjected to super heating and cooling at the rate of 106 – 107 K/s using these shock tube facilities. At this rate of heating and cooling, the kinetics and dynamics of phase transformation, surface modification, material properties and electronic structure of shock exposed materials are being probed. This novel experimental technique is used to study materials under strong shock loading.

Faculty & Staff

NAGA PHANI B AETUKURI | PhD (Stanford), Assistant Professor

BIMAN BAGCHI | PhD (Brown), FASc, FNASc, FNA, FTWAS, Professor

ANINDA J BHATTACHARYYA | PhD (Jadavpur), Associate Professor

GAUTAM R DESIRAJU | PhD (Illinois), FASc, FNASc, FNA, FTWAS, Professor

A GOVINDARAJ | PhD (Mysore), Principal Research Scientist

V JAYARAM | PhD (IISc), Principal Research Scientist

KR KANNAN | MSc (Engg) (IISc), Senior Scientific Officer

ABHISHAKE MONDAL | PhD (UPMC Paris-6), Assistant Professor

S NATARAJAN | PhD (IIT Madras), FASc, FNASc, Professor

ANSHU PANDEY | PhD (Chicago), Assistant Professor

SATISH A PATIL | PhD (Wuppertal), Associate Professor

GOVARDHAN REDDY | PhD (Wisconsin), Assistant Professor

DD SARMA | PhD (IISc), FASc, FNASc, FNA, FTWAS, Professor

R SATHISHKUMAR | MTech (Madras), Scientific Officer

C SHIVAKUMARA | PhD (IISc), Senior Scientific Officer

NY VASANTHACHARYA | PhD (IISc), Senior Scientific Officer

Associate Faculty

HANUDATTA S ATREYA | PHD (BOMBAY), ASSOCIATE PROFESSOR

GIRIDHAR MADRAS | PhD (Texas A&M), Professor

N SURYAPRAKASH | PhD (Bangalore), FNASc, Professor

S VASUDEVAN | PhD (IIT Kanpur), Professor

Honorary And Emeritus Professors

J GOPALAKRISHNAN | PhD (IISc), FASc, FNA, FNASc, FWIF, Emeritus Professor

MS HEGDE | PhD (IIT Kanpur), FASc, CSIR Emeritus Scientist, Emeritus Professor

S RAMASESHA | PhD (IIT Kanpur), FASc, FNA, FTWAS, Honorary Professor

KJ RAO | PhD (IIT Kanpur), FASc, FNASc, FNA, FWIF, Emeritus Professor

T N GURU ROW | PhD (IISc), FASc, FNA, FRSC, Honorary ProfessorA K Shukla | PhD (IIT Kanpur), FASc, FNAE, FNASc, FNA, UGCBSR Faculty, Emeritus Professor

S YASHONATH | PhD (IISc), FASc, FNA, Emeritus Professor

Core Research

The work of the faculty of the Unit covers the following areas of research: Materials for energy generation and storage, statistical mechanics, quantum chemistry and electronic structure, spectroscopy, crystallography and structural chemistry, and chemistry and physics of organic and inorganic materials

FACT FILE

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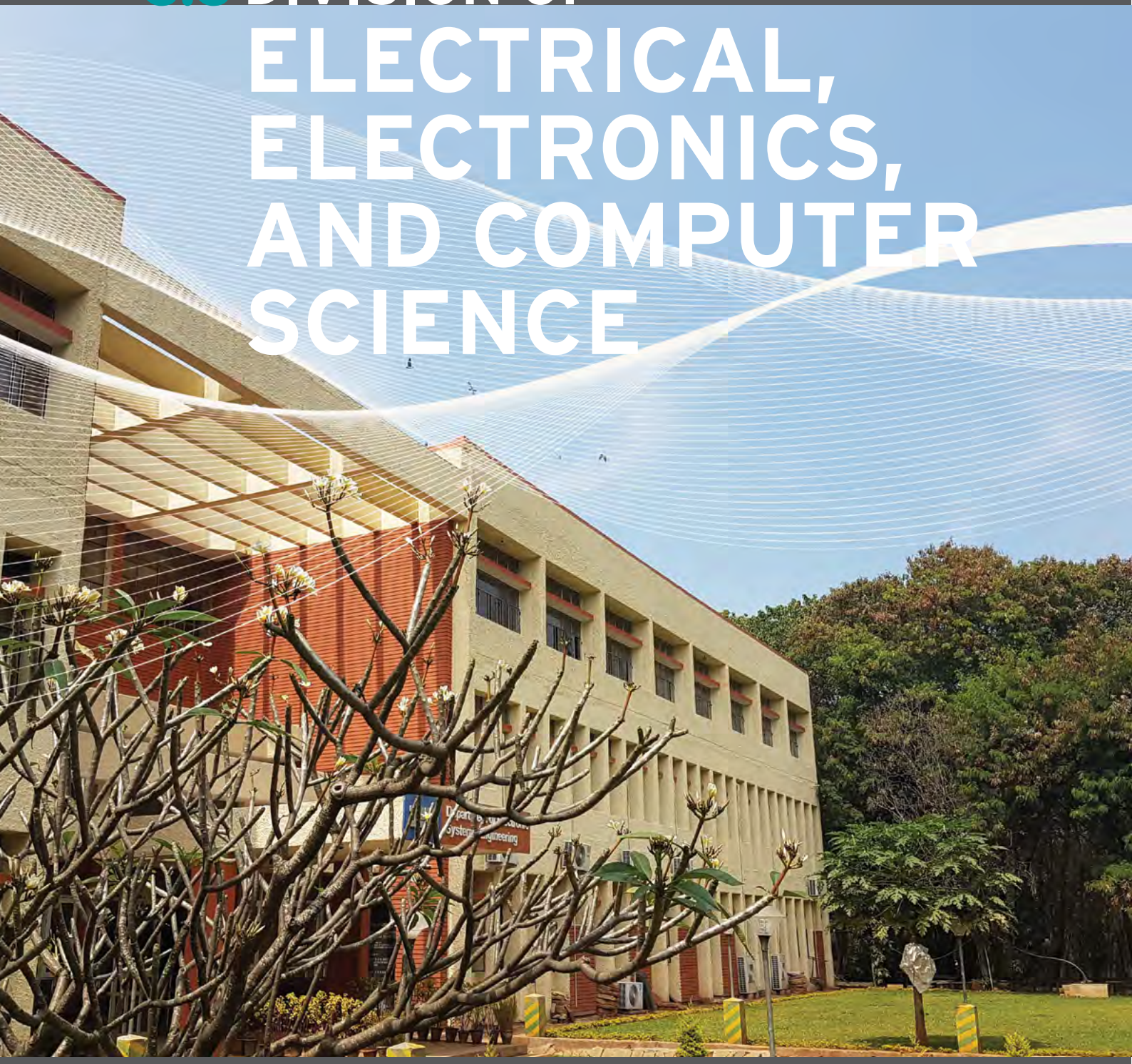
Degree Programs offered **PhD and Int PhD**

IN NUMBERS

10 Academic Staff
6 Scientific Staff
66 PhD Students
17 Int PhD Students
133 Publications
1 Int PhD Conferments
13 PhD Conferments

Chairperson: **ANINDA J BHATTACHARYYA**

3.3 DIVISION OF ELECTRICAL, ELECTRONICS, AND COMPUTER SCIENCE



The Division is assiduously seeking fundamental advances in the following core areas: Signal Processing, Communications, Networks, Microelectronics and Devices, Photonics, Theoretical Computer Science, Computer Systems and Software, Artificial Intelligence and Machine Learning, Control and Optimization, Power Systems, Power Electronics and High Voltage Engineering.

Themes

A feature of the Division's R&D activities is its focus on rigorous innovation in contemporary, interdisciplinary themes: Cyber Physical Systems, Big Data Analytics, 5G Technologies, Devices for Healthcare, Electronics for Strategic Sector, Network Science, Cybersecurity, Neuromorphic computing, Image and Video Processing, and Smart Grids.

Research Highlights

The Division of Electrical, Electronics, and Computer Sciences comprises four Departments: Computer Science and Automation; Electrical Communication Engineering; Electrical Engineering; and Electronic Systems Engineering. A feature of the Division's R&D activities is its forays into contemporary, inter-disciplinary, and nationally relevant themes including Cyberphysical Systems, Cybersecurity, Data Science, and Neurocomputing. The Division is also actively participating in Institute level programs on Smart Energy, Smart Water, Smart Cities, and Devices for Healthcare, and Electronics for the Strategic Sector

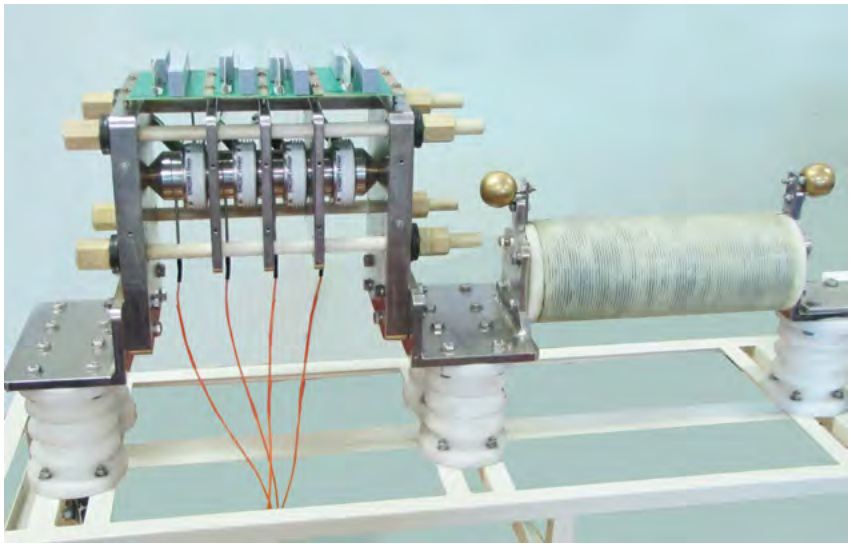
DEPARTMENTS | CENTRES | UNITS

- COMPUTER SCIENCE AND AUTOMATION
- ELECTRICAL COMMUNICATION ENGINEERING
- ELECTRICAL ENGINEERING
- ELECTRONIC SYSTEMS ENGINEERING

IN NUMBERS

- 93 ACADEMIC STAFF
- 347 PHD STUDENTS
- 420 MASTER'S STUDENTS

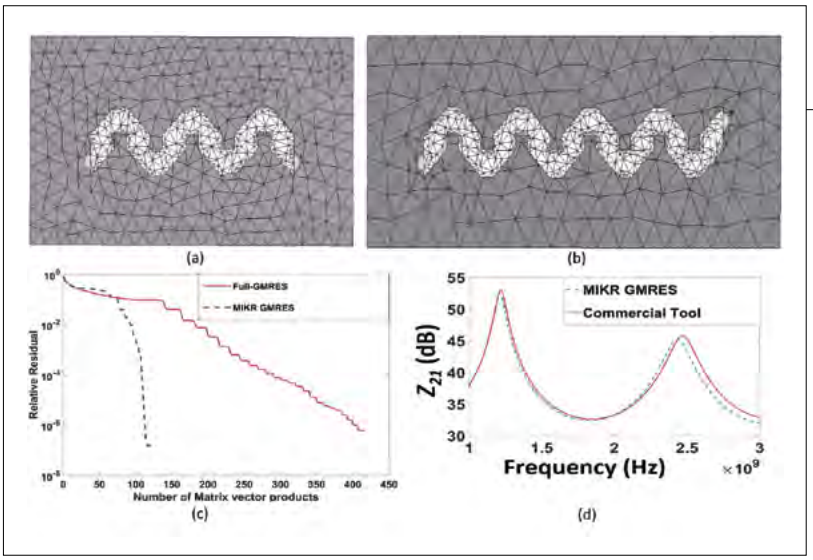
RESEARCH SNAPSHOTS 2017-18



1. Vinod John (EE)

Microwave tubes (MWT) require protection to prevent system failure and economic loss. A fast-acting crowbar can be used for this. The solid-state crowbar (SSC), shown in the picture, has been designed and developed at IISc-Bangalore and CDAC-Thiruvananthapuram. It is India's first 10 MegaWatt pulse-power SSC for MWT protection. The SSC is currently being used at the Institute for Plasma Research, Ahmedabad.

Reference: TG Subhash Joshi, V John (2017) Performance Comparison of ETT- and LTT-Based Pulse Power Crowbar Switch. *IEEE Transactions on Plasma Science,* 45(11): 2994-3000 (doi: 10.1109/TPS.2017.2759668)



2. Dipanjan Gope (ECE)

Today's 3D full-wave electromagnetic solvers treat each model independently regardless of any similarity with a previously solved model. In this work, a Mesh-Interpolated Krylov Recycling (MIKR) technique is proposed to reuse the Krylov subspace of the base design (Figure a) to expedite the 3D full-wave electromagnetic solution of a design variant (Figure b). Numerical results demonstrate up to 4x speed-up (Figure c) over existing commercial solution with uncompromised accuracy (Figure d).

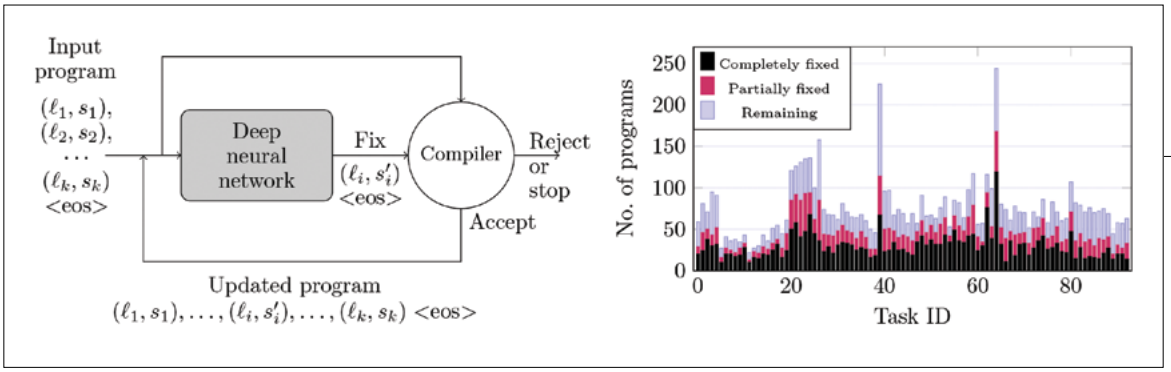
Reference: G Chatterjee, A Das, SV Reddy and D Gope (2017) Mesh Interpolated Krylov Recycling Method to expedite 3D Full-Wave MoM Solution for Design Variants. *IEEE Transactions on Microwave Theory and Techniques,* 65 (9): 3159-3171.

3. Gurunath Gurrala (EE)

As part of E-Sense project for home automation, a small form factor device has been developed. It converts the existing manual electrical switch to a remotely controllable switch through Wi-Fi. Simultaneous remote and manual operation is possible. It also has an inbuilt fail-safe mechanism to protect the devices in case of remote control failure. Provisional Patent has been filed for the device and the and the possibility of setting up a start-up is being explored.

Reference: A Joglekar, G Gurrala and A Lele (2017) Provisional Patent: 201741016231, *Controlling Electrical Devices,* Indian Institute Of Science.

4. Aditya Kanade (CSA)



DeepFix is the first end-to-end deep learning based system to automatically correct common programming errors. It can help provide automated feedback in massive open online courses (MOOCs). (Left) The iterative procedure of DeepFix to fix multiple programming errors. (Right) The performance of DeepFix in fixing erroneous programmes written by students during 93 different programming assignments in an introductory programming course.

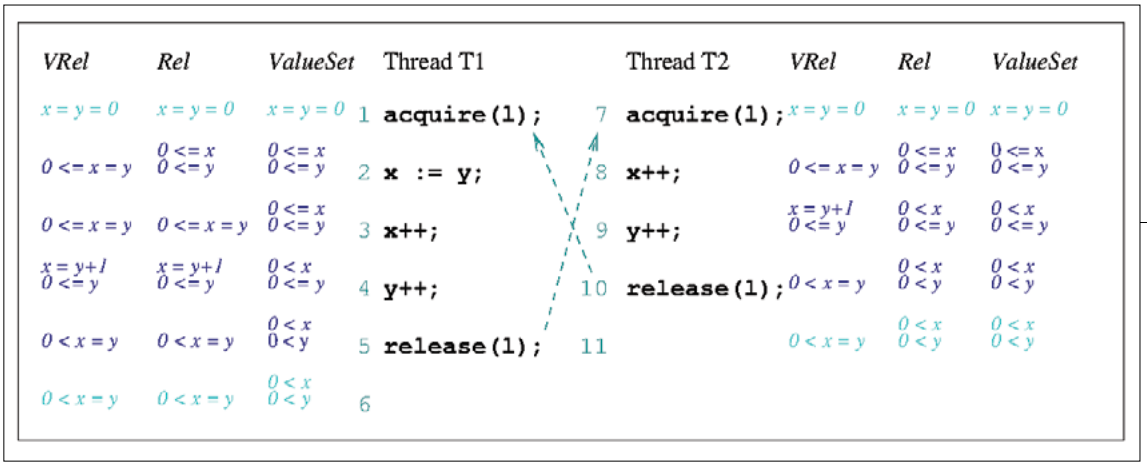
Reference: R Gupta, S Pal, A Kanade, SK Shevade (2017) DeepFix: Fixing Common C Language Errors by Deep Learning. *Proceedings of the Thirty-First AAAI Conference on Artificial Intelligence.* 1345-1351.

5. TV Prabhakar (DESE)

A hybrid ultra-low power embedded system has been prototyped for monitoring latches/hatches in an aeroplane. The system, with a guaranteed life of 10 years, can be configured to function in modes such as SECURITY CONFIG, ARM, DISARM and STATUS and is available via an android app. This is an energy harvesting system accompanied by a 250mAH coin cell battery.

Reference: TV Prabhakar, MB Madhuri, K Anup K and S Sudhir. Tamper Monitoring IoT Network, Internal report DESE - 2018.

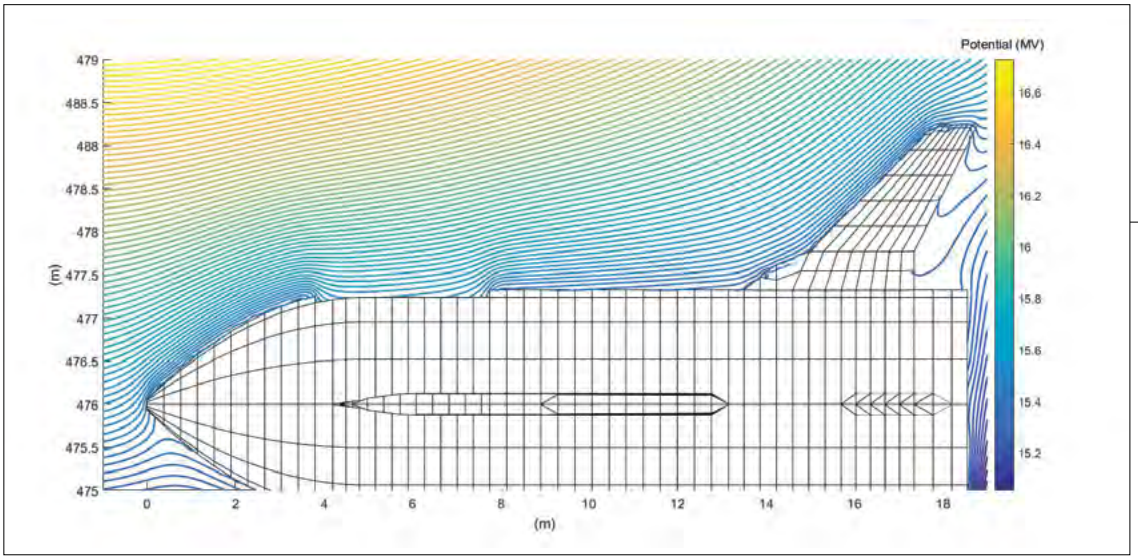
6. Deepak D'Souza (CSA)



Static analysis of concurrent programmes is challenging due to the many possible interleavings of programme threads. This work proposes a way of efficiently analyzing the class of data-race-free programmes, based on a thread-local semantics. The figure shows the control-flow structure of a programme with two threads, and the facts inferred about programme variables by three different analyses.

Reference: S Mukherjee, O Padon, S Shoham, D D'Souza and N Rinetzky (2017) A Thread-Local Semantics and Efficient Sequential Abstractions for Race-Free Programmes. *Proc. Static Analysis Symposium* 2017.

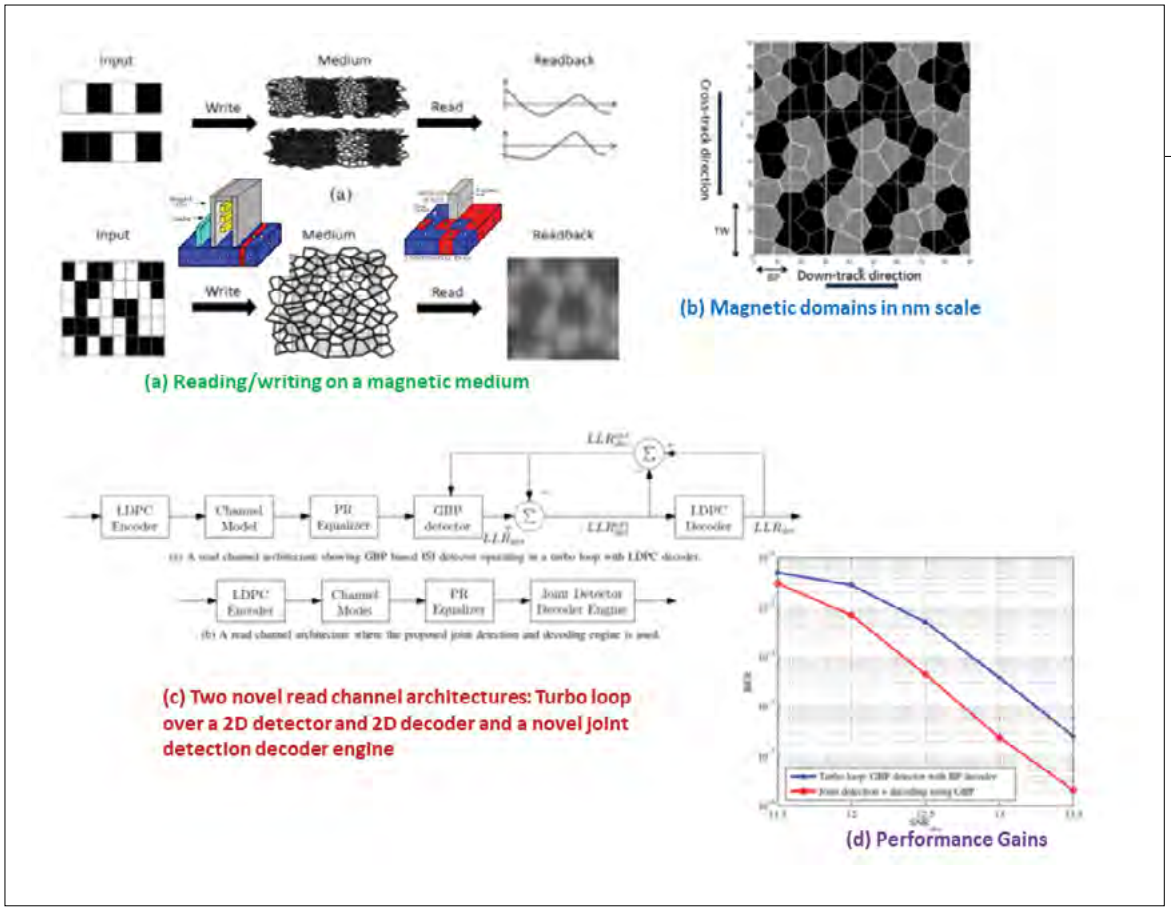
7. Udaya Kumar (EE)



A simulation of the electric potential around a standard dynamic model aircraft flying at 500 m altitude due to an approaching lightning leader.

Reference: U Kumar and V Coooray (2017) Limitations of RSM in Zoning of Aircrafts, *10th Asia-Pacific International Lightning Conference 2017,* Thailand.

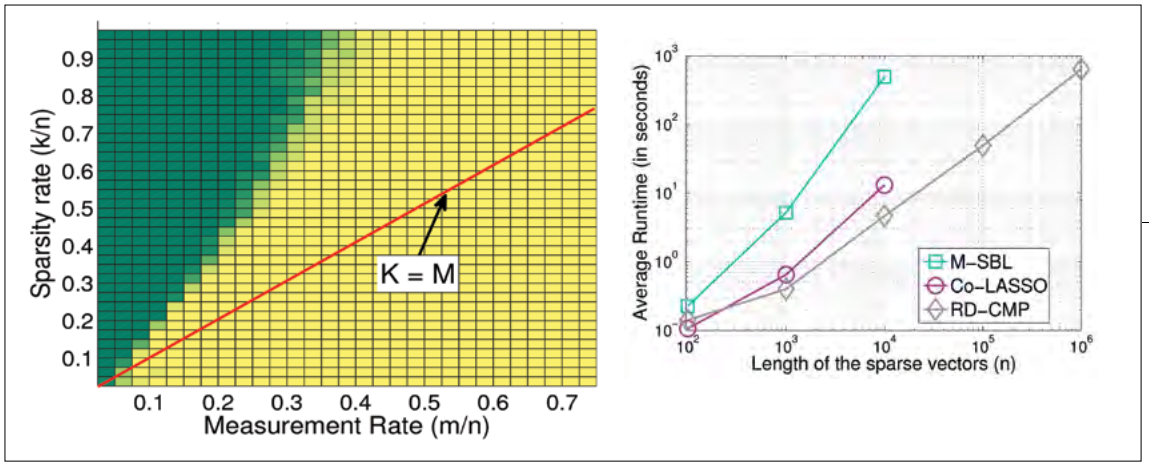
8. Shayan Garani Srinivasa (DESE)



Two-dimensional magnetic recording is an emerging technology to boost areal densities in magnetic memories driven purely from a systems framework using powerful 2D signal processing and coding methods and can add additive areal density (AD) gains over bit patterned media (BPM) and energy assisted magnetic recording (EAMR). We have conceived a fully native 2D channel from first principles attuned to TDMR technology. This includes the 2D detection decoding engines within a turbo loop, as well as, a complex joint 2D detection decoder algorithm, which is the best channels architecture. Using these channels technology, areal densities can be more than doubled.

Reference: CK Matcha, S Roy, M Bahrami, B Vasic, and SG Srinivasa (2018) 2D LDPC Codes and Joint Detection and Decoding for Two-Dimensional Magnetic Recording. *IEEE. Trans. Magn.* 54 (2): 3100111

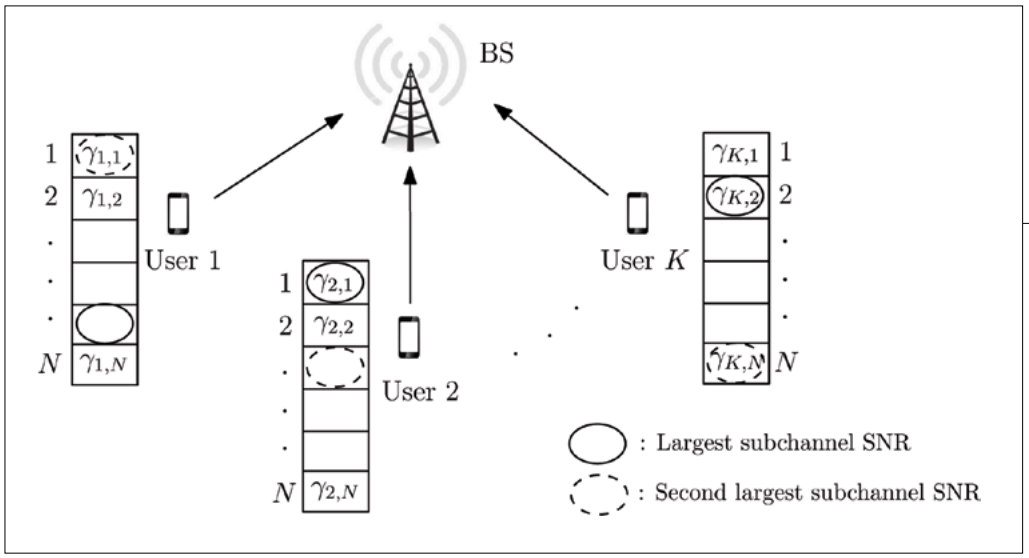
9. Chandraramabhadra Murthy (ECE)



The study proposes an algorithm for recovering jointly sparse vectors from noisy underdetermined linear measurements. Left: it can recover supports of size larger than the number of measurements per vector (yellow: success, green: failure); Right: it is the fastest solver available.

Reference: S Khanna and CR Murthy (2017) Rényi Divergence Based Covariance Matching Pursuit of Joint Sparse Support. *Proceedings of IEEE 18th International Workshop on Signal Processing Advances in Wireless Communications,* July 2017.

10. Neelesh Mehta (ECE)



A new throughput-optimal policy developed for contemporary cellular wireless communication systems. It enables a base station to perform spectrally-efficient user scheduling and rate adaptation with very limited information about the channels it is transmitting on. The figure illustrates the best-m limited feedback scheme that is employed by the 4G Long Term Evolution (LTE) standard for which the policy was developed.

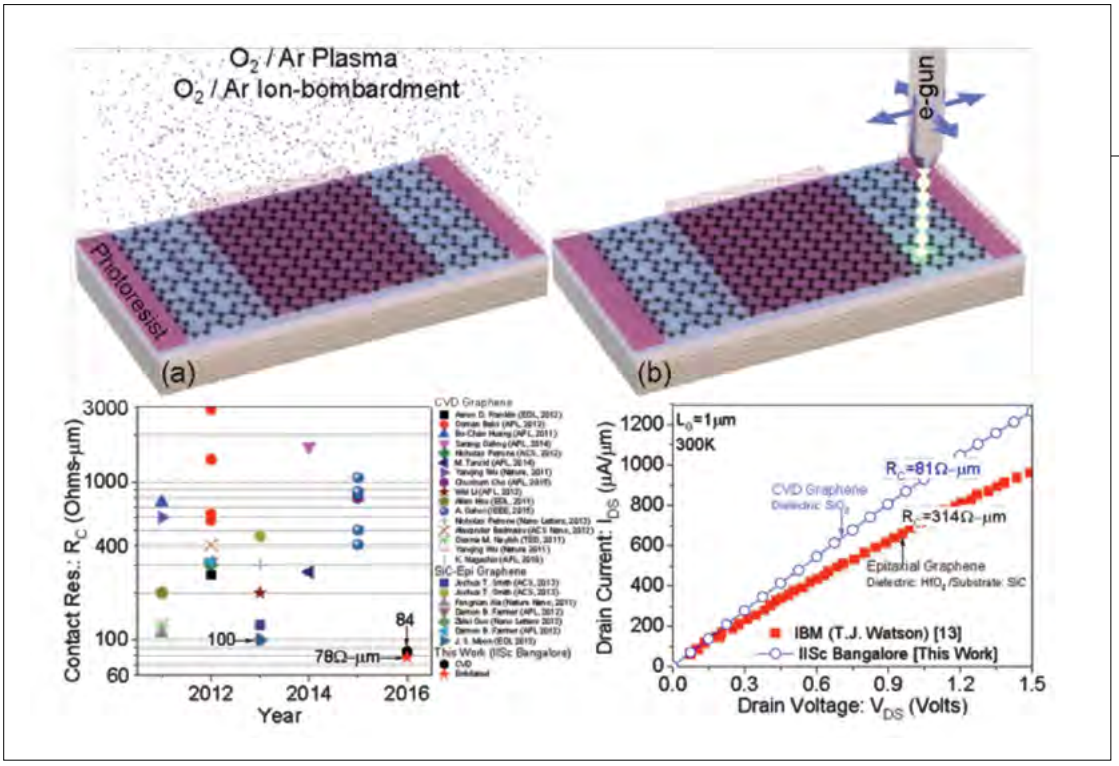
Reference: J Francis and NB Mehta (2017) Throughput-Optimal Scheduling and Rate Adaptation for Reduced Feedback Best-M Scheme in OFDM Systems. I*EEE Trans. Communications,* 65 (7):3053–3065.

11. Prasanta Kumar Ghosh (EE)

Electromagnetic articulograph (EMA) uses sensors to measure the motion of speech articulators namely, tongue, jaw, lips in synchrony with the microphone-based speech recording. Placement of EMA sensors (shown in close-view) is critical for recording good quality speech articulation, which, in turn, helps in providing articulatory feedback in several applications including pronunciation evaluation and clinical applications related to speaking disorders.

Reference: PA Kumar, A Illa, A Afshan and PK Ghosh (2018) Optimal sensor placement in electromagnetic articulography recording for speech production study. *Computer Speech & Language* 47(2018): 157-174.

12. Mayank Shrivastava (DESE)



In a significant breakthrough in our in our understanding of the quantum nature of graphene's interface with outside world, the authors of the paper studied how the overlap of atomic orbitals between carbon and metal atoms affects the graphene-metal interface. The study has enabled them to invent novel techniques to engineer graphene contact that has the lowest recorded resistance to the external world. Their discovery and subsequent invention, while breaking several records – including the one from IBM's research centre in T. J. Watson, USA – has helped achieve the highest transistor performance. This work was showcased at International Electron Device Meeting (IEDM, Dec. 2016), the world's most competitive platform in the field of electron devices, which mostly showcases technology and fundamental breakthroughs in the field.

References:

1. A Meersha, HB Variar, K Bharadwaj, A Mishra, S Raghavan, N Bhat and M Shrivastava (2016) Record Low Metal – (CVD) Graphene Contact Resistance Using Atomic Orbital Overlap Engineering. *Proceedings of IEEE International Electron Device Meeting,* December, USA, 2016.

2. A Mishra, A Meersha, S Raghavan and M Shrivastava (2018) Observing Non-equilibrium State of Transport through Graphene Channel at the Nano-Second Time Scale. *Applied Physics Letters,* 111 (26): 263101-6. DOI: 10.1063/1.5006258.

3.3.1 COMPUTER SCIENCE AND AUTOMATION

Research activities of the Department of Computer Science and Automation (CSA) can be classified broadly into three streams: Theoretical Computer Science; Computer Systems and Software; and Intelligent Systems.

Core Research

Theoretical Computer Science: Algorithms and Complexity Theory, Combinatorial and Computational Geometry, Cryptography, Distributed Computing, Game Theory, and Graph Theory

Computer Systems and Software: Programming languages, Software engineering, High-performance computing, Compilers, Computer architecture, Operating Systems, Databases, Systems Security, Scientific Visualization

Intelligent Systems: Machine Learning, Reinforcement Learning, Game Theory and Mechanism Design, Stochastic Optimization and Control Algorithms, Computational Biology, Data Analytics in Computer Systems

Current Research

(A) THEORETICAL COMPUTER SCIENCE: In the area of algorithms, we have developed approximation algorithms for graph partitioning, and, for pseudorandom colourings of random graphs. We have proposed efficient algorithms and hardness results for finding hidden sparse structures in data. We have also discovered an efficient game-theoretic algorithm for approximately fair division for submodular valuations. In the area of geometric algorithms, we have devised efficient algorithms for computing contour trees for piece-wise polynomial scalar data, for computing compact representations of Voronoi diagrams, and for geometric packing and covering problems.

In the area of graphs, we have proved a generalized version of the Lovasz-Gyori Theorem, which was then used to provide an improved upper bound for the spanning tree congestion problem. We also showed a circular separation dimension of at most two for an important class of planar and series-parallel graphs.

In the area of codes and cryptography, we have designed and studied constant-rate non-malleable codes. We have proposed cryptographic bilinear maps and cryptographic protocols based on these maps. Finally, in the area of secure multi-party computation, we have constructed a size-zero garbled circuit, breaking a long-standing lower bound.

(B) COMPUTER SYSTEMS AND SOFTWARE: Research in Computer Systems and Software has been in areas including programming languages, compilers, high-performance computing, computer architecture, operating systems, databases, and scientific visualization.

Databases
In the area of databases, new techniques were developed for robust declarative query processing, which are capable of providing worst-case performance guarantees that are linear in the dimensionality of the selectivity error space, representing a significant improvement compared to the quadratic dependency of prior art.

Compilers, High-Performance Computing, and Architecture
New domain-specific compiler optimization techniques were developed to deliver high parallel performance for the domains of image processing pipelines, geometric multigrid for solving PDEs, and dense linear algebra computations. A new domain specific language, FALCON, for implementing Graph based applications on GPUs and multi-core CPUs has been designed and implemented. Novel and scalable techniques were proposed for precise estimation of worst case execution time estimation of concurrent programs. Work was carried out on developing a shared last-level stacked DRAM cache organization and associated optimizations for heterogeneous CPU/GPU on-die multicore architectures. A study was also performed to characterize the behaviour of GPGPU programs.

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Degree Programs offered **PhD and Int PhD**

IN NUMBERS

28 Academic Staff
72 PhD students
32 MTech (Res)
97 MTech
117 Publications
11 MSc (Engg)
19 PhD Conferments

Chairperson: **SHALABH BHATNAGAR**

Program Analysis and Software Engineering
Research was carried out on (a) deadlock detection for asynchronous C# programs, (b) using deep learning techniques for software engineering, and (c) precise end-to-end verification of functional properties for web applications.

Operating Systems and Networks
In operating systems, techniques were developed to improve the effectiveness of memory allocation affected by aspects such as RCupd, huge pages, and virtual machines. A TDMA-based reliable multicast MAC protocol was developed for wireless sensor networks with flexibility to trade-off between latency and reliability, and weighted average-based improved clock synchronization protocols for wireless sensor networks.

Visualization
Fast algorithms were developed for computing a topological structure called the contour tree for scalar data represented as piecewise polynomial functions.

(C) INTELLIGENT SYSTEMS: During 2017, the major research focus of the faculty members has been in the areas of Reinforcement Learning, Social Networks, Blockchain Design, Mechanism Design, Deep Learning, and some interdisciplinary areas like Computational Neuroscience and Autonomous Navigation.

Novel reinforcement learning algorithms that compute globally optimal policies under certain conditions were proposed and the first convergence proofs of these algorithms were provided. The first set of sufficient conditions for stability and convergence of stochastic approximations was provided. Online algorithms that provide robust performance in the presence of strategic agents were developed with application to crowdsourcing and Internet advertising. Work on game theoretic analysis and mechanism design for blockchain based systems was initiated. A team of faculty members also initiated an interdisciplinary project on autonomous navigation of Drones.

An axiomatic framework for centrality in social networks was studied and a semi-supervised classification algorithm for entities in social networks was proposed. Deep learning algorithms for unsupervised learning and one-shot learning were proposed. Consistency of spectral uniform hypergraph partitioning with sampling was established. A new approach for mapping distinct timescales of functional interactions in brain networks was developed.

Faculty & Staff

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DEEPAK D'SOUZA | PhD (CMI), Associate Professor

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K GOPINATH | PhD (Stanford), Professor

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RC HANSDAH | PhD (IISc), Professor

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ANAND LOUIS | PhD (Georgia Institute of Technology), Assistant Professor

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KV RAGHAVAN | PhD (Wisconsin), Associate Professor

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SHIRISH K SHEVADE | PhD (IISc), Associate Professor

YN SRIKANT | PhD (IISc), Professor

MATTHEW JACOB THAZHUTHAVEETIL | PhD (Wisconsin), Professor

B UDAY KUMAR REDDY | PhD (Ohio State), Associate Professor

INSA Senior Scientist

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Adjunct Faculty

RAMESH HARIHARAN | PhD (Courant), FASc, FNAE, Adjunct Professor

RAVI KANNAN | PhD (Cornell), FACM, Adjunct Professor

3.3.2 ELECTRICAL COMMUNICATION ENGINEERING

Current Research

(A) COMMUNICATION, NETWORKING, AND INFORMATION THEORY: In 4G networks, the base stations have to be switched off during lean periods for energy efficiency. A well-known algorithm called max-weight algorithm has been augmented with explicit learning for wireless scheduling in a setting where base stations have switching costs. Reduced state scheduling in wireless networks was explored with application to the design of distributed, high performance medium access control. Algorithms have been proposed for deploying IEEE 802.15.4 multi-hop wireless networks, with IoT applications. Formal Specification and Description Language to specify RESTful Web Services was used and the performance was studied and tested. Work on various 5G topics have commenced, such as device-to-device communications, full-duplex radios, and milli-meter wave communication systems. A new MIMO modulation scheme, termed as media-based modulation (MBM), has been investigated. Diversity results for full-duplex spatial modulation systems in feedback-assisted MIMO systems and antenna selection for error-prone feedback systems have been developed.

Index coding for noisy broadcast channels has been studied. In particular, index coded PSK modulation for prioritized receivers and characterizing the number of optimal Index codes and their relation to error performance have been studied. A fundamental exploration of the trade-offs between public discussion rates and secret-key generation rates in the multiterminal source model has been studied. It is shown that the secret key capacity at zero rate of public discussion equals the Gacs-Korner common information in some important special cases of the multiterminal source model. It has been demonstrated that a certain computational barrier, known to exist for single small-sized community detection problems, disappears when side information (in the form of cues) is available to the analyst. A decision-theoretic basis and a quantitative explanation have been provided for why search times by human subjects to detect an oddball target are inversely correlated with the L1 distance between firing rate vectors elicited by the associated images on macaque brains.

Core Research

Information Theory, Communications, Communication Networking, Signal processing, Photonics, Electromagnetics, Nanoelectronic Devices and VLSI

(B) SIGNAL PROCESSING, INTERNET OF THINGS, AND CYBER PHYSICAL SYSTEMS: Several image and video processing topics have been explored, including low light image enhancement, quality assessment of image stitching algorithms, and user experience models for rate adaption in video streaming. Fast k-space sampling techniques for Magnetic Resonance Imaging have been developed using compressed sensing and optimization tools reducing the scan time. New algorithms for distributed sparse signal recovery were developed, when compressive measurements of sparse vectors with a common support are available at the nodes. Online algorithms were also proposed for the recovery of sparse vectors under the multiple measurement vector model.

An open source middleware was developed to enable IoT data exchange and edge analytics. The middleware is currently getting deployed in a smart city test bed in Electronics City. A key feature of the system is the ability to handle video and video analytics, along with other sensory data. The usefulness of feedback in reducing electricity consumption during a field trial in Aluva covering 20,000 households has been demonstrated. It suggested methods to reduce consumption, captured usage trends, and provided comparisons with neighbours.

(C) RF, MICROWAVE, PHOTONICS, AND MICROELECTRONICS: Various components for fully integrated radar-on-chip systems are being developed as part of the on-going indigenous translational research. An all pass filter network-based scheme is developed and tested for potential applications in wideband radar with a low probability of interception. Research on wideband antennas was extended for designing FMCW radar operating at frequencies below 5 GHz with 300 MHz bandwidth. Work on various aspects of computational electromagnetics applicable to high speed circuit design and radio-frequency Imaging has been carried out. Research work is initiated on EMI/EMC pre-compliance simulation methodologies. A novel configuration of integrated optic photonic switch matrix is proposed and analysed to implement quantum information functions.

A novel asymmetrically encapsulated ITO/MoS2/Cu2O vertical heterojunction photodetector was designed and experimentally demonstrated, achieving record high specific detectivity at a given input light power (3.2x1014 Jones @ 0.26 Wm-2) and with a capability of zero external bias operation. Also, an ultra-low operating voltage SnSe2 photodetector was demonstrated with very high responsivity. An unambiguous and novel experimental technique was devised to explain the paradox of negligible photoluminescence peak shift in two-dimensional systems embedded in different dielectric media by introducing energy state dependent varying compensation of excitonic binding energy changes and quasi-particle bandgap renormalization.

FACT FILE

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Degree Programs offered

PhD, MSc (Engg),

ME (Communication & Networks),

ME (Signal Processing) jointly with EE,

ME (Microelectronics) jointly with ESE

IN NUMBERS

22 Academic Staff

5 Scientific Staff

129 PhD students

1 MTech (Res)

9 MTech (Res)

50 MTech (D)

18 MSc (Engg)

2 ME

131 Publications

33 MSc Conferments

17 PhD Conferments

Chairperson: A CHOCKALINGAM

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PARIMAL PARAG | PhD (Texas A&M), Assistant Professor

K ELIZABETH RANI | BTech (JNTU), Technical Officer

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NAVAKANTA BHAT | PhD (Stanford), Professor

AMBARISH GHOSH | PhD (Brown), Associate Professor

MANOJ VARMA | Phd (Purdue), Associate Professor

Honorary Professor

P VENKATARAM | PhD (Sheffield), FIEE, Honorary Professor

Adjunct Faculty

KUMAR SIVARAJAN | PhD(CalTech) | FNAE, Adjunct Professor

3.3.3 ELECTRICAL ENGINEERING

Current Research

(A) POWER SYSTEMS: Hardware implementation of an adaptive relay needed in microgrid was completed. An algorithm was proposed using zbus Matrix for calculating the fault current in microgrid in an adaptive condition. Small signal testing of proposed relay was done using LabVIEW-dac interface and tested the function like synchronisation, over-current situation, reverse power, etc.

(B) POWER ELECTRONICS: There has been significant research conducted on various components of an AC microgrid such as: 1) Single phase to three phase power conversion using a novel auxiliary capacitor topology that leads to a 53% reduction in the converter VA ratings and a 40% reduction in power loss. 2) Advanced algorithms have been developed for identifying the global maximum power point for photovoltaic power conversion systems. 3) New system topology for a dual mode solar inverter based on a new virtual battery emulation method using a photovoltaic power converter. 4) Audio susceptibility analysis for a series resonant converter performed for the first time. This analysis results in series resonant converters that can be designed with superior performance. The results are verified on a 10kV, 10kW series resonant power converter.

Novel pulse width modulation (PWM) methods have been proposed and evaluated for split-phase induction motor drives. PWM schemes have also been developed to reduce pulsating torque and current distortion in switching-frequency-constrained high-power and high-speed induction motor drives. Analysis of capacitor current stress in neutral-point-clamped multilevel converters has been carried out. Light-load instability in induction motor drives

Core Research

The area of Power Engineering includes Power Systems, Power Electronics and High Voltage Engineering. The area of Systems and Signal Processing includes Signal Processing, Embedded Systems, Sensor Networks, Real Time Systems, Speech Processing, Audio Processing, Image and Video Processing, Computer Vision, Multimedia, Machine Learning, Pattern Recognition, Networked control systems, Networked transportation (Smart transportation), Cyber physical systems, and Auditory Neuroscience

due to inverter dead time has been analysed. A novel switched reluctance machine in collaboration with mechanical engineering and interdisciplinary centre for energy research has been designed and developed. Indigenous fabrication of gallium nitride based transistors for power electronic applications through collaborative efforts of CeNSE, EE and DESE faculty members has been underway. New project on Design, Development and Control of High-Speed Switched Reluctance Generator for Thermal Turbomachinery, through an IMPRINT grant from the Govt of India, of 395.04 lakhs has been under progress. Planned future research in power electronics includes PWM methods for high-speed switched reluctance machine, control methods for switched reluctance motors and generators, control methods for double fed induction machines in wind energy generation systems, switching characterization of power semiconductor devices.

(C) HIGH VOLTAGE ENGINEERING: A simple analytical method devised for indirect measurement of air-cored inductance of an iron-cored transformer winding using frequency response data. Oxides of nitrogen present in biodiesel exhaust were cleaned, utilizing the waste associated with marine industry and fossil fuel based thermal power plant. The oyster shells waste thrown across the coastal regions were tested successfully for their NOx adsorption when the exhaust was pre-treated with electrical discharge plasma. Similarly, lignite ash waste from lignite coal was proved to be a better alternative for commercial NOx adsorbents while treating an exhaust coming through a electric plasma curtain.

Limitations of the classical method, which is suggested in the relevant standards, for the assessment of lightning attachment to aircraft have been identified and quantified. The propagation characteristics of the nanosecond pulses in the helical winding have been investigated.

(D) SYSTEM SCIENCE AND SIGNAL PROCESSING: Distributed control of automated vehicles in the context of traffic management has been developed and an efficient control over networks under packet drops has been achieved. The research work on cross-modal retrieval, surveillance applications and NIR-VIS image matching is in progress. Identifying the spoken language and speaker from speech content using background model based approach has been investigated. Modulation transfer functions and filters which suppress the noise in audio signals is determined. Mapping the brain states in learning a new language using Electroencephalogram (EEG) signals has been studied. Deep learning based super resolution of document and natural images has led to better recognition accuracy and PSNR. Suppression of speaker information in the development of a DNN-based automated speech recognition system for Tamil was done. A Hindi online handwriting recognition system was developed.

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Degree Programs offered

PhD, MTech (Research), MTech (Electrical Engineering), MTech (Systems Science & Automation) jointly with CSA, MTech (Signal processing) jointly with ECE

IN NUMBERS

20 Academic Staff

4 Scientific Staff and **1** Technical Staff

8 MSc (Engg), **46** ME and **10** PhD Conferments

78 PhD students

1 MSc (Engg)

46 ME

13 MTech (Res)

70 MTech

111 Publications

Chairperson: A G RAMAKRISHNAN

Faculty & Staff

MUTHUVEL ARIGOVINDAN | PhD (EPFL), Assistant Professor

KAUSHIK BASU | PhD (Minnesota), Assistant Professor

SOMA BISWAS | PhD (Maryland), Assistant Professor

MK CHAMPAKA | MSc (Engg) (IISc), Scientific Officer

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VENU MADHAV GOVINDU | PhD (Maryland), Associate Professor

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BS RAJANIKANTH | PhD (IISc), Professor

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M JOY THOMAS | PhD (IISc), Assistant Professor

Associate Faculty

SUPRATIM RAY | PhD (Johns Hopkins), Assistant Professor

3.3.4 ELECTRONIC SYSTEMS ENGINEERING

The department nurtures educational research with a theme: "Atom to System", which encompasses nano-electronics, communication networks, neuromorphic integrated circuits, Internet of Things, signal processing, diagnostic and healthcare devices and power electronic drives. It runs one of the most unique and successful M Tech programs in the country on Electronic Systems Engineering.

Current Research

In nano-electronics, we employed atomistic modelling techniques along with density functional theory and quantum transport model to understand carrier transport in parallel and vertical hetro-2D material interfaces. We also developed analytic solution of coupled Schrodinger-Poisson equation system for III-V materials which find application in compact models for high mobility transistors.

We considered the problem of distributed scheduling in wireless communication networks, in which heterogeneously delayed queue lengths and channel

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IN NUMBERS

10 Academic Staff
4 Scientific Staff
68 PhD students
2 MSc (Engg)
46 ME
1 MTech (Res)
9 MTech (D)
61 MTech

64 Publications
30 MTech and
7 PhD Conferments

states of all links are available at all transmitters. We proposed a new distributed scheduling policy that fully exploits the most recent commonly available state information, thereby greatly improving upon the computational complexity and delay performance of state-of-the-art policies. Moreover, we were able to establish the throughput optimality of our policy analytically.

In power-electronics, the significant contribution was in generation of high resolution voltage space vector structures (6-side,12-side, 18-side) using single DC-source for Variable Frequency Drives. Such techniques allow to obtain nearly sinusoidal motor phase currents without the use of bulkier passive filters. We also developed grid interactive inverter with unified control architecture for seamless transition from grid follower operating mode to autonomous operating mode.

In embedded systems, we developed hardware accelerators for deep convolutional network (DCNN), which is based on designing a dynamically reconfigurable FPGA based hardware to do the training and classification. We also designed a RISC-V processor IP for System on Chip Applications, which supports Integer, Multiply, and Atomic instructions. We have initiated activities in design, fabrication, and characterization of micro-engineering devices (Bio-resorbable sensors), flexible sensors, microfluidic devices for cancer therapies (immunotherapy, chemotherapy).

In the area of neuromorphic IC design, we have started projects on Image recognition and reconstruction in the compressive sensing domain and audio-visual saliency fusion for defence application.

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Core Research

The core research areas pursued in the department include: Nanoelectronics and power semiconductor devices; Signal and quantum information processing; Communication Networks; Internet of Things and Embedded Systems; Very Large Scale Integration; Neuromorphic Engineering; Power electronics Drives; Energy Harvesting; Mechatronics; Microengineering of diagnostic devices

3.4 DIVISION OF INTERDISCIPLINARY RESEARCH

Interdisciplinarity is the characteristic feature of the research carried out in this Division. Specific research areas include Bioengineering, Urban infrastructure and transportation, Nanoscale materials, Nano devices and systems, Economics, Finance, Human resource management, Marketing, Optimization, Public policy, Energy, Water, Internet of things, Distributed sensing, Computer systems, Computational science, Data sciences and bioinformatics.

Themes

Interdisciplinary research has emerged as a crucial part of the research landscape in recent years. By breaking down departmental barriers, interdisciplinary research facilitates novel breakthroughs that may not be possible within the confines of a particular discipline. The Division of Interdisciplinary Research has a wide range of Departments/Centres with the common theme of a strong interdisciplinary focus.

Research Highlights

The Division of Interdisciplinary Research consists of the Centre for BioSystems Science and Engineering, Centre for Contemporary Studies, Centre for Infrastructure, Sustainable Transportation and Urban Planning, Centre for Nano Science and Engineering, Department of Computational and Data Sciences, Department of Management Studies, Interdisciplinary Centre for Energy Research, Interdisciplinary Centre for Water Research, Robert Bosch Centre for Cyber Physical Systems and Supercomputer Education & Research Centre

DEPARTMENTS | CENTRES | UNITS

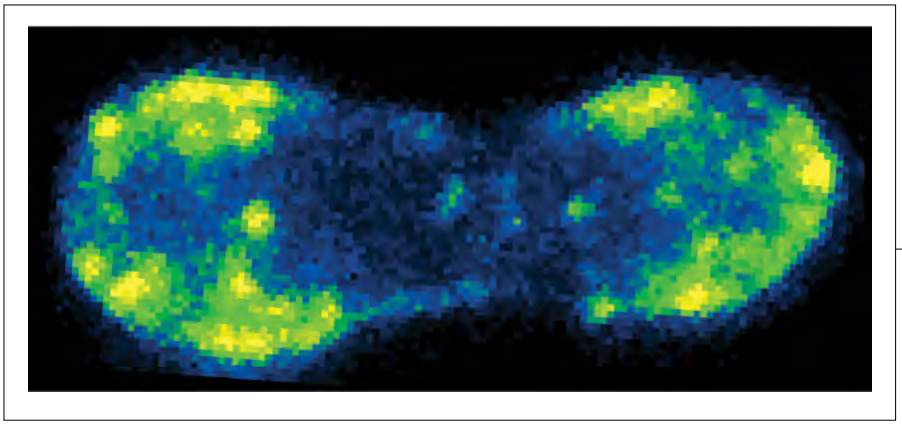
- CENTRE FOR BIOSYSTEMS SCIENCE AND ENGINEERING
- CENTRE FOR CONTEMPORARY STUDIES
- CENTRE FOR INFRASTRUCTURE, SUSTAINABLE TRANSPORTATION AND URBAN PLANNING
- CENTRE FOR NANO SCIENCE AND ENGINEERING
- COMPUTATIONAL AND DATA SCIENCES
- MANAGEMENT STUDIES
- INTERDISCIPLINARY CENTRE FOR ENERGY RESEARCH
- INTERDISCIPLINARY CENTRE FOR WATER RESEARCH
- ROBERT BOSCH CENTRE FOR CYBER PHYSICAL SYSTEMS
- SUPERCOMPUTER EDUCATION AND RESEARCH CENTRE

IN NUMBERS

- 37 FACULTY MEMBERS
- 264 PhD STUDENTS
- 117 MASTER'S STUDENTS

RESEARCH SNAPSHOTS 2017-18

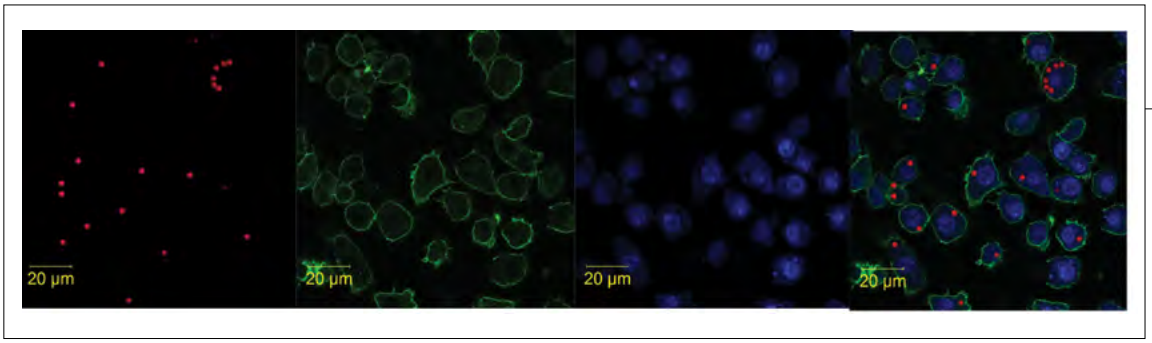
1. Vaishnavi Ananthanarayanan (BSSE)



In this study, by employing quantitative microscopy and image analysis, the researchers discovered that the actin-based myosin I motor regulates the activity of the microtubule-based cytoplasmic dynein in fission yeast. The image is that of fluorescent anchor protein clusters of cytoplasmic dynein on the cortex, visualized using confocal microscopy.

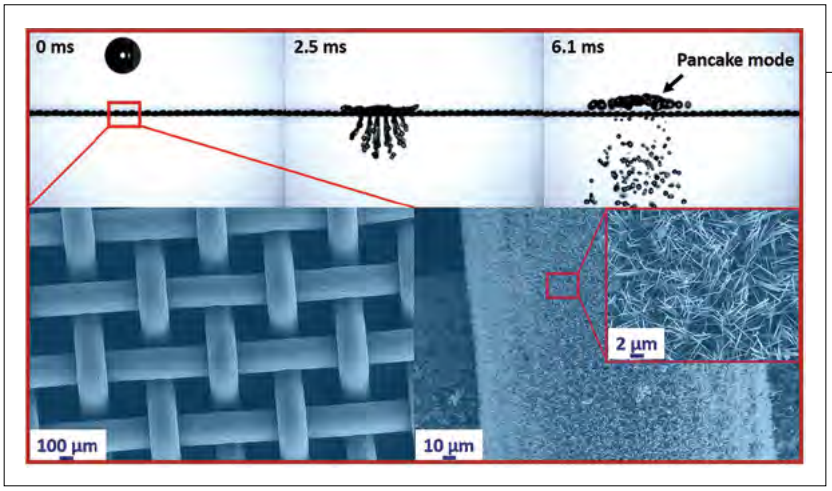
Reference: JM Thankachan, SS Nuthalapati, NA Tirumala, V Ananthanarayanan (2017) Fission Yeast Myosin I Facilitates PI(4,5)P2 –mediated Anchoring of Cytoplasmic Dynein to the Cortex. *Proc. Nat. Acad. Sci.* 114: E2672-E2681

2. Siddharth Jhunjhunwala (BSSE)



The image shows uptake of particles (red) by phagocytic immune cells (nuclei in blue and cytoskeleton in green). The researchers were interested in developing surface modifications that enhance or prevent interaction of nano/micro particles with immune cells.

Reference: P Sharma, V Gadiyar, V Neelakantan, V Shankar, S Jhunjhunwala (2018). Presented at Nanobioteck 2018 (submitted for peer review).

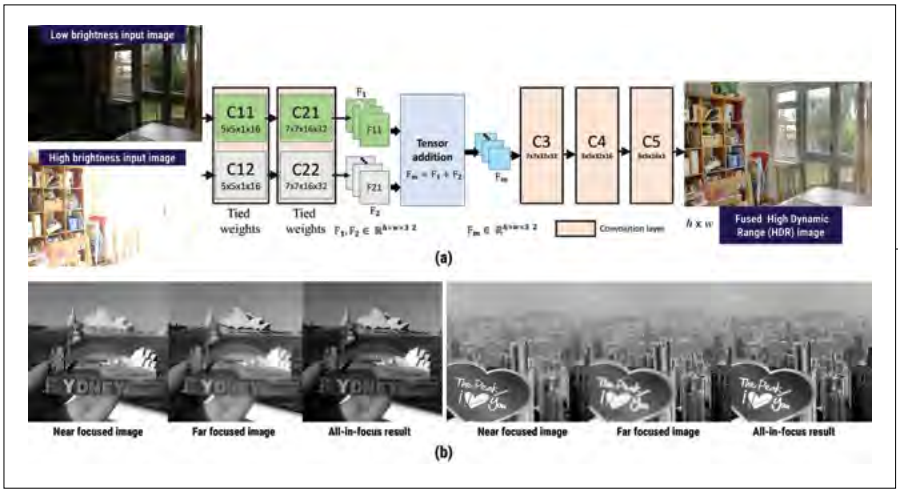


3. Prosenjit Sen (CeNSE)

Meshes are observed ubiquitously in several applications. Understanding the dynamics of droplet impact on such meshes with controlled surface wettability is of paramount importance for development of surfaces with enhanced functionality. The authors have studied the effect of various geometrical parameters on the rebound of the impacting droplets on superhydrophobic meshes.

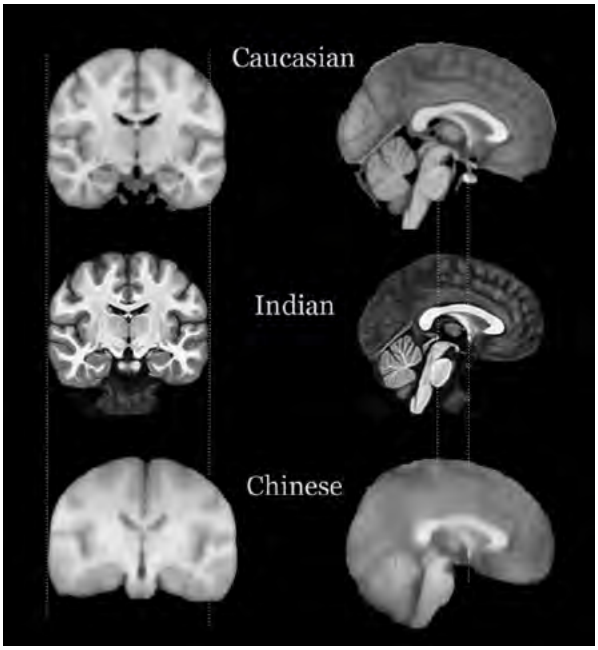
Reference: A Kumar, A Tripathy, Y Nam, C Lee and P Sen (2018) Effect of geometrical parameters on rebound of impacting droplets on leaky superhydrophobic meshes. *Soft Matter.* DOI: 10.1039/C7SM02145C

4. Venkatesh Babu (CDS)



This work proposes a deep learning framework for fusing extreme exposure (low and high) images to create a HDR image. This is the first data-driven approach for image fusion. The proposed fusion is generic in nature and could be easily adapted to other problems such as Multi-focus fusion. The proposed deep model is suitable for embedded devices such as mobile phones for creating high quality HDR photographs.

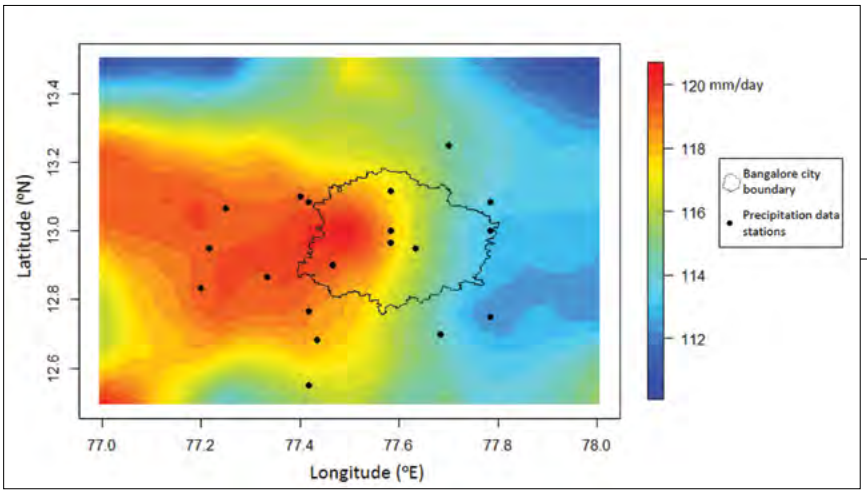
Reference: KR Prabhakar, VS Srikar, and RV Babu (2017) DeepFuse: A Deep Unsupervised Approach for Exposure Fusion with Extreme Exposure Image Pairs. *Proceedings of IEEE International Conference on Computer Vision* (ICCV), 4714-4722.



5. Phaneendra Yalavarthy (CDS)

Brain templates provide a standard anatomical platform for population based morphometric assessments, used in diagnosis of neurological disorders. Typically, standard brain templates for such assessments are created using Caucasian brains, which may not be ideal to analyse brains from other ethnicities. This study developed the first Indian brain template in collaboration with NIMHANS, Bangalore, which is currently being used in assessing Dementia, Schizophrenia, and Bipolar disorders.

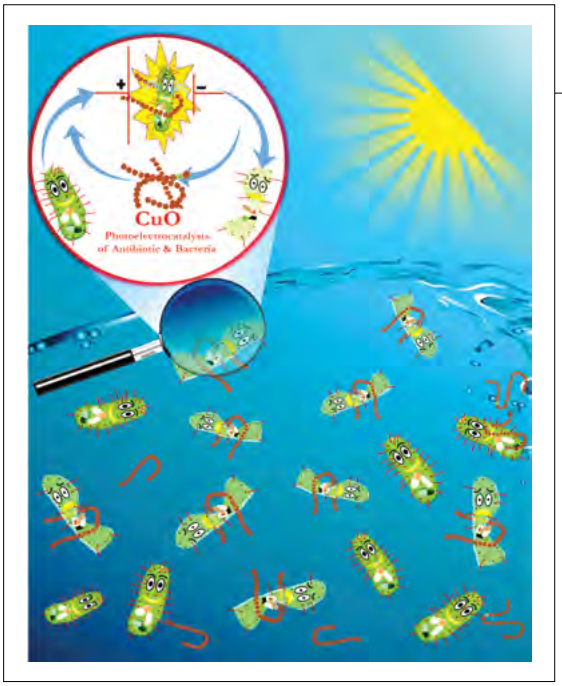
Reference: N Rao, H Jeelani, R Achalia, G Achalia, A Jacob, RD Bharath, S Varambally, G Venkatasubramanian, and PK Yalavarthy (2017) Population differences in Brain morphology: Need for population specific Brain template Psychiatry research. *Neuroimaging*. 265, 1-8.



6. P Mujumdar (ICWaR)

A general methodology has been developed, using the Bayesian Hierarchical Model for quantification of uncertainty in spatial distribution of urban precipitation extremes, to provide crucial input for urban flood risk assessment and modelling. The figure shows spatial map of precipitation intensity of a ten-year return period in and around Bangalore city.

Reference: RC Rupa and PP Mujumdar (2018) Quantification of Uncertainty in Spatial Return Levels of Urban Precipitation Extremes. *ASCE Journal of Hydrologic Engineering.* 23(1): 04017053.

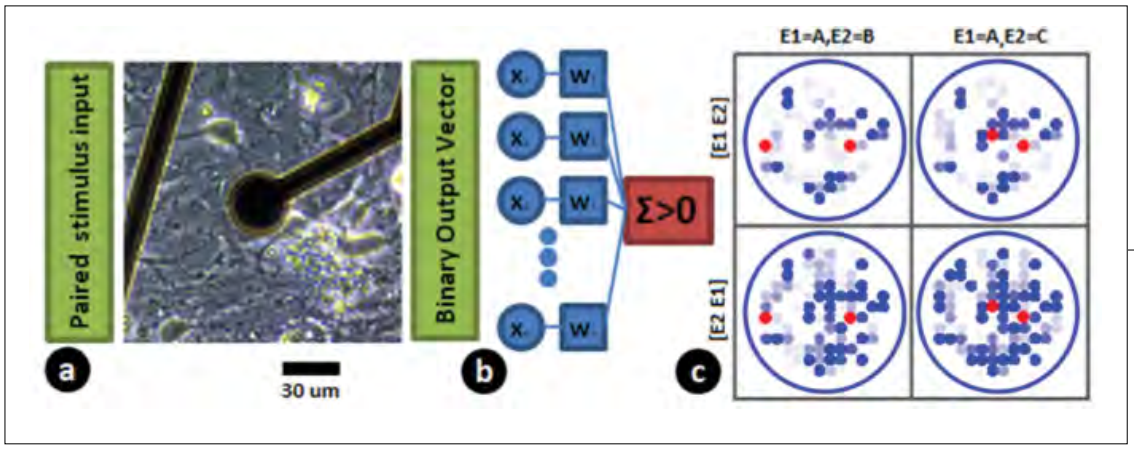


7. Giridhar Madras (ICER)

This image depicts the fate of antibiotic and bacteria in the contaminated water during photoelectrocatalysis process using solution combustion synthesized copper oxide.
A new material (network structured copper oxide) was synthesized which on the application of light and potential inactivates the bacteria and degrades the antibiotic simultaneously. This prevents the bacteria from becoming drug resistant.

Reference: NKR Eswar, SA Singh and G Madras (2018) Photoconductive network structured copper oxide for simultaneous photoelectrocatalytic degradation of antibiotic (tetracycline) and bacteria *(E. coli), Chemical Engineering Journal,* 332: 757-774.

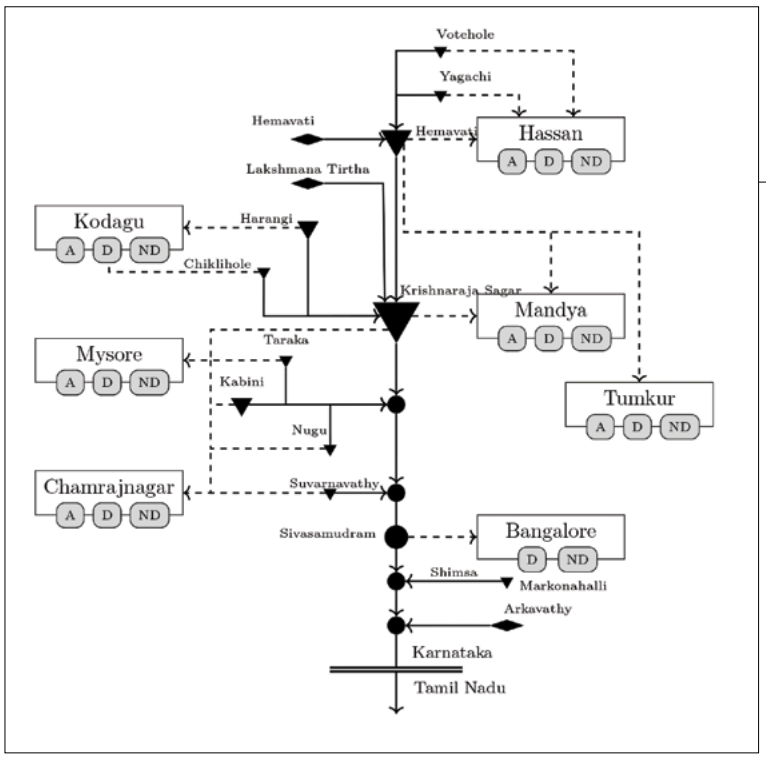
8. Bharadwaj Amrutur (RBCCPS)



The study investigates how neuronal cultures grown in-vitro can be used for computation in hybrid neuro-electronics systems. Figure shows the architecture of a proposed system consisting of the culture paired with a perceptron decoding layer to achieve classification of four types of input stimuli.

Reference: JB George, G Abraham, Z Rashid, B Amrutur, and S Sikdar (2018) Random neuronal ensembles can inherently do context dependent coarse conjunctive encoding of input stimulus without any specific training. *Nature Scientific Reports.* 8:1403. DOI:10.1038/s41598-018-19462-3)

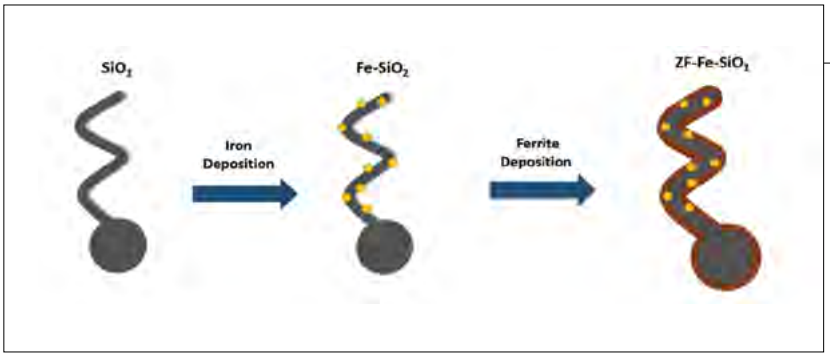
9. Parthasarathy Ramachandran (MGMT)



The study attempted to understand the optimal water allocation in a river basin among competing users with basic water right for consumptive use. The image is a node network diagram of the study area: Upper Cauvery river basin.

Reference: SS Patel and P Ramachandran (2018) An Optimization Model and Policy Analysis of Water Allocation for a River Basin. *Sustainable Water Resource Management* (In Press) DOI: 10.1007/s40899-017-0124-5.

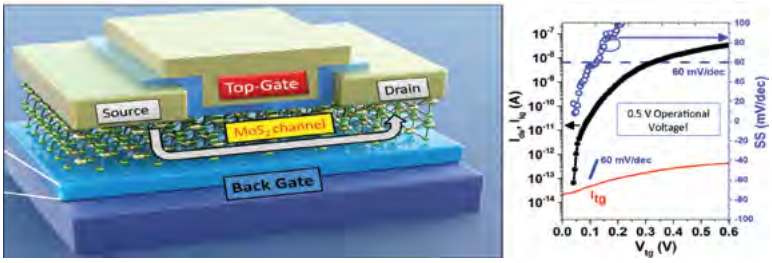
10. SA Shivashankar (CeNSE)



Magnetic nanomotors can be manuevered using small magnetic fields, which is useful for therapeutic purposes. In this paper, magnetic nanomotors were coated with a ferrite layer making them capable of killing cancer cells by increasing the temperature, and also preventing their agglomeration.

Reference: Venugopalan PL, Jain S, Shivashankar SA, and Ghosh A (2018). "Single coating of zinc ferrite renders magnetic nanomotors therapeutic and stable against agglomeration", *Nanoscale,* 10, 2327-2332).

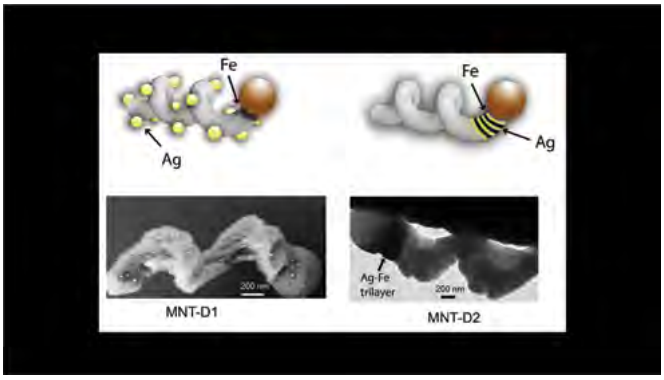
11. Navakanta Bhat (CeNSE)



Traditionally, although a transistor can be made smaller, the voltage required to operate it cannot be reduced. Researchers have experimentally demonstrated a novel nanotransistor that reduces power consumption in modern electronic devices, replacing traditional semiconductors and offering high performance low power computing for transistors operating in the sub-0.5V regime.

Reference: Bhattacharjee S, Ganapathi KL, Mohan S, and Bhat N (2017). "A sub-thermionic MoS2 FET with tunable transport," *Applied Physics Letters*, 111(16): 163501.

12. Ambarish Ghosh (CeNSE)



Mobile nanotweezers' (MNTs) combine plasmonic tweezers with magnetically driven helical micro robots, so that objects as small as 100 nm can be captured, transported and released with high speed and efficiency. These MNTS can be used in biomedicine, quantum technologies, sensor devices and more

Reference: Ghosh S and Ghosh A. "Mobile nanotweezers for active colloidal manipulation (2018) *Science Robotics*, 3(14):eaaq0076.

3.4.1 CENTRE FOR BIOSYSTEMS SCIENCE AND ENGINEERING

The Centre for Bio Systems Science and Engineering was founded as an academic department in June 2015, to facilitate interdisciplinary research in bioengineering. Its five-year old PhD programme currently has 38 PhD students advised by more than 40 faculty members from 18 departments. The Centre has 3 primary and 38 associate faculty.

Current Research

(A) DEVELOPING FUNCTIONAL BIOMATERIALS

The aim of this work is to fabricate biomaterials that may be controlled through external energy sources.

Applications of such work lie in the area of drug delivery and developing micro-robots for disease diagnosis and surgery. Manipulating motor proteins: The principal focus is to study the cytoskeletal

Core Research

BSSE's research areas include biomaterials, biomechanics, bionetworks. biosensors, computational bioengineering, drug-delivery, immuno-engineering, motor proteins, neuro-engineering, and systems biology. Development of biomedical devices and theme-based research on diabetes are also initiated in BSSE

structures of a cell. Specifically, ongoing work focuses on imaging a variety of cytoskeletal proteins to characterize their role in the regular cellular processes.

(B) DEVELOPING FUNCTIONAL BIOMATERIALS

The aim of this work is to fabricate biomaterials that may be controlled through external energy sources. Applications of such work lie in the area of drug delivery and developing micro-robots for disease diagnosis and surgery.

(C) MANIPULATING MOTOR PROTEINS

The principal focus is to study the cytoskeletal structures of a cell. Specifically, on-going work focuses on imaging a variety of cytoskeletal proteins to characterize their role in the regular cellular processes.

(D) MODULATING IMMUNITY USING ENGINEERING TOOLS

Research in this area is directed towards the development of drug delivery systems and biomedical implants that have the capacity to modulate inflammatory immune responses with the ultimate goal of treating specific diseases.

(E) CYBERGUT

An interdisciplinary team of five faculty members from diverse backgrounds initiated a project entitled "CyberGut" to investigate gut biology using gut-on-a-chip technology, active scaffolds, in situ force-sensing, cell signalling, machine learning, and bionetwork analysis. This project is funded by the Robert Bosch Centre for Cyber Physical Systems at IISc.

Other topics of research of BSSE PhD students include pore-forming toxins, mechanobiology of HCV-infected hepatocytes, motor-learning, control issues in saccadic eye-movements, biomaterial scaffolds in cancer biology, motion analysis of dynein motor proteins, shock waves in biology, biodegradable bio-nano composites, nanoparticles of targeting pathogens, application of nuclear magnetic resonance and Raman spectroscopy in biology, dynamics of two-component signalling systems, membranes for water-filtration, microfluidics, etc.

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3 Academic Staff
29 PhD students
5 Publications

Chairperson: **G K ANANTHASURESH**

Faculty & Staff

RACHIT AGARWAL | PhD (Texas), Assistant Professor

VAISHNAVI ANANTHANARAYANAN | PhD (Max Planck Institute, Dresden), Assistant Professor

SIDDHARTH JHUNJHUNWALA | PhD (Pittsburgh), Assistant Professor

Associate Faculty

GK ANANTHASURESH | PhD (Michigan), ProfessorGanapathy Ayappa | PhD (Minnesota), Professor

BIKRAMJIT BASU | PhD (Katholieke), Professor

DIPSHIKHA CHAKRAVORTTY | PhD (NCCS), Professor

NAGASUMA CHANDRA | PhD (Bristol), Professor

KAUSHIK CHATTERJEE | PhD (Penn State), Assistant Professor

SAUMITRA DAS | PhD (Kolkata), Professor

NARENDRA DIXIT | PhD (Illinois), Associate Professor

NAMRATA GUNDIAH | PhD (Berkeley), Associate Professor

ASHOK M RAICHUR | PhD (Nevada), Professor

ANNAPOORNI RANGARAJAN | PhD (NCBS), Associate Professor

RAHUL ROY | PhD (Illinois), Assistant Professor

DEEPAK KUMAR SAINI | PhD (AIIMS), Assistant Professor

SANDHYA S VISWESWARIAH | PhD (IISc), Professor

3.4.2 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 is providing opportunities to the scientific community in IISc., to experience a sample of the best scholarship and creativity outside the traditional boundaries of natural science.

Current Research

The Centre was established with the aim of opening a window to the Social sciences, Humanities and Arts. The Centre for Contemporary Studies, a relatively new experiment at the Institute, endeavours to bring to the campus some of the best practitioners of different disciplines in the human sciences, such as philosophy, sociology, economics, law, literature, poetry, art, music, cinema, etc. These scholars, drawn from all over the world, visit and lecture at the Institute and some are in residence for periods ranging from a few days to several months. Students, faculty and staff of the Institute, as well as a number of people

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Degree Programs offered
MTech and PhD

IN NUMBERS

8 Publications

Chairperson: **SASHI KUMAAR GANESAN**

from other institutes in Bangalore, attend these lectures. The aim of this experiment is to forge useful and meaningful interaction between the natural sciences and human sciences with special focus on understanding the diverse research methodologies of different disciplines and create opportunities to rethink the foundations of our own disciplines - often the opportunity to criticise the methodological foundation of another discipline leads to a re-examination of the foundation of one's own discipline. In addition to such one-off lectures, the Centre offers (presently, once in two years), a one-semester course entitled "The Production of Knowledge – A Comparison of Natural and Social Sciences".

Associate Faculty

HN CHANAKYA | PhD (UAS), Chief Research Scientist

RAGHAVENDRA GADAGKAR | PhD (IISc), Professor

RUDRA PRATAP | PhD (Cornell), Professor

S RAMAKRISHNAN | PhD (Massachusetts), Professor

Core Research

The aim of the Centre for Contemporary studies is to forge meaningful interactions between the natural sciences and human sciences by bringing to the campus guest faculties from diverse disciplines in the human sciences such as philosophy, History, Economics, Law, Sociology, Psychology, Literature, Art, Cinema, etc

3.4.3 COMPUTATIONAL AND DATA SCIENCES

The department focusses on inter-disciplinary programs driven by computation and data-intensive methods, systems and applications. The research is aligned along computational science and computer and data systems. The former explores computational methods and applications to scientific domains, while the latter into design, implementation and evaluation of high performance hardware and software systems.

Current Research

In the domain of Computer & Data Systems, several advancements were achieved during the year. In the area of robust declarative query processing, a new technique called Aligned Bound was designed, which is capable of providing worst-case performance guarantees that are linear in the dimensionality of the selectivity error space, and represents a significant improvement compared to the quadratic dependency of the earlier SpillBound algorithm. Several advancements were made in research targeted towards design and development of accelerators for HPC and reactive applications.

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Degree Programs offered
MTech and PhD

IN NUMBERS

13 Academic Staff
4 Scientific Staff
29 PhD students
8 MSc (Engg)
35 MTech
23 MTech (Res)
44 Publications
8 MSc and **4** PhD Conferments

Chairperson: **SASHI KUMAAR GANESAN**

Among them REDEFINE (Many-core SoC (System-on-a-chip) for accelerating HPC kernels) and AccuRA (Accurate aligner of short genomic reads on scalable reconfigurable accelerators) were landmarks. Innovative vector processing architectures have also been implemented to learning Neural Networks and QR factorization for several other applications. In specific to data systems, application of graph theory based models has been the emphasis. Goal-directed schema induction, interpretable representation learning, quality estimation in crowdsourcing, various problems in knowledge graphs has been the highlights of the study. Distributed data stream processing is another approach that has been tried. In the area of middleware and runtime systems, novel techniques were developed to improve the scalability of graph applications using MPI-3 nonblocking collectives, a divide-and conquer framework for hybrid CPU-GPU processing of graph applications, and acceleration of convection routines in climate models using Xeon Phi processors.

Faculty & Staff

SIVARAM AMBIKASARAN | PhD (Stanford), Assistant Professor

R VENKATESH BABU | PhD (IISc), Assistant Professor

SASHIKUMAAR GANESAN | PhD (Otto-von-Guericke), Assistant Professor

JAYANT R HARITSA | PhD (Wisconsin-Madison) Professor

ATANU MOHANTY | PhD (Brooklyn Polytechnic), Associate Professor

SK NANDY | PhD (IISc), Professor

DEBNATH PAL | PhD (Jadavpur), Associate Professor

SOUMYENDU RAHA | PhD (Minnesota), Professor

K SEKAR | PhD (Madras), Associate Professor

YOGESH SIMMHAN | PhD (Indiana), Assistant Professor

PARTHA PRATIM TALUKDAR | PhD (Penn), Assistant Professor

SATHISH S VADHIYAR | PhD (Tennessee), Associate Professor

MURUGESAN VENKATAPATHI | PhD (Purdue), Assistant Professor

PHANEENDRA YALAVARTHY | PhD (Dartmouth College), Associate Professor

Core Research

- Computational methods for Compressed Domains, Dynamical Systems, Finite elements, Natural language processing, Numerical analysis, Signal processing, Statistics
- Computational Science research aims to design architectures and platforms for Big Data, Cloud computing, Databases, Accelerators, Reconfigurable Architectures, hybrid CPU-GPU graph processing, middleware strategies for supercomputer systems, etc
- Computer and Data systems research find application in Climate modelling, Electromagnetics, Fluid mechanics, Internet of Things, Knowledge Harvesting, Medical imaging, Video Analytics, Photonics,\ Structural biology, Systems Biology, etc

3.4.4 CENTRE FOR NANOSCIENCE AND ENGINEERING

CeNSE is an interdisciplinary research centre with a focus on nanoscale systems. The research facilities include national nanofabrication facility (14,000 square feet clean room) and characterization labs that cater to material, electronic, mechanical, chemical and optical characterization. At present, the centre has 12 faculty members, 150 PhD and 20 MTech students.

Current Research

Raman Fiber Lasers, Narrow-linewidth lasers, Power-Combining lasers, have been successfully developed. On-chip Nonlinear Photonics components have been fabricated to address the requirement of on-chip optical interconnects. Graphene lined Nano-channels were shown to have 100-1000 times enhanced diffusivity. It was demonstrated that the diffusion

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Degree Programs offered **MTech, PhD**

IN NUMBERS

12 Academic Staff
120 PhD students
2 MSc (Engg)
17 MTech
156 Publications
6 MTech and **16** PhD Conferments

Chairperson: **NAVAKANTA BHAT**

of water through Nano-channels, 20-100 nm in height, increases by 100 to 1000 times on lining them with graphene. While this phenomenon was known earlier with carbon nano-tubes, the ability deploy it technologically such as in point-of-care diagnostics is only possible with graphene. The key was the fabrication of nano-channels lined with graphene, achieved in the CeNSE nano-fabrication facility.

Four sensing element-based gas sensor array for monitoring CO, CO_2, NO_2 and SO_2 is developed on a single chip. Four independent micro-heaters share a single suspended SiO_2 diaphragm, utilizing thermal proximity to achieve low power consumption (~10 mW for 300oC). PECVD SiO_2 diaphragm is demonstrated to give higher yield than thermally grown SiO2. Sensor array elements are fabricated by customizing each element to sense a specific gas. Optimized thin films of ZnO, $BaTiO_3$-CuO doped with 1% Ag, WO_3, and V_2O_5 are used for selective sensing of CO, CO_2, NO_2 and SO_2, respectively. The sensor array is packaged on Kovar header and characterized for gas sensing. It is demonstrated that the sensors exhibit good sensitivity and selectivity.

Graphene monolayers were shown to reduce permeability of polymers by a million-fold. In collaboration with Prof. Praveen Ramamurthy from Materials Engineering, Prof. Raghavan's group demonstrated that a monolayer of graphene can reduce, by a million-fold, the water permeability of many commonly used polymers. Large area, > 1 sq. inch, transparent and flexible polymer-graphene hybrids were demonstrated. Such low permeability polymers are very important for packaging with EMI shielding capabilities in organic electronics, and the emerging flexible electronics and light weight electronics areas. This development has received wide spread publicity in the print media, in India and the US, an Indian patent has been filed and many companies have evinced interest in licensing the technology.

In the continuing effort on nanomotors coated with magnetic material and propelled by a rotating magnetic field, the problem of the agglomeration of nanomotors has been overcome by the application of a microwave-synthesized zinc ferrite layer on the magnetic nanomotors that acts as a spacer layer, reducing the agglomeration by an order of magnitude, which allows them to be stored in a colloidal suspension for longer than six months without affecting their propulsion efficiency. This is the first demonstration of the integration of hyperthermia potential to nanomotors using ferrite layer which has been further demonstrated by their cytotoxic effects on cancer cells. The two functionalities were inter-related since higher hyperthermia efficiency requires a denser suspension, both of which were achieved in a single microwave-synthesized ferrite coating. The ferrite coating allows the scaling up and storage of magnetic nanomotors, taking us a step closer to Prof. Richard Feynman's vision of a swarm of fantastic nanovoyagers deployed in humans.

Transistors scaling is encountering some fundamental issues, constrained by Boltzmann limit (60mV/decade at 300K), which in turn restricts the minimum gate voltage required for transition from ON to OFF state (and vice-versa). This is due to the fundamental nature of "over the barrier" transport in the conventional thermionic MOSFETs. Although Tunnel FETs (TFETs) beat the Boltzmann limit through "across the barrier" tunneling, their ON state current is severely limited, thus affecting performance. We proposed a novel transistor design which combines both "tunnel transport" and "thermionic transport" in a single device thus providing the best of both kinds. A tunable transport MoS_2 FET is demonstrated for the first time, using schottky barrier as switching element, sulfur treated contacts and e-beam evaporated 30nm top and bottom HfO_2 gate dielectric.

• GaN RF and Power electronics technology has been developed with several innovations in materials processing, devices design and packaging technologies. Through an interdisciplinary initiative iGaN540 device with 5A and 40V specification has been developed under the National Mission on Power Electronics Technology. Based on the extensive experience gained on GaN technology a detailed project report has been submitted to GoI to set-up a commercial GaN foundry in the country.

Faculty & Staff

SUSHOBHAN AVASTHI | PhD (Princeton), Assistant Professor

NAVAKANTA BHAT | PhD (Stanford), Professor

AMBARISH GHOSH | PhD (Brown), Associate Professor

AKSHAY NAIK | PhD (Maryland), Assistant Professor

N DIGBIJOY NATH | PhD (Ohio State), Assistant Professor

RUDRA PRATAP | PhD (Cornell), Professor

SRINIVASAN RAGHAVAN | PhD (Penn State), Associate Professor

SHANKAR KUMAR SELVARAJA | PhD (Ghent), Assistant Professor

PROSENJIT SEN | PhD (California), Assistant Professor

VR SUPRADEEPA | PhD (Purdue), Assistant Professor

MANOJ VARMA | PhD (Purdue), Associate Professor

Associate Faculty

GAURAB BANERJEE | PhD (Washington), Assistant Professor

ARINDAM GHOSH | PhD (IISc), Associate Professor

PS ANIL KUMAR | PhD (Pune), Associate Professor

C RAMAMURTHY PRAVEEN | PhD (Clemson), Associate Professor

SUJIT KUMAR SIKDAR | Dr. Med. Sci. (Kyushu), Professor

V VENKATARAMAN | PhD (Princeton), Professor

KJ VINOY | PhD (Penn State), Professor

Core Research

Current research topics include, but are not limited to, nanoelectronics, MEMS/NEMS, nanomaterials, photonics, lasers, nano-biotechnology, Biosensors, GaN RF and power electronics, Oxide/chalcogenide electronics, 3D systems scaling, photovoltaics and energy harvesting devices, Sensors for agriculture, food and environment, computational nano-engineering

3.4.5 CENTRE FOR INFRASTRUCTURE, SUSTAINABLE TRANSPORTATION AND URBAN PLANNING

Centre for Infrastructure, Sustainable Transportation and Urban Planning (CiSTUP) conducts interdisciplinary research on understanding, planning, design, operation, and control of transportation systems. Development of state-of-the-art transportation modelling and analysis tools for safe, efficient, and sustainable mobility and city planning is a focus area. CiSTUP advises transportation agencies, civic authorities, and policy makers on scientific approaches to designing, planning, and operation of transportation systems.

Core Research

Transportation planning, Transportation Engineering, Travel demand modelling, Traffic operations and control, Transportation networks, Operations research in transportation, Travel behaviour, Integrated and multimodal transportation systems, Public transportation operations and planning, Shared mobility, Smart mobility, Intelligent transportation systems (ITS), Emerging transportation technologies (electric, connected, automated vehicles), Sustainable transportation and urban planning, Transportation infrastructure, Pavement engineering

Current Research

CiSTUP's current research focuses on the mathematical modelling, simulation, and optimization of transportation systems toward efficient and sustainable mobility. Specific topics of research are:

• Modelling driving behaviour in heterogeneous and undisciplined traffic streams, simultaneously considering longitudinal and lateral movements.

• Analysis of the influence of disciplined movements and personalized route guidance in heterogeneous traffic streams.

• Motion planning algorithms for autonomous vehicles in mixed and undisciplined traffic streams.

• Characterization and quantification of uncertainty in travel demand forecasts used for planning and operating transportation systems.

• Development of transportation demand forecasting model systems for Indian cities, considering emerging travel modes, including shared mobility and ride hailing services.

• Modelling and analysis of land-use and vehicle ownership interactions.

• Urban transit network design (hub-and-spoke) and selection of inter-city transit technologies.

Associate Faculty

BHARADWAJ AMRUTUR | PhD (Stanford), Professor

ANBAZHAGAN | PhD (IISc), Assistant Professor

GURTOO ANJULA | PhD (IIM Ahmedabad), Professor

GL SIVAKUMAR BABU | PhD (IISc), Professor

MH BALASUBRAMANYA | PhD (ISEC), Professor

IPSITA BANERJEE | PhD (Univ. of California), Research Scientist

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B GURUMOORTHY | PhD (Carnegie Mellon), Professor

PARAMESHWAR P IYER| PhD (California), Principal Research Scientist

JM CHANDRA KISHEN | PhD (Colorado), Professor

MS MOHAN KUMAR | PhD (IISc), Professor

MONTO MANI | PhD (IIT Madras), Professor

CALEB RONALD MUNIGETY | PhD (IIT Bombay), Research Scientist

ABDUL R. PINJARI | PhD (Texas), Associate Professor

TV RAMACHANDRA | PhD (IISc)Scientific Officer

PARTHASARATHY RAMACHANDRAN | PhD (Oklahoma State), Professor

ANANTH RAMASWAMY | PhD (Louisiana State), Professor

TARUN RAMBHA | PhD (Texas), Assistant Professor

K S NANJUNDA RAO | PhD (IISc), Principal Research Scientist

M SEKHAR | PhD (IISc), Professor

TG SITHARAM | PhD (Texas), Professor

M SUDHAKAR RAO | PhD (Pune), Professor

L UMANAND | PhD (IISc), Associate Professor

ASHISH VERMA | PhD (IIT Bombay), Assistant Professor

3.4.6 INTERDISCIPLINARY CENTRE FOR ENERGY RESEARCH

This new centre is uniquely placed to address the research challenges in the diverse fields related to energy, by engaging in interdisciplinary studies across many different fields as well as research that cover areas from the basics through to application and development. Thus, the Centre has taken a highly interdisciplinary approach toward translating fundamental knowledge into practical solutions that will enable sustainable energy production both in the urban and rural sector. Some major projects which have been initiated under the Centre include the India-US consortium named Solar Energy Research Institute for India and the United States (SERIIUS) under the US-India Joint Clean Energy Research and Development Centre (JCERDC) programme, the National Centre for Combustion Research & Development (NCCRD), Research Centre for Solar Power in Challakere Campus for development of research test beds in solar thermal as well as in photovoltaics, Adsorption based Solar Cooling, Solar Research and Reliability Dashboard, Optoelectronic Materials and Devices laboratory and Photovoltaic laboratory.

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Degree Programs offered **PhD**

IN NUMBERS

5 Publications
33 PhD

Chairperson: **GIRIDHAR MADRAS**

Core and Current Research

During the last year, the primary installation of the test bed for organic rankine cycle power block with solar field deploying newly designed parabolic reflector as well as a PV field is completed. These are being instrumented. Simultaneously we have been developing a dash board in collaboration with Robert Bosch Centre for Cyber Physical Systems.

For photovoltaic research, the centre has set up a set up facilities for synthesizing new solar cell materials and printing of solar cell. In the area of concentrated solar thermal the centre is setting up an ambitious test loop for supercritical CO_2 power system. Most of the installation has already been completed. As a part of the National Centre for Combustion, several fully instrumented state of the art combustion systems have been set up for studying various combustion processes.

Associate Faculty

HN CHANAKYA | PhD (UAS), Chief Research Scientist

PRADIP DUTTA | PhD (Columbia), Professor

CHATTOPADHYAY KAMANIO | PhD (BHU), Professor

GIRIDHAR MADRAS | PhD (Texas A&M), Professor

CHARLIE OOMMEN | PhD (IISc), Principle Research Scientist

PRAVEEN C RAMAMURTHY | PhD (Clemson), Professor

BN RAGHUNANDAN | PhD (IISc), Professor

RV RAVIKRISHNA | PhD (Purdue), Professor

DD SARMA | PhD (IISc), Professor

3.4.7 INTERDISCIPLINARY CENTRE FOR WATER RESEARCH

Reaching across traditional disciplinary boundaries ICWAR aims to provide a comprehensive understanding of impact of complex environmental factors on areas related to water science and technology and offer efficient and effective engineering solutions to environmental problems. Students in ICWAR receive a broad education and carry out research addressing some of the grand science and engineering challenges of modern society.

Current Research

Current research in the ICWAR program is focussed on (i) assessment of hydrologic impacts of climate change on local and regional hydrological regimes, ecological, social and economical systems, (ii) development of effective methodologies for sustainable water management at local and basin scales; (iii) development of smart water solutions for agriculture sector (irrigation and water management) by integration of observations of sensors and satellite and ICT tools, (iv) development of methodologies for intelligent water supply network monitoring and control for equitable distribution of water in mega cities; and (v) understanding interactions, synergies, and feedbacks that link the land surfaces, freshwater, oceans, and atmosphere systems.

FACT FILE

Established **2015**
Phone **+91 80 2293 2669**
Fax **+91 80 2360 0404**
Email **office.icwar@iisc.ac.in**
URL **icwar.iisc.ac.in**

IN NUMBERS

5 PhD students
2 Publications

Chairperson: **P P MUJUMDAR**

Faculty & Staff

KB AKHILESH | PhD (IISc), Professor

GURTOOANJULA | Fellow (IIM Ahmedabad), Professor

P BALACHANDRA | PhD (IISc), Principal Research Scientist

MH BALASUBRAHMANYA | PhD (ISEC), Professor

SHASHI JAIN | PhD (TU Delft), Assistant Professor M Mathirajan | PhD (IISc), Chief Research Scientist

C MUKHOPADHYAY | PhD (Missouri), Professor

PARTHASARATHY RAMACHANDRAN | PhD (Oklahoma State), Associate Professor

YADNYVALKYA | MS (Engg) (Moscow), MA (Russian) (CIEFL), Principal Research Scientist

Core Research

Urban water systems; Urban hydrology/ hydrogeology; Watershed and river basin hydrology; Floods and droughts; water management; Agrohydrology; Satellite hydrology; Wetland science; Land-atmosphere interactions; Lake ecosystems; Aquatic geochemistry; Geothermal reservoir modelling; Global water cycle and impacts of climate change; Isotope hydrology; Applications of sensor and satellite technologies; Water and wastewater treatment

3.4.8 MANAGEMENT STUDIES

The oldest management education department in the country, tracing its origin back to 1947, currently has a masters and a doctoral program. The department faculty and students engage in research in a wide array management topics and seek to set standards of excellence in management research and education.

Current Research

The study of Sustainability Transitions of various economic systems is an emerging research domain. The current research has mainly focused on benchmarking, modelling, planning, assessment, policy analysis of sustainable transitions of national electricity systems, rural energy-enterprise systems, urban mobility, corporate sector and urban system. One of the major initiatives (research project) within this domain is to conceptualize, develop and field demonstrate package of bioenergy solutions as EnergyPlus intervention for rural empowerment.

Developing tests for Event Studies, which are concerned with assessing the change in wealth and information content of corporate events. Both frequentist and Bayesian tests for such changes have been developed under a fixed-effect model, while their extensions to more comprehensive random-effect models are under way.

Technology start-ups, their ecosystem, structure and components, and the role that these ecosystem components play in the three life cycle stages of tech

FACT FILE

Established **2015**
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URL **icwar.iisc.ac.in**

IN NUMBERS

14 PhD Conferments
2 Publications

Chairperson: **PARTHASARATHY RAMACHANDRAN**

start-ups are probed in an ideal context feasible in Indian economic environment, as well as with respect to Bangalore and Hyderabad. The absorptive capacity of high-tech manufacturing firms in the Bangalore cluster is probed and analyzed its influence on innovation and economic performance.

The faculty also worked on water rights and allocation policy, water sharing and pricing.

Associate Faculty

KB AKHILESH | PhD (IISc), Professor

GURTOOANJULA | Fellow (IIM Ahmedabad), Professor

P BALACHANDRA | PhD (IISc), Principal Research Scientist

MH BALASUBRAHMANYA | PhD (ISEC), Professor

SHASHI JAIN | PhD (TU Delft), Assistant Professor

M MATHIRAJAN | PhD (IISc), Chief Research Scientist

C MUKHOPADHYAY | PhD (Missouri), Professor

PARTHASARATHY RAMACHANDRAN | PhD (Oklahoma State), Associate Professor

YADNYVALKYA | MS (Engg) (Moscow), MA (Russian) (CIEFL), Principal Research Scientist

Core Research

Technology Start-ups; Ecosystem and Lifecycle; Event Studies; Dynamic Pricing and Revenue Management; Human Resource Management; Production operations & Supply chain management; public policy; Energy & Environment; Sustainable Energy Access; Technology and Sustainability; Sustainability Transitions

3.4.9 ROBERT BOSCH CENTRE FOR CYBER PHYSICAL SYSTEMS

RBCCPS was established in 2011 to promote research in cyber-physical systems (CPS). The Centre brings together expertise from various departments and in-house research staff and students to develop and apply CPS concepts to solve pressing societal-scale problems in areas such as energy, health, mobility, manufacturing, water and robotic systems.

Current Research

The current research activities of the Centre are concentrating on foundational aspects of CPS and the research vectors (1) IoT/SmartX Systems in the application areas of energy, water, manufacturing and transportation and (2) Autonomous Systems.

In the first area, examples for research activities are the projects Smart City Test Bed (PI: Bharadwaj Amrutur), Design of large-scale IoT networks (PI: Rajesh Sundaresan), Distributed multi-agent algorithms for micro grid control (PI: Shalabh Bhatnagar), Condition based solar PV plant maintenance and monitoring using sparse, low cost sensors (PI: Ashish Joglekar), and Industrial Internet of Things for energy efficient assembly lines (PI: Rajesh Sundaresan).

FACT FILE

Established **2011**

Phone **+91-80-2293 2046/3430**

Fax **+91-80-2293 2046**

Email **manager@rbccps.org**

URL **www.rbccps.org**

Degree Programs offered **PhD**

IN NUMBERS

155 Publications

Chairperson: **BHARADWAJ AMRUTUR**

In the second area, examples are Chemotactic Robot Swarms (PI: Manoj Varma) and

Autonomous Navigation of Drones (PI: Chiranjib Bhattacharyya).

More information on the current research projects is available at http://www.rbccps.org/projects/on-going-projects/.

The following projects have been completed:

(1) Developing a framework for using electricity consumption data to drive energy efficiency in the residential sector

(2) IISc Smart Campus: Closing the loop from network to knowledge

(3) Kangaroo Mother Care Project

(4) The Kumbh Mela experiment: Measuring and understanding the dynamics of humankind's largest crowd

(5) A solar dashboard for India. A cooperative project between ICER & RBCCPS

(6) Sensor network based cyber-physical infrastructure for continuous monitoring of water distribution networks

In addition to the research activities, RBCCPS started a new course format called "Impulse Courses" which are directed at IISc students and interest students/ company employees outside IISc. The courses focus on hands-on activities and aiming to complement the IISc curriculum with topics in the interdisciplinary field of CPS.

Technical Staff

ARUN BABU | PhD (Homi Baba National Institute), Member of Technical Staff

JOSEPHINE SELVARANI RUTH D | PhD (NIT Tiruchirapalli), INSPIRE Faculty

ASHISH JOGLEKAR | PhD (IISc), Member of Technical Staff

NEHA KARANJKAR | PhD (IIT Bombay), PostDoc

SHISHIR N Y KOLATHAYA | PhD (Georgia Institute of Technology), INSPIRE Faculty

RAGHU KRISHNAPURAM | PhD (Carnegie Mellon University), Distinguished Member of Technical Staff

ALEXANDRE REIFFERS | PhD (National Research Institute in Computer Science and Control), PostDoc

ABHAY SHARMA | PhD (IISc), Member of Technical Staff

S SRIDHAR | PhD (Institute of Mathematical Sciences), Member of Technical Staff

Associate Faculty

BHARADWAJ AMRUTUR | PhD (Stanford), FNAE, Professor

GK ANANTHASURESH | PhD, (Michigan), Professor

R VENKATESH BABU | PhD (IMSc), Assistant Professor

KAUSHIK BASU | PhD (Minnesota), Assistant Professor

SHALABH BHATNAGAR | PhD (IISc), FNAE, Professor

ARNAB BHATTACHARYYA | PhD (MIT), Assistant Professor

CHIRANJIB BHATTACHARYYA | PhD (IISc), FNAE, Professor

DEEPAK D'SOUZA | PhD (CMI), Professor

HARESH DAGALE | MSc (Engg) (IISc), Principal Research Scientist

VINOD GANAPATHY | PhD (Wisconsin), Assistant Professor

ASHITAVA GHOSAL | PhD (Stanford), Professor

AMBARISH GHOSH | PhD (Brown), Associate Professor

PRASANTA KUMAR GHOSH | PhD (USC), Assistant Professor

ADITYA GOPALAN | PhD (Texas), Assistant Professor

DIPANJAN GOPE | PhD (Washington), Assistant Professor

GURUNATH GURRALA | PhD (IISc), Assistant Professor

M S MOHAN KUMAR | PhD (IISc), Professor

KAUSIK MAJUMDAR | PhD (IISc), Assistant Professor

CHANDRA R MURTHY | PhD (UC San Diego), Associate Professor

OMKAR S N | PhD (IISc), Chief Research Scientist

PARIMAL PARAG | PhD (Texas A&M), Assistant Professor

ARPITA PATRA | PhD (IIT Madras), Assistant Professor

T V PRABHAKAR | PhD (TU Delft), Principal Research Scientist

CHANDRA SEKHAR SEELAMANTULA | PhD (IISc), Associate Professor

YOGESH SIMMHAN | PhD (Indiana), Assistant Professor

RAJIV SOUNDARARAJAN | PhD (Texas), Professor

T V SREENIVAS | PhD (TIFR Bombay), Professor

RAJESH SUNDARESAN | PhD (Princeton), Professor

HIMANSHU TYAGI | PhD (Maryland), Assistant Professor

MANOJ VARMA | PhD (Purdue), Associate Professor

ASHISH VERMA | PhD (IIT Bombay), Associate Professor

Core Research

The Centre focuses on experimental and theoretical research to gain a deep understanding of key CPS components: Sensor and actuation systems, modelling and analytics sciences, control and optimization frameworks and the associated systems engineering encompassing security, verification, simulation, computation, communication, signal processing, electronics and middleware

3.4.10 SUPERCOMPUTER EDUCATION & RESEARCH CENTRE

The Supercomputing Education and Research Centre (SERC), at IISc provides the state-of-the-art computing environment, which compares well with the top Computing Centres anywhere in the world, catering to the ever-increasing demands of high performance computing for scientific and engineering research. The centre pursues advanced research and education in various aspects of supercomputing systems and applications. In addition, the Centre leads several national initiatives and provides consultancy services.

In 2017, our supercomputer systems have catered close to 60 scientific groups in the Institute in various fields including aerospace, physics, mechanical engineering, materials research, chemistry, climate modelling, molecular biophysics, microbiology and cell biology, computational and data sciences, etc. About 13 million CPU core hours have been provided for research in these areas.

Current Research

Faculty conducted research on cloud systems with research students from CDS in the "Cloud Systems Lab". For the year 2017, there has been a good interaction with M/s Flipkart, India wherein two students from this lab have interned with the company for two months during Jun – Jul, 2017. As fallout of this internship, both students are working on the following identified problems that are mutually relevant. Flipkart has also communicated to support this research through a possible faculty grant.

A project on evaluating Virtual machine placement consideration using multi-tiered applications and associated constraints for converting suitable applications to containerized platforms was undertaken.

Core Research

Supercomputing systems and applications, Cloud Computing, networking, digital library, information security, computational electromagnetics

Faculty & Staff

TA CHANDRAPPA | MSc (Bangalore), Scientific Assistant

J LAKSHMI | PhD (IISc), Principal Research Scientist

FILBERT MINJ | MTech (JNU), Principal Research Scientist

YOGENDRA KUMAR NEGI | MTech (Delhi), Scientific Officer

KP RAGHURAMAN | MSc (Bharatidasan), Technical Officer

NALINI SREESHYLAN | MSc (Bangalore), Scientific Assistant

Associate Faculty

N BALAKRISHNAN | PhD (IISc), Honorary Professor

R GOVINDARAJAN | PhD (IISc), Professor

Honorary Professors

N BALAKRISHNAN | PhD (IISc), Honorary Professor

FACT FILE

Established **1970**

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URL **www.serc.iisc.in**

IN NUMBERS

1 Publication

1 PhD Conferments

Chairperson: **SATHISH VADHIYAR**

3.5 DIVISION OF MECHANICAL SCIENCES

Geotechnical Engineering, Civil & Aerospace Structures, Transportation, Water Resources, Environmental Engineering and Sustainable Habitat, Climate, Structural and Functional Materials, Manufacturing, Design Theory and Methodology, Geochemistry, Tectonics, Planetary Evolution, Remote Sensing and GIS Applications, Aerodynamics, Combustion, Navigation and Guidance, Solid Mechanics, Fluid Mechanics, Thermal Sciences, Acoustics, Robotics, Dynamics, Biomolecular Engineering, Catalysis, Colloids and Interfacial Science, Nanotechnology, Thermodynamics and Simulations across length scales.

Themes

Research work in the Division encompasses diverse areas. Seismology and climate change -- modelling as well as paleo studies -- are focus areas, which lead naturally to work on environmentally sustainable materials and design and on waste management. The work on materials includes study and modelling of biomaterials, polymers and photovoltaics. Fluid dynamics, including shock waves and other phenomena at hypersonic speeds, is another key area of study that cuts across the various departments in this Division. Researchers in this Division also work on identifying novel drug and vaccine targets for viral infections such as HIV, hepatitis C and dengue.

Research Highlights

The Division consists of departments of Aerospace Engineering (which includes DRDL-IISc Joint Advanced Technology Programme and ISRO-IISc Space Technology Cell), Civil Engineering, Chemical Engineering, Materials Engineering, Mechanical Engineering, Centre for Atmospheric & Oceanic Sciences, Centre for Earth Sciences, Centre for Product Design and Manufacturing, Centre for Sustainable Technologies and Divecha Centre For Climate Change

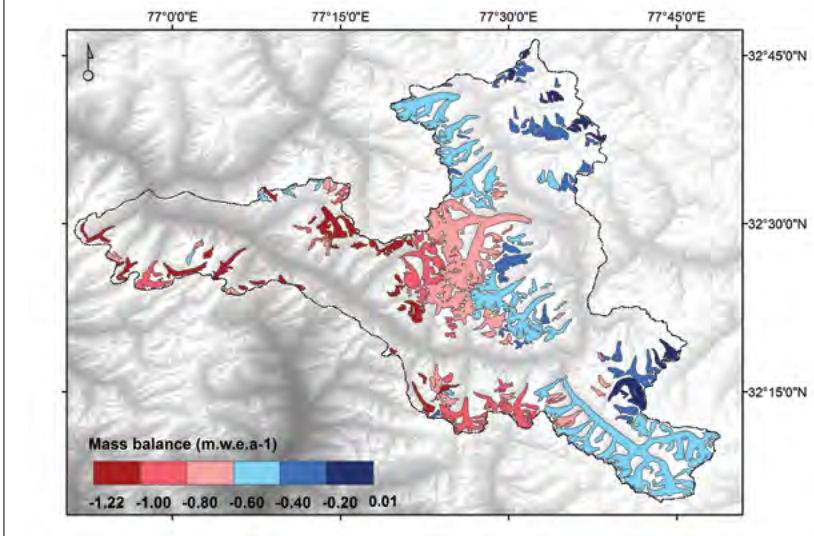
DEPARTMENTS | CENTRES | UNITS

- AEROSPACE ENGINEERING
- CENTRE FOR PRODUCT DESIGN AND MANUFACTURING
- CHEMICAL ENGINEERING
- MATERIALS ENGINEERING
- MECHANICAL ENGINEERING
- CIVIL ENGINEERING
- CENTRE FOR EARTH SCIENCES
- CENTRE FOR ATMOSPHERIC AND OCEANIC SCIENCES
- CENTRE FOR SUSTAINABLE TECHNOLOGIES
- DIVECHA CENTRE FOR CLIMATE CHANGE

IN NUMBERS

- 152 FACULTY MEMBERS
- 710 PhD STUDENTS
- 351 MASTER'S STUDENTS

RESEARCH SNAPSHOTS 2017-18

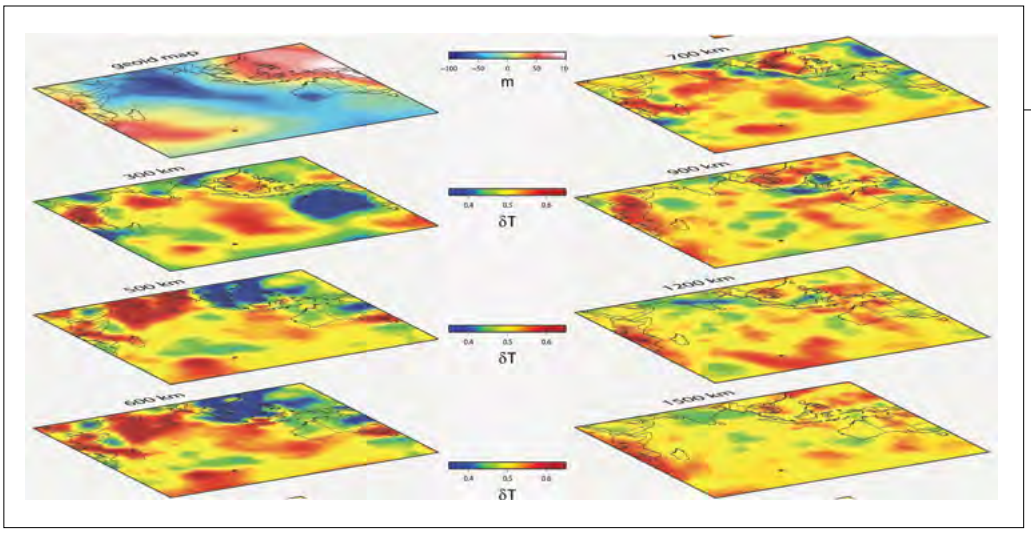


1. Anil Kulkarni (DCCC)

A glacier mass balance model using temperature, precipitation and Accumulation Area Ratio was developed. An annual mass loss from 1982 to 2012 for 146 glaciers covering an area of 637 sq km in Chandra basin, Himachal Pradesh was estimated. An overall loss of 18% was estimated, however small and low altitude glaciers lost almost 70% of glacier stored water, indicating looming water scarcity for the villagers in the valley.

Reference: Sayli Tawde, AV Kulkarni, G Bala (2017) An estimate of glacier mass balance for the Chandra basin, western Himalaya, for the period 1984-2012. *Annals of Glaciology.* 1-11. doi: 10.1017/aog. 2017.18

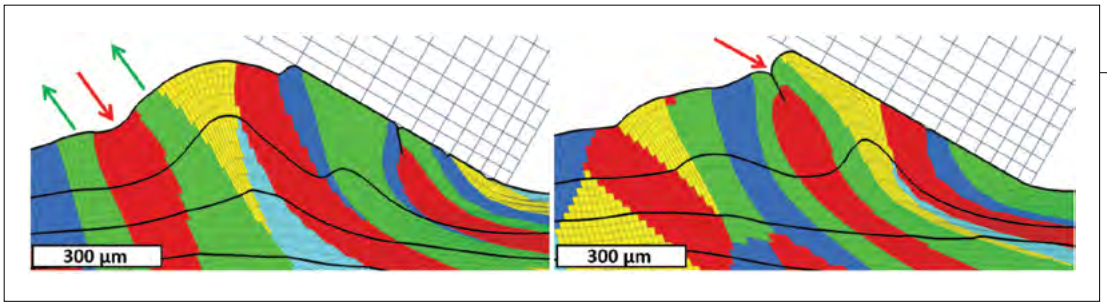
2. Attreyee Ghosh (CEaS)



The most negative geoid anomaly on Earth lies in the Indian Ocean. So far, there has been no agreement regarding the source of this anomalous low. The current study finds that upper to mid-mantle low density (high temperature) structures are mainly responsible for the formation of this anomaly. The figure shows modeled geoid and temperature variations inside the Earth at various depths.

Reference: A Ghosh, G Thyagarajulu, B Steinberger (2017) The Importance of Upper Mantle Heterogeneity in Generating the Indian Ocean Geoid Low. *Geophys. Res. Lett.* 44, 9707-9715.

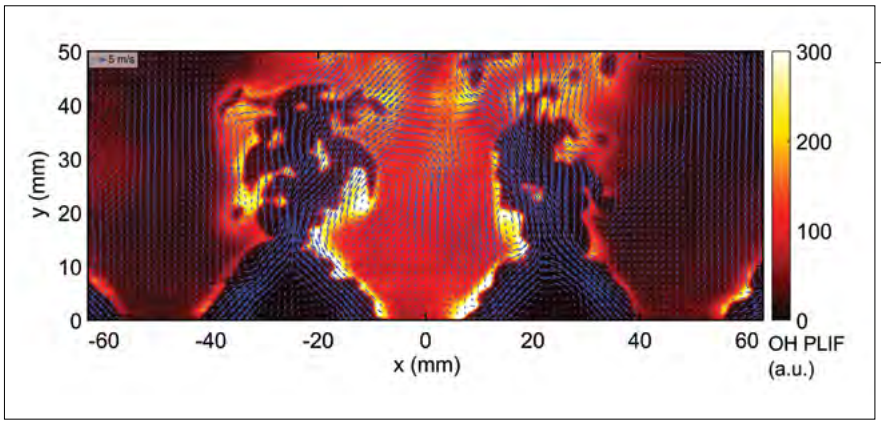
3. Narayan Sundaram (CiE)



Microstructural effects can produce unexpected surface damage during deformation processing of metals via surface fold formation. Two frames from a finite element (FE) simulation depicting a surface depression (a), which then forms a surface fold (b), in sliding of aluminum-1100 modeled as a heterogeneous polycrystalline aggregate. The fold eventually becomes a crack-like damage feature on the residual surface.

Reference: NK Sundaram, A Mahato, Y Guo, K Viswanathan, S Chandrasekhar (2017) *Acta Mat* 140: 67-78.

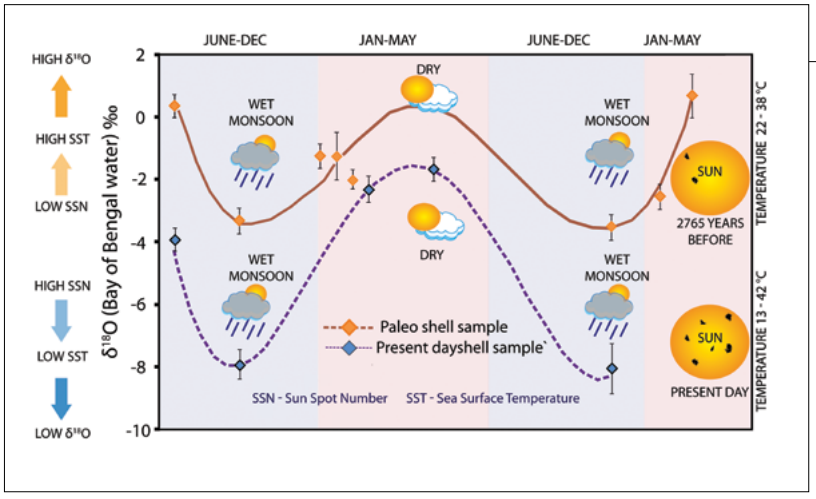
4. Swetaprovo Chaudhuri (AE)



The image captures the instantaneous velocity and reactive species fields inside a model gas turbine combustor. This is experimentally obtained by simultaneous Particle Image Velocimetry and Planar Laser Induced Fluorescence of hydroxyl (OH) radical. In the image, the blue arrows represent flow velocity vectors corresponding to the turbulent swirling flow and the color scale represents the OH fluorescence intensity, respectively.

Reference: RB Vishwanath, PM Tilak, and S Chaudhuri. An Experimental Study of Interacting Swirl Flows in a Model Gas Turbine Combustor, *Experiments in Fluids,* In Press. DOI: 10.1007/s00348-018-2495-2

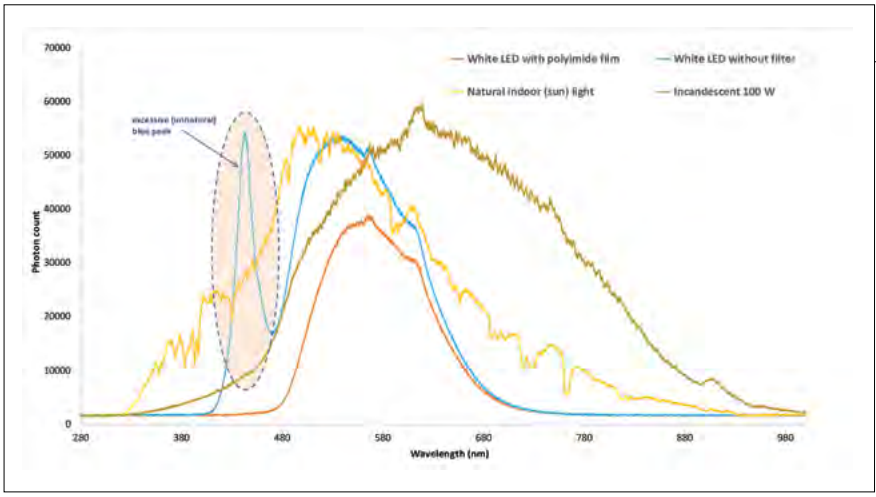
5. Prosenjit Ghosh (CeaS)



A study on mollusc shells collected from the Hendri Island of Bay of Bengal revealed growth features denoting seasonal bands recording water temperature and salinity. These findings documented paleo seasonal hydrological condition near the mouth of Ganga Brahmaputra river system during 2765 ± 130 years; marking a time of solar minima. Evidences suggests warming of coastal environment due to the presence of marine warm pool during solar minima as compared to the present day.

Reference: Y Banerjee, P Ghosh, R Bhushan, P Rahul (2017) Strong sea forcing and warmer winter during solar minima Ð2765 yr B.P. recorded in the growth bands of Crassostrea sp. from the confluence of river Ganges, Eastern India. *Quaternary International* (In Press)

6. Monto Mani (CST)



Commercial Cool White LEDs are presumed environment friendly (luminous efficacy >90 lm/W) but with detrimental impacts on vision and increased stress due to the unnatural blue peak (400-460 nm). Current research led to the identification of an affordable solution, based on a stable polyimide film, being adopted by many luminaire companies, health-care practitioners and in IISc.

Reference: M Manish, RR Rao, P Ramamurthy, and M Mani. Safety of Light Emitting Diode (LED) based Domestic Lighting: Rural Context. *International RuTAG Conference on Rural Technology Development and Delivery,* March 9-11, 2018, IIT Delhi

7. Tejas Murthy (CiE)

Naturally occurring geomaterials such as sandstones, soft rocks, are comprised of particulates, often held together by cohesion between them. The geology, surrounding environs bring forth this cohesion between the particulates. We study the structure and mechanical behaviour of such cohered granular materials at multiple length scales. The figure presents an x-ray computed tomography image of a cemented granular ensemble.

Reference: S Singh, RK Kandasami, RK Mahendran., and TG Murthy (2017) System size effects on the mechanical response of cohesive-frictional granular ensembles, *EPJ Web Conf.,* 140: 08007, doi: 10.1051/epjconf/201714008007

8. Ashwini Ratnoo (AE)

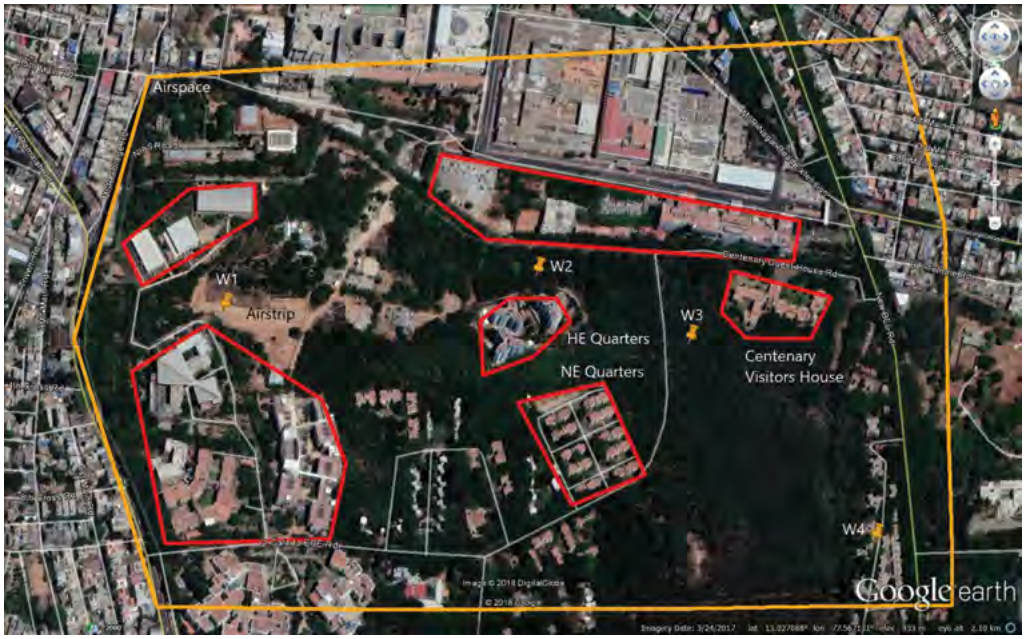


Fig A

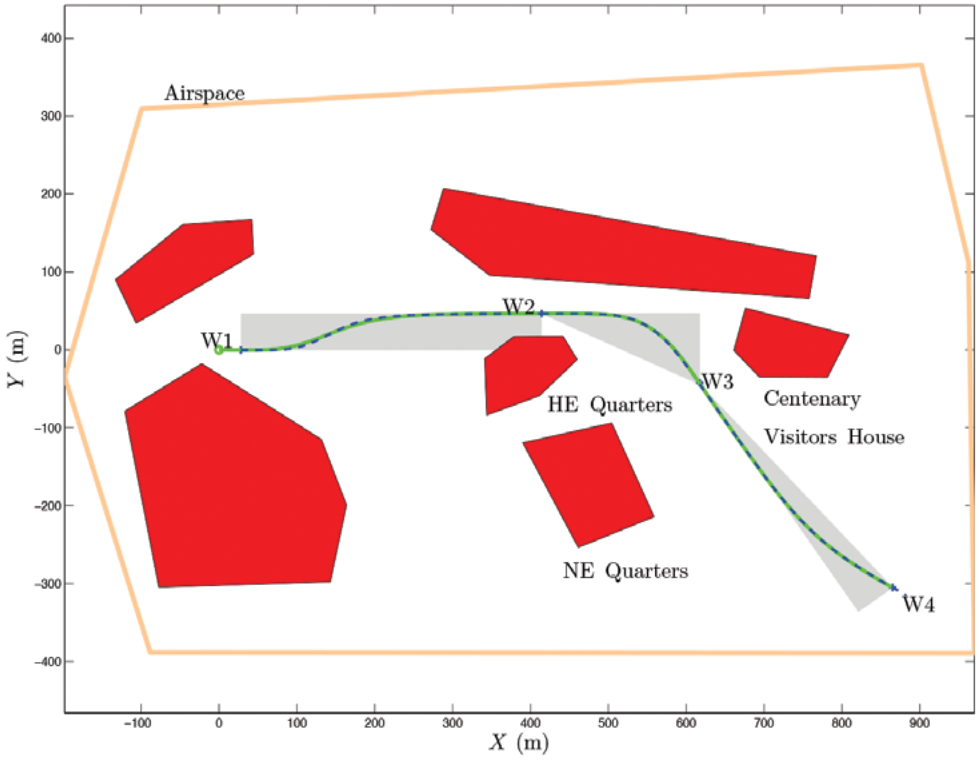


Fig B

The figure above showcases results from a novel continuous curvature path planning methodology for Unmanned Aerial Vehicles (UAVs) developed using four parameter logistic curves. Fig A presents the scenario with an airspace defined in the IISc north area and restrictions within the airspace modeled as convex polygons. Fig B presents the planned (dashed curve) and followed path (solid line) connecting four waypoints using a simulation.

Reference: S Upadhyay and A Ratnoo (2017) Smooth Path Planning for Unmanned Aerial Vehicles with Airspace Restrictions. *AIAA Journal of Guidance, Control, and Dynamics*, 40(7): 1596-1612

9. Dibakar Sen (CPDM)

Developed with funding from Wellcome Trust (UK), PURAK-prosthesis provides functionality with affordability. With its single motor driven fully articulated structure controlled by a novel myo-mechanical control interface, it can adaptively grasp arbitrary shapes and let the user feel the grasp force too! It weighs just 500gm and costs less than a 10th of its competition.

Reference: Patent 1554/CHE/2013, Design 287834

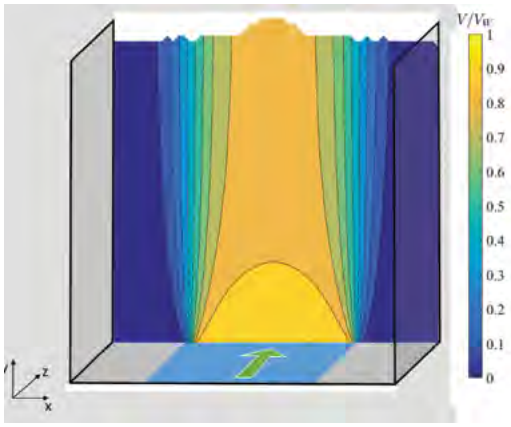


Fig (a)

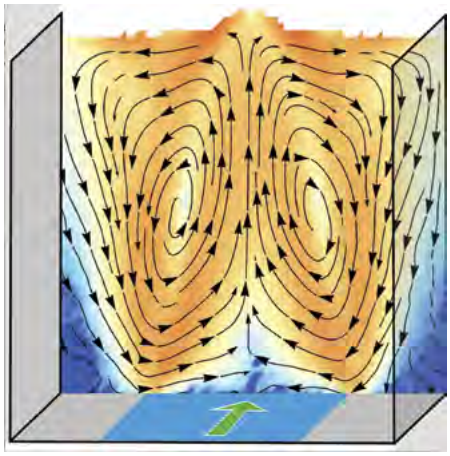


Fig (b)

10. Prabhu Nott (CE)

The shear of dense granular materials is accompanied by density reduction, leading to anomalous mechanical response. Here, a granular material sheared in a split-bottom Couette cell, wherein a section of the base (blue) moves with velocity Vw relative to the stationary walls (grey), exhibits a dilation-driven secondary flow: fig(a) primary velocity (z direction), fig(b) secondary velocity in the x-y plane.

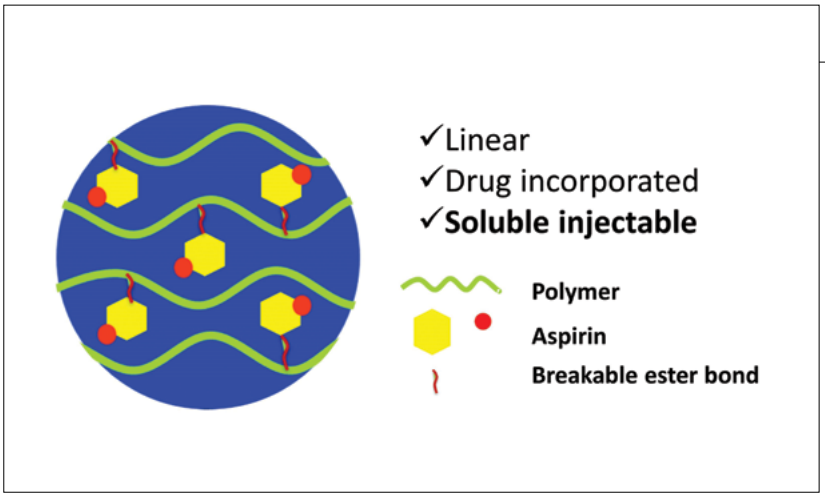
Reference: PV Dsouza, KP Krishnaraj and PR Nott (2017) Secondary flows in slow granular flows, Powders and Grains. EPJ Web of Conferences. 140: 03028. DOI: 10.1051/epjconf/201714003028

11. Sambuddha Misra (CeAS)

Oceans absorb carbon dioxide from the atmosphere, and this exchange has modulated global temperature over earth's history. This paper shows how a record of this interaction could be inferred from the isotopic composition of lithium in calcium carbonate shells of microscopic organisms, which is strongly correlated with the acidity of its ocean environment.

Reference: Roberts J, Kaczmarek K, Langer G, Skinner LC, Bijma J, Bradbury H, Turchyn AV, Lamy F, Misra S (2018). Lithium isotopic composition of benthic foraminifera: A new proxy for paleo-pH reconstruction, *Geochimica Et Cosmochimica Acta,* 2018 (in press, but published online).

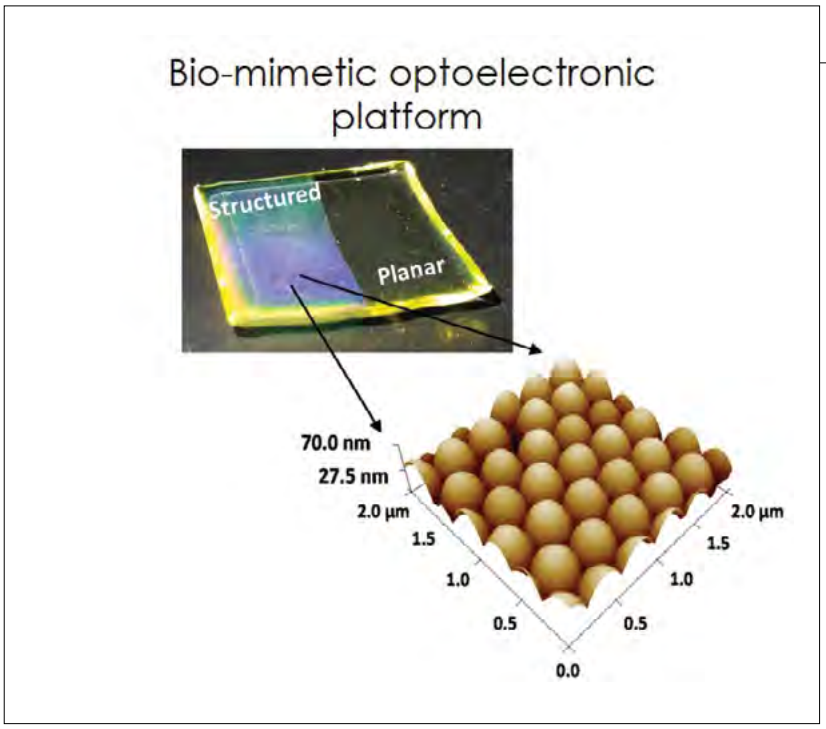
11. Kaushik Chatterjee (MT)



An interdisciplinary team has designed a novel chemical compound that can be tailored to release aspirin over a desired duration inside the body. It has several advantages over existing mechanisms: it is harmless to living cells, can carry a large amount of drug, and can easily be injected.

Reference: Dasgupta Q, Movva S, Chatterjee K, Madras G (2017). Controlled release from aspirin based linear biodegradable poly(anhydride esters) for anti-inflammatory activity, *International Journal of Pharmaceutics,* 528(1-2), 732-740).

12. P Ramamurthy (MT) and DR Mahapatra (AE)



This paper reports the development of a new material that enables etching of nano-scale patterns to enhance light harvesting in photovoltaic applications and also charge transport in organic solar cells. The nano-scale patterns were inspired by those found on the exterior surface of eyes of certain nocturnal insects

Reference: Jagdish K, Garg K, Ramamurthy P, Mahapatra DR, and Hegde G (2018). Moldable biomimetic nanoscale optoelectronic platforms for simultaneous enhancement in optical absorption and charge transport, Nanoscale (RSC), 10, 3730-3737.

3.5.1 AEROSPACE ENGINEERING

The department was founded in the year 1942 as Department of Aeronautical Engineering. It was renamed as Department of Aerospace Engineering in the year 1982. The department runs PhD, MTech and MTech (Res) programs and currently has 33 faculty and 248 research students. The academic and research activities are in four major areas, namely, Structures, Aerodynamics, Combustion and Propulsion, and Guidance & Control.

Current Research

Following are the research highlights of the Department of Aerospace Engineering for the year 2017.

AEROSPACE STRUCTURES
The main research focus here is in the development of new design methodologies, manufacturing, modelling and analysis of composite, sandwich &

Core Research

- Aerodynamics: Hypersonics and Shock waves, Low speed Aerodynamics, Computational Fluid Dynamics, LES, Aero-acoustics, Turbulence and shear flows
- Combustion and Propulsion: Combustion instability, atomization and sprays, scramjet combustion
- Aerospace Structures: Wave propagation, structural health monitoring, nanocomposites, composite structures, smart materials, functionally graded materials, non-linear analysis, finite element methods, vibrations, and Non-Destructive Evaluation
- Guidance and Control: Optimal control, path planning, Unmanned Aerial Vehicle, Image processing, obstacle avoidance, multi-agent systems

multi-functional structures and materials under harsh loading conditions. The structural integrity evaluation of these structures forms an important component of research. Additionally, some faculty members are involved in nano materials and structures research, and structural health monitoring (SHM). A software framework to integrate SHM during inspection process automation for application in aircraft industry has been developed. Another added area of research in this group is composite manufacturing, which includes composite process modelling using both conventional and multi-scale modelling methods. 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. More recently, wave propagation studies have been undertaken in the context of bifurcation in triatomic granular cyclic chains, and nonlinear dynamics of snap through one-dimensional lattices. The other areas pursued include non-destructive testing, aero-servo elasticity, helicopter dynamics, UAVs, and blast mitigation strategies.

AERODYNAMICS

The department houses 75,000 square feet of wind tunnel testing space, ranging from subsonic to supersonic speeds. The Laboratory for Shock Wave and Hypersonic Research (LHSR) houses a variety of shock tunnels and performs research ranging from chemical kinetics to shock wave-boundary layer interaction. A new hydrogen-oxygen combustion based fluid jet delivery method has been developed, which will also be useful in bacterial transformation experiments. The feasibility of using alternate thermal protection systems including mass transfer based cooling for re-entry vehicles is being explored. Apart from the large Open Circuit Wind Tunnel, there are several other tunnels of smaller size as part of the Low Speed Aerodynamics Laboratory, which are being primarily used for carrying out research on flow separation, transition and turbulence. One of the areas that has been pursued is the effect of favourable pressure gradient/acceleration on boundary layer turbulence. Another important activity that has been initiated is the highly-resolved measurement of turbulent pressure fluctuations inside a boundary layer using in-house developed probes. A detailed physics-based reduced-order analysis of supersonic heated jets has provided new insights into the instability of such jets. Other areas of research performed by faculty Include CFD, LES code development for Aerospace systems design, Aero-acoustics, Jet noise, shock wave research and other allied areas.

COMBUSTION AND PROPULSION

The main areas of research of faculty in this group

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Degree Programs offered **PhD, MSc (Engg) and ME**

IN NUMBERS

23 Academic Staff

10 Scientific Staff

170 PhD Students

9 MTech (Res)

37 MTech-D

2 ME, **21** MSc (Engg)

194 Publications

11 MSc (Engg), **34** ME

14 PhD Conferments

Chairperson: **S GOPALAKRISHNAN**

include gas turbine propulsion, spray droplet dynamics, green propellants, combustion instability and development of new modelling tools. Research in new green propellants for space propulsion, nano catalysts for composite solid propellants and super burning rate propellants. New energetic materials are being developed for applications in rocket propellants. Spray formation inside an engine combustion chamber is a complex fluid dynamic process involving several sub-processes such as liquid jet/sheet instability, ligament breakup, spray-wall interaction, and secondary atomization. Some of these research activities are actively pursued by faculty in this group. Computational investigations and stability analyses seeking to understand the role of hydrodynamic instability in promoting thermo-acoustic instabilities in combustion systems are on-going. Recent research has made significant headway into understanding unsteady dynamics of swirl flows in realistic combustors using local stability analysis tools. Additionally, the group lab on turbulent combustion and propulsion with activities and contributions ranging from fundamentals of turbulence-flame interaction, novel technology development to establishment and research in large scale prototypical facilities. A new scramjet facility is commissioned recently to study hypersonic combustion.

GUIDANCE AND CONTROL

Research activities were carried out 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, synchronous and asynchronous pursuit strategies, multi-vehicle formation stabilization with heterogeneous controllers, optical flow based guidance of small UAVs, collision avoidance maps, time optimal guidance with impact angle constraint, seekerless interceptor guidance, and on swarm intelligence algorithm based on behaviour of glowworms. Significant research contributions were made in the areas of curvature constrained trajectory generation for waypoint following for miniature air vehicle and satellite image processing for land use and land cover mapping.

JOINT ADVANCED TECHNOLOGY PROGRAM

The programme is a joint initiative of DRDL and IISc. It underwent a transition in 2017 into a new phase for a proposed period of five years of collaborative research, resulting in a number of research publications of relevance to DRDO, which was the result of about six projects currently in progress at IISc. As envisaged in the program, one of such in-house project has led to a larger project directly sponsored by DRDL. In the new phase of the program, the in-house project for funding IISc faculty is about 70 Lakhs INR, and the total outlay is about 130 Lakhs INR per year, aiming at translational research to be carried out IISc faculty members, networking with DRDO labs through workshops and supporting post-doctoral fellowships nationally to work at IISc.

ISRO-IISC SPACE TECHNOLOGY CELL

This cell was set up as per an initial MOU 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 2017. These projects were in the broad areas of computational mechanics, syntheses and characterization of new materials, micro-electronics, sensors, and applications of remote sensing. Several projects were completed during the year and some were started.

Twenty eight projects ended, 20 continued and 19 new projects started in 2017. Theoretical studies were of flow modelling including aeroacoustics and atomization, and of frictional effects at contacts. Experimental facilities were built for several kinds of property measurements and characterization of new propellant catalysts. Some others include studies on urban development, forest degradation, vegetation dynamics, heat pipes, image processing, semiconductor nanocrystals, MEMS switch, colloidal quantum dot photodetectors, and sensors for health monitoring.

Every year an annual STC symposium is held. This year it was in January 2017 where progress and evaluation of more than 70 projects and new proposals were presented to an audience of faculty, students, and scientists from ISSC and ISRO.

Faculty & Staff

N BALAKRISHNAN | PhD (IISc), Professor

M RAMACHANDRA BHAT | PhD (IISc), Chief Research Scientist

M SEETHARAMA BHAT M | PhD (IISc), FNAE, Professor

SWETAPROVO CHAUDHURI | PhD (Connecticut), Assistant Professor

SOURABH SUHAS DIWAN | PhD (IISc), Assistant Professor

RANJAN GANGULI | PhD (Maryland), FNAE, Professor

DEBASISH GHOSE | PhD (IISc), FNAE, Professor

S GOPALAKRISHNAN | PhD (Purdue), FASc, FNAE, Professor

SUHASINI GURURAJA | PhD (Washington), Associate Professor

DINESH KUMAR HARURSAMPATH | PhD (Georgia Tech), Associate Professor

SANTOSH HEMCHANDRA | PhD (Georgia Tech), Assistant Professor

GOPALAN JAGADEESH | PhD (IISc), FNAE, Professor

SB KANDAGAL | PhD (IISc), Principal Research Scientist

PS KULKARNI | PhD (IISc), Chief Research Scientist

KN LAKSHMISHA | PhD (IISc), Professor

V MANI | PhD (IISc), Professor

JOSEPH MATHEW | PhD (MIT), FNAE, Professor

G NARAYANA NAIK | PhD (IISc), Principal Research Scientist

SN OMKAR | PhD (IISc), Chief Research Scientist

CHARLIE OOMMEN | PhD (IISc), Principal Research Scientist

RADHAKANT PADHI | PhD (Missouri), Professor

NKS RAJAN | PhD (IISc), Chief Research Scientist

O N RAMESH | PhD (IISc), Professor

S V RAGHURAMA RAO | PhD (IISc), Associate Professor

ASHWINI RATNOO | PhD (IISc), Assistant Professor

KPJ REDDY | PhD (BIT-Ranchi), Professor

D ROY MAHAPATRA | PhD (IISc), Associate Professor

ARNAB SAMANTA | PhD (Illinois), Assistant Professor

S SARAVANAN | PhD (IISc), Principal Research Scientist

TS SHESHADRI | PhD (Georgia Tech), Associate Professor

D SIVAKUMAR | PhD (IISc), Associate Professor

V SURENDRANATH | MSc (Engg) (IISc), Principal Research Scientist

B VASUDEVAN | MASc (Toronto), Principal Research Scientist

KARTIK VENKATRAMAN | PhD (IIT Madras), Associate Professor

SRISHA RAO M V | PhD (IISc), Assistant Professor

3.5.2 CENTRE FOR ATMOSPHERIC & OCEANIC SCIENCES

Established in 1982, Centre for Atmospheric & Oceanic Sciences (CAOS) carries out research in the broad field of tropical climate focussing on the monsoons and offers academic programs leading to MTech and PhD degrees. The centre has played a leading role in shaping-up the research in atmospheric and ocean sciences in India.

Core Research

- Monsoons and its diurnal to decadal variability
- Oceanography: Indian Ocean dynamics and modelling, observations, ecosystem processes
- Aerosols physics: Observations, chemistry and interaction with clouds and climate
- Geophysical Fluid Dynamics: models of flows at different spatio-temporal scales.
- Land-atmosphere interaction: response of different types of land and ocean
- Atmospheric measurements
- Climate change: Observations and Modelling, Radiative forcing and climate system feedback estimates, Carbon sources and sink estimation, Satellite meteorology

Current Research

In 2017, CAOS continued to lead sustained, multi-institution field expeditions supported by the National Monsoon Mission. We use ships, aircraft, radars and a variety of autonomous instruments to study (i) monsoon convection, (ii) aerosols, clouds and radiation, and (iii) Bay of Bengal air-sea interaction.

We have worked on multi-scale monsoon clouds and climate variability on decadal-centennial scales from observations and continued efforts to improve models of monsoon convection and rainfall, and conducted "thought experiments" using comprehensive numerical models of the ocean-atmosphere-land system to understand facets of global climate. CAOS students and faculty published important advances in the areas of organized tropical convection, clouds and aerosols; multi-decadal changes in monsoon rain, monsoon active-break cycles and extreme rainfall events; the relation between Amazon river discharge and climate; the impact of Arctic Geoengineering on global monsoons, and the depletion of heavier isotopes of hydrogen and oxygen in rain water in response to a warming climate.

Embedded within 1000 km scale monsoon cloud bands are smaller (100 km) regions of intense rainfall from "mesoscale" convective systems (MCS). Doppler weather radar data reveal that several tall cumulonimbus clouds cluster together to form an MCS, an important finding in the quest for improved monsoon models, and for the design of new satellites to observe tropical rainfall.

Intra-seasonal (30-60 day) oscillations (ISO) of the summer monsoon are closely related to floods and droughts in India. ISO variance has decreased over the last six decades, while the frequency of extreme rainfall events has increased. Model experiments indicate that the increase in extreme rainfall events is responsible for the decline in ISO amplitude (Karmakar et al., Nature Sci. Rep. 2017).

Climate model simulations indicate a significant response of global climate to artificial reduction in runoff from the Amazon river into the Atlantic Ocean. Our simulations indicate that Amazon discharge has far-reaching influence on the climate of Europe, North America and the Arctic, by changing the atmospheric Hadley cell (Jahfer, Vinayachandran and Nanjundiah, Nature Sci. Rep., 2017).

Artificially reducing the local absorption of sunlight has been proposed to counteract rapid climate change in the Arctic. We investigated the impact of Arctic geoengineering on the monsoons using a climate model. The simulations indicate that Arctic geoengineering would lead to a southward shift of tropical rain belts, resulting in substantial decline of precipitation in the northern hemisphere monsoon regions (Nalam, Bala and Modak, Climate Dynamics 2017).

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Degree Programs offered **PhD, MSc (Engg) and MTech (Climate Science)**

IN NUMBERS

8 Academic Staff
37 PhD Students
2 MSc (Engg)
9 MTech
39 Publications
3 MSc (Engg)
2 MTech and
3 PhD Conferments

Chairperson: DEBASIS SENGUPTA

Faculty & Staff

G BALA | PhD (McGill), Professor

GS BHAT | PhD (IISc), FASc, Professor

ARINDAM CHAKRABARTHY | PhD (IISc), Associate Professor

RAVI S NANJUNDIAH | PhD (IISc), Professor

SK SATHEESH | PhD (Kerala), FASc, FNASc, FNA, Professor

DEBASIS SENGUPTA | PhD (Bombay), Professor

JAI SUKHATME | PhD (Chicago), Assistant Professor

PN VINAYACHANDRAN | PhD (IISc), FASc, FNA, Professor

VENUGOPAL VURPUTUR | PhD (Minnesota), Associate Professor

Associate Faculty

PROSENJIT GHOSH | PhD (Devi Ahiliya Vishwa Vidhyalaya, Indore), Associate Professor

Honorary Professor

J SRINIVASAN | PhD (Stanford), FASc, FNAE, FNA, Honorary Professor

3.5.3 CENTRE FOR EARTH SCIENCES

The faculty members 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, they are working on diverse problems in earthquake geology, global tectonics, core dynamics, ocean-atmosphere interaction, climate change and paleoclimate studies, petrology and geochemistry of igneous, sedimentary and metamorphic rocks, chemical weathering of the continents.

Current Research

Advances in understanding the mechanism of earthquakes along the India-Eurasia plate boundary-the Himalaya-Andaman-Sumatra and the oceanic intraplate activity in the Indian Ocean plate.

Mechanisms that support topography such as those in the India-Eurasia collision zone, investigating the stability of continental cratons; identification of the possible source of the Indian Ocean geoid low.

Insights obtained on tectonic correlation of India and Madagascar; CO_2 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

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IN NUMBERS

7 Academic Staff
30 PhD Students
2 MSc (Engg) and **10** MTech
32 Publications
2 MTech
2 PhD Conferments

Chairperson: **D NAGESH KUMAR**

the Sittampundi complex of southern India.

The first results on tangent cylinder convection obtained from the Little Earth Experiment. New insight on core-mantle interaction obtained from computational and experimental models developed in CEaS. A new constraint is proposed for the strength of Earth's toroidal magnetic field.

Estimating temperature of oil and gas formation in sedimentary strata. Retrievals of seasonality from fossil record of Phanerozoic age. Reconstruction of climate during Harappan civilization.

Geochemical and isotopic study melt droplets (spherules) from the Lonar crater, India, reveal the nature of the extra-terrestrial impactor, evaporation-condensation effects and melting of the Precambrian basement; Geochemical and isotopic studies reveal the origin of lamprophyre dykes from Wajrakarur, India from a modified sub-continental lithospheric mantle; Economically viable REE deposits from the beach placers of Andhra Pradesh were identified.

Seasonal variation in light stable isotope geochemistry of Godavari River: An attempt to quantify the role of chemical weathering of continental silicate rocks in controlling atmospheric CO2 concentrations.

Core Research

Dynamo theory, Planetary magnetism, Magnetohydrodynamics, Climate Change (Past and Present), Geobiology, Isotope Hydrology, Climate-Tectonics Interaction, Chemical Oceanography, Environmental Tracers, Microchronology, Petrology, Metamorphism, Isotope geochemistry, Origin and evolution of the Solar System, Crust-mantle processes, Paleoclimate reconstruction, Early life signatures, Solid Earth Geophysics, Lithosphere dynamics, Mantle convection, Mechanics of Faulting, Intraplate Seismicity, Seismic Hazard, Chemical weathering and planetary thermostat

Faculty & Staff

RAMANANDA CHAKRABARTI | PhD (Rochester), Assistant Professor

ATTREYEE GHOSH | PhD (Stony Brook), Assistant Professor

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Associate Faculty

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PP MUJUMDAR | PhD (IISc), Professor

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DEBASIS SENGUPTA | PhD (Bombay), Professor

JAI SUKHATME | PhD (Chicago), Assistant Professor

VENUGOPAL VURPUTUR | PhD (Minnesota), Associate Professor

3.5.4 CHEMICAL ENGINEERING

The Department of Chemical Engineering is a centre of excellence in chemical engineering research and education. It has 12 faculty and 67 students carrying out research in both fundamental and applied areas with a strong synergy with industry.

Current Research

(A) GRANULAR FLOW: The gravity flow of spherical particles through a vertical channel was simulated using the discrete element method. Preliminary results show that there are normal stress differences, a feature that is not prescribed by most of the available continuum models.

(B) HEPATITIS C TREATMENT: We performed analyses of current hepatitis C drugs and suggested combinations that would act the most potently.

(C) SOFT-PARTICLE SUSPENSIONS: The rheology and shape dynamics of soft particles suspended in a viscous fluid are being studied. Droplet microfluidics was used to synthesize particles of tunable stiffness.

(D) TRANSITION IN SOFT-WALLED TUBES: Two different types of transitions have been observed in the flow past soft surfaces. There is an initial soft-wall transition, where the wall motion is primarily tangential to the surface. This is followed by the wall flutter transition, where both tangential and normal displacement is observed.

(E) FLEXIBLE ELECTRONICS: Process development to fabricate nanostructured thin films on flexible substrates using low-cost additive patterning techniques such as inkjet printing, and product development to fabricate low-cost sensors for chemical/mechanical sensing were pursued.

Core Research

- Biomolecular and Biomedical Engineering
- Catalysis and Reaction Engineering
- Colloids and Interface Science
- Complex Fluids and Transport Processes
- Nanotechnology
- Energy Science and Engineering
- Environmental Engineering
- Thermodynamics, Statistical Mechanics and Molecular Simulations

(F) CLATHRATE HYDRATES: Clathrate hydrates were studied using Monte Carlo and molecular dynamics simulations. The theory has been considerably improved by including the flexibility of the water lattice in the partition function.

(G) CRYSTAL NUCLEATION: Crystal nucleation in systems such as binary hard-sphere mixtures, protein solutions and molecular crystals has been studied by calculating the free energy of formation of the critical nucleus inside the fluid phase.

(H) SUPERCAPACITORS AND FLOW BATTERIES: Techniques for atomistic simulations and a comprehensive continuum model is developed for supercapacitors. The model predicts extended charge-redistribution in super-capacitors, which is validated experimentally.

The soluble lead redox flow battery experiences strong lead concentration gradient driven natural convection. Measurements carried out using PIV confirm it. Designs based on split and staggered electrodes show promise.

(I) POINT-OF-CARE DIAGNOSTICS: An isothermal DNA amplification assay was developed for the detection of Tuberculosis and translated into paper.

(J) MEMBRANE BIOPHYSICS: Molecular dynamics simulations were used to study the interaction of pore forming toxins on lipid bilayer membranes. Dye leakage experiments and kinetic modelling studies reveal oligomeric protein arcs cause leakage. Super-resolution STED microscopy shows complex nanoscale domain formation.

(K) FLUIDS AT INTERFACES: Molecular simulations of water structure and dynamics on graphene-oxide materials reveal the influence of hydrophobic and hydrophilic patches on water adsorption and film growth. Molecular dynamics of fluids confined in slit pores reveal a glass-like structure and dynamics.

(L) CATALYSIS: A microkinetic model for CO oxidation over palladium-substituted ceria was developed. Platinum and ruthenium substituted titania catalysts were synthesized using the sonochemical method and used for reforming and partial oxidation. Photocatalysts using AgBr and Ag3PO4 with ceria nanoflakes as a substrate, and graphene oxide foams showed a high degradation of dyes and antimicrobial activity.

(M) GLYCOPROTEIN ENGINEERING: The Pichia N-glycosylation pathway was re-engineered to mimic the human type N-glycosylation. These modifications resulted in the conversion of the yeast Man9+20GlcNAc2 glycan structure to a more human like GlcNAc2Man3GlcNAc2 form.

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Degree Programs offered **PhD, MSc (Engg) and ME**

IN NUMBERS

15 Academic Staff

1 Scientific Staff

47 PhD Students

5 MSc (Engg), **4** MTech (Res), **9** MTech-D

41 Publications

3 MSc (Engg), **6** ME

11 PhD Conferments

Chairperson: **GANAPATHY K AYAPPA**

(N) FRICTION BETWEEN SOFT SURFACES: Studies are initiated to measure friction between soft surfaces and its modulation by adsorbed surface active molecules on them.

(O) NANOPORE ASSEMBLY: The kinetics of nanopore assembly by pore forming toxins was studied using single molecule imaging. Cholesterol was found to be a critical component for effective pore formation.

(P) AUGMENTED GIBBS-TOLMAN (AGT) MODEL FOR SURFACE TENSION: The Gibbs-Tolman (GT) model is used along with the Lee and Kesler equation of state to fit data on the variation of surface tension with temperature for a large number of liquids and liquid mixtures.

(Q) MICROBIAL FUEL CELL (MFC) FOR THE DENITRIFICATION OF WATER: A model is being developed for the biocathode (where denitrification occurs)

(R) FLUORESCENT BIOSENSORS: Two new biosensors for blood protein, thrombin and antibiotic, kanamycin were developed that allow 'one-pot' simple and sensitive fluorescence based detection.

(S) FUSIBLE MICROELECTRODES FOR IMPEDANCE CYTOMETRY: A facile and cheap method for generating microelectrodes was developed that allows sensitive and fast detection of single cells.

Faculty & Staff

GANAPATHY AYAPPA | PhD (Minnesota), Professor

NARENDRA M DIXIT | PhD (Illinois), Associate Professor

M GIRIDHAR | PhD (Texas A&M), Professor

SANJEEV KUMAR GUPTA | PhD (IISc), Professor

V KUMARAN | PhD (Cornell), Professor

JAYANT M MODAK | PhD (Purdue), Professor

PRABHU R NOTT | PhD (Princeton), Professor

SUDEEP PUNNATHANAM | PhD (Purdue), Associate Professor

K KESAVA RAO | PhD (Houston), Professor

RAHUL ROY | PhD (Illinois), Assistant Professor

BHUSHAN J TOLEY | PhD (Massachusetts), Assistant Professor

S VENUGOPAL | PhD (Purdue), Assistant Professor

3.5.5 CIVIL ENGINEERING

The department spans four major areas: Structural, Geotechnical, Water Resources and Environmental, and Transportation Engineering. A wide spectrum of research activities –analytical, numerical, and experimental – are pursued. In addition to the doctoral and masters research, a unique MTech program is offered where a student can opt for a major and a minor.

Current Research

Uncertainties in design and analysis in geotechnical engineering have been significant and hence risk and reliability analysis procedures have become important in geotechnical engineering. Development of reliability based design procedures for rock slopes and tunnels considering uncertainties have been developed. Use of geocell and geogrids as potential reinforcement and confinement layers has been explored and both experimental and numerical analysis results confirm the benefits of using these

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IN NUMBERS

22 Academic Staff
4 Scientific Staff
110 PhD Students
2 MSc (Engg), **8** MTech (Res), **60** MTech-D
141 Publications
3 MSc (Engg), **1** MTech, **25** ME
14 PhD Conferments

Chairperson: **SUDHAKAR M RAO**

materials in pavement layers. Design and analysis procedures for the use of geocells and geogrids in pavements have been developed. A constitutive model for municipal solid waste is developed and is used in the analysis of performance of lined landfills. Large-scale experiments have been conducted to understand the relationship between settlements, gas generation and leachate removal and circulation in conventional landfills and bioreactor landfills. The experimental and numerical analysis results highlight the importance of these factors in landfill design. Reliability based analysis is also performed on landfill systems.

Image based material characterisation, Microtopographical analysis of sand-geosynthetic interface friction, image based shape characterisation of granular materials, shear velocity dependent strength of jointed rocks, probabilistic stability analysis of rock slopes, scale effects in triaxial testing of reinforced sand.

The slip line method was extended to deal with the problem of determining the bearing capacity of ring foundation. The lower bound finite elements limit analysis approach was extended to deal with the Hoek & Brown yield criterion which is applicable to rocks. A method was established to determine the predominant modes while doing the analysis of layered ground media by using multi-channel analysis of surface waves.

Ground motion prediction equations (GMPE) are playing very important role in prediction of seismic hazards. However very limited region specific GMPE were developed in India. Study focussed on developing function form of GMPE and new GMPE applicable for wide range magnitude and distance were developed in first time for Himalayan region. New concept of integrated subsurface investigation was adopted to solve some peculiar industrial and research problems in geotechnical Engineering. In the integrated approach, limited drilling, possible Multichannel analysis of surface wave (MASW) and extensive GPR surveys were carried out to get the required information for the project.

Climate change impacts on hydrology/water resources, statistical downscaling of GCM outputs, urban flooding, risk and reliability assessment, planning and operation of large scale water resources systems, and uncertainty modelling, detection and attribution of hydrologic change, development of downscaling models and quantification and reduction of uncertainty in climate change impact assessment.

Understanding the mechanics of transitional geomaterials at multiple length scales. Advances in imaging (ex. tomography) and image processing for understanding inter-grain interactions and its manifestation at the ensemble level are used for this purpose. Theoretical and numerical explorations of this work is also carried out here.

Under transportation engineering research static and dynamic traffic network equilibrium, congestion pricing, stochastic shortest paths, shared mobility, transportation logistics, transit systems, evacuation models, have been studied. We are currently working on multiple-class traffic assignment models for mixed traffic conditions and on addressing the issue of bus bunching in transit networks.

Stochastic Hydrology covered development of approaches to estimate hydrological processes and environmental extreme events (design storms, floods, droughts) in sparsely gauged river basins.

Development of scalable solvers and application of high performance computing in uncertainty quantification, exploration of nano- and multi-scale mechanics targeted at developing novel materials.

Fire structural engineering: experimental and computational studies, including risk and reliability analysis of structures under fire load.

Faculty & Staff

P ANBAZHAGAN | PhD (IISc), Assistant Professor

GL SIVAKUMAR BABU | PhD (IISc), Professor

DEBRAJ GHOSH | PhD (Johns Hopkins), Associate Professor

JM CHANDRA KISHEN | PhD (Colorado), Professor

JYANT KUMAR | PhD (IISc), Professor

MS MOHAN KUMAR | PhD (IISc), Professor

D NAGESH KUMAR | PhD (IISc), Professor

GALI MADHAVI LATHA | PhD (IIT Madras), Professor

CS MANOHAR | PhD (IISc), Professor

PP MUJUMDAR | PhD (IISc), Professor

TEJAS GORUR MURTHY | PhD (Purdue), Assistant Professor

ANANTH RAMASWAMY | PhD (Louisiana), Professor

KS NANJUNDA RAO | PhD (IISc), Chief Research Scientist

P RAGHUVEER RAO | MSc (Engg) (Bangalore), Principal Research Scientist

M SUDHAKAR RAO | PhD (Pune), Professor

BV VENKATARAMA REDDY | PhD (IISc), Professor

DEBASISH ROY | PhD (IISc), Professor

R VIDYA SAGAR | ME (Bharatiyar), Principal Research ScientistM Shekar | PhD (IISc), Professor

VV SRINIVAS | PhD (IIT Madras), Professor

NARAYAN K SUNDARAM | PhD (Purdue), Assistant Professor

SITHARAM G THALLAK | PhD (Waterloo), Professor

S VENKATESHA | BE (Bangalore), Senior Scientific Officer

ASHISH VERMA | PhD (IIT Bombay), Assistant Professor

Core Research

Some major research thrust areas, are predictive science, theoretical and applied mechanics, large-scale testing, water resources and environmental engineering, and transportation engineering. While the analytical and computational research spans from theoretical development to high performance computing, the experimental research spans from laboratory based to field studies

3.5.6 CENTRE FOR PRODUCT DESIGN AND MANUFACTURING

Centre for Product Design and Manufacturing (CPDM) is among the most research and technology intensive design and manufacturing schools in India, steeped in the ambience of Indian Institute of Science (IISc). CPDM is the design and manufacturing face of IISc.

Current Research

(A) PRODUCT DEVELOPMENT PROCESS, INFORMATICS, INNOVATION: A web-based methodology and tool for automated generation of feedback-based sensor designs is developed. A model of the idea generation process has been proposed. A study to compare the effects of brainstorming with bio-inspiration on ideation revealed that concepts ideated using bioinspiration were at higher abstraction levels than those using brainstorming, and the average novelty of concepts produced using biocards to be greater than that using brainstorming. In another study, analogies from the biological domain were found to produce significantly greater novelty in designs over analogies from cross- and in-domain for less comprehensive explanations. In another study, interactions in design for significant parameters were found to influence the efficacy of interaction in both original and redesign processes. In another study, a hybrid representation is proposed to overcome the current limitations in modelling heterogeneous objects, such that the existing class

Core Research

PD Process, Informatics, Innovation, Entrepreneurship - creativity, biomimetics, KBS, PLM Human Factors – digital anthropometry, modelling, HMI, OHAS Technology Integration – Medical Devices, CAD/CAE Sustainability – green buildings, sustainable materials, design for BoP Materials and Manufacturing - computational metrology, metal foams, bio-composites, smart factory, additive manufacturing

of material functions (distance based function) can be used to define desired material variation in heterogeneous objects.

(B) HUMAN FACTORS: A finite element model is developed to determine the stress on the discs adjacent to the fused segment following different types of floating lumbar spinal fusions. In another study, an in-house-developed 50 degree-of-freedom multi-occupant vehicle model is employed to obtain the vehicle and occupant biodynamic responses for various cases of vehicle velocities and road roughness. A study is carried out to explain why there are varying number of elements used by designers and how one can expand the basic elements of design, form and colour. Another study compared three different input modalities for the performance index, cognitive load and the system usability. In another study, to improve pointing speeds for people with arm or hand impairments, different smoothing and prediction models are compared, and the best algorithms ascertained.

(C) MATERIALS AND MANUFACTURING: A novel approach for tracking body segments of workers in real-time and for analysing the tracked data to identify distinct events in an assembly process has been developed; this paves way for automated, real-time assessment of assembly difficulty and its sources. To support reuse of legacy knowledge in appropriate manufacturing scenarios, automated identification of the context of diagnostic knowledge from documents is needed; a method for understanding the context of issues in documents is proposed.

(D) SUSTAINABILITY: An uncertainty category called 'solution-variant definition' has been proposed to assess the uncertainty involved in assessing environmental impacts of design concepts, thereby allowing design for sustainability to be applied earlier in product development, with profound impact on the product with respect to its environmental-benignity. A web-based tool called InDeaTe for knowledge-driven, sustainable design process support is developed for improving sustainability considerations in design. The tool has been tested in six case studies in India and the USA, with significant improvements in design of sustainable systems.

(E) TECHNOLOGY INTEGRATION: In one study, numerical prediction of the behaviours of axially impacted adhesively bonded double-hat section components has been carried out using explicit finite element modelling and analysis. In another study, the effectiveness of advanced CAE (Computer-Aided Engineering) tools for predicting the mechanical behaviour of jute fiber-reinforced plastics (JFRP) has been demonstrated. An automatic and direct method to manipulate global parameters of the object for prototyping and simulation, given an STL mesh model

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Degree Programs offered **PhD, MSc (Engg) and MDes**

IN NUMBERS

7 Academic Staff
1 Scientific Staff
51 PhD Students
51 MDes, **7** MSc (Engg), **1** MTech (Res)
42 Publications
14 MDes, **2** MSc (Engg)
4 PhD Conferments

Chairperson: **AMARESH CHAKRABARTI**

of a thin-walled object is proposed; it is useful in rapid prototyping, where changing the global parameters of an STL mesh is often required. Another work revisits the classical envelope theory in plane, which deals with two planar curves in a point contact moving in relative roll-slide motion. The well known result about the centres of curvature of the generating curve and the envelope curve behaving as coordinated centres, is shown to be valid even if the instantaneous relative angular velocity is zero. Intravenous (IV) drip usage and its associated risks are reviewed and a solution is proposed to enable monitoring and control of IV drip based on sensing of drops falling through the drip chamber. Such a device will potentially reduce complication and provide peace of mind to users of IV drip system.

Faculty & Staff

MANISH ARORA | PhD (Twente), Assistant Professor

PRADIPTA BISWAS | PhD (Univ of Cambridge), Assistant Professor

AMARESH CHAKRABARTI | PhD (Cambridge), Professor

ANINDYA DEB | PhD (New York), Professor

B GURUMOORTHY | PhD (Carnegie Mellon), Professor

RINA MAITI | PhD (IIT Bombay), Assistant Professor

DIBAKAR SEN | PhD (IISc), Associate Professor

ND SHIVAKUMAR | ME (Bangalore), Principal Research Scientist

Associate Faculty

GK ANANTHASURESH | PhD (Michigan), Professor

JAYWANT ARAKERI | PhD (Caltech), Professor

ASHITAVA GHOSAL | PhD (Stanford), Professor

PARAMESHWARA P IYER | PhD (UC), Principal Research Scientist

SATISH VASU KAILAS | PhD (IISc), Professor

MONTO MANI | PhD (IIT Madras), Associate Professor

3.5.7 CENTRE FOR SUSTAINABLE TECHNOLOGIES

The Centre for Sustainable Technologies established in 1974 as ASTRA (Application of Science and Technology for Rural Areas), pursues cross-cutting collaborative research in areas of sustainable energy, buildings and environment. Current research addresses a host of global concerns while focusing on decentralized S&T based interventions: efficient use of primary resources, development of low energy buildings, building integrated photovoltaics, waste & sanitation, clean & renewable energy, waste management including sanitary land filling, waste to energy, waste recycling & waste disposal, bio-mass for energy, plasma technology, bio-methanation, turbomachinery research for energy & water pumping.

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Degree Programs offered **PhD and MTech (Res)**

IN NUMBERS

5 Academic Staff
1 Scientific Staff
25 PhD Students
1 MSc (Engg), **1** MTech (Res)
31 Publications
2 PhD Conferments

Chairperson: **B V VENKATARAMA REDDY**

Current Research

(A) BIOENERGY AND BIOMASS: Anaerobic digestion of biomass for energy and treatment of wastewater, including biofilms to treat xenobiotic dosed greywater. The major focus on the thermo-chemical conversion of biomass is towards generating PEM quality hydrogen- 99.999 % purity for transport sector. Establishing renewable energy fuel for Solid Oxide fuel cell (SOFC)

(B) FUEL EFFICIENT DEVICES: Development of a stove-mould assembly for rapid self-construction of fuel-efficient domestic cooking and bath stoves, jaggery furnaces and driers with high operating efficiency and lower cooking time in comparison other technologies

(C) CLIMATE RESPONSIVE ARCHITECTURE: Building and architectural sciences dealing with climate-responsive performance of buildings, experimental investigation into the thermal resilience of vernacular and conventional building materials in response to climate change. Integrability investigations into the BIPV performance comprising building thermal comfort and PV performance in Tropical Regions

(D) SUSTAINABILITY & DESIGN: Design for the BoP, adopting Capability Approach, in the development of a de-skilling mould for construction of firewood cookstoves. Sustainability science based on systems thinking to assess and forecast sustainability in design and technology, and the identification of suitable design based interventions

(E) LANDFILL ENGINEERING: Model bioreactors and their performance is against available literature models. Design of landfill components such as liners, covers, leachate collectors and site location are studied using risk and reliability analysis principles

(F) TURBOMACHINERY: Designing and building turbomachinery equipment covering both generation and utilization aspects of renewable energy including decentralized systems. Hydro turbomachinery and thermal turbomachinery (organic rankine cycles, high pressure ration steam, and super critical CO2) are included. Innovative machinery for pumped hydro energy storage

(G) PLASMA TECHNOLOGY: Non-Thermal Plasma Cleaning, Enrichment and Reforming of Gaseous Hydrocarbons. Plasma activated water characterization and its application for surface hygiene and food preservation. Plasma grey water treatment for recycling purposes.

(H) BUILDING MATERIALS: Industrial waste blast furnace slag is being studied for its use as fine aggregate in mortar and concrete

Core Research

Biomethanation; Energy Efficient Wood Burning Devices; Alternative & Green Building Technologies; Sustainable Architecture and climate-responsive designs; Building Integrated Photovoltaics; Sanitation; Waste Management; Turbomachinery for Renewable Energy; Bioenergy; Plasma reforming of syngas, Plasma activated water and Plasma waste water treatment, Plasma Assisted Combustion, Plasma reforming of heavy hydrocarbons; Hydrogen from Biomass, SOFC; Building materials from non-organic solid wastes

Faculty & Staff

HN CHANAKYA | PhD (UAS), Chief Research Scientist

S DASAPPA | PhD (IISc), Associate Professor

MONTO MANI | PhD (IIT Madras), Associate Professor

LAKSHMINARAYANA RAO M P | PhD (McGill Univ, Canada), Assistant Professor

PUNIT SINGH | PhD (Karlsruhe), Assistant Professor

D VENKATA KRISHNAPPA | MSc (Bangalore), Scientific Assistant

Associate Faculty

GL SIVAKUMAR BABU | PhD (IISc), Professor

P BALACHANDRA | PhD (IISc), Principal Research Scientist

JAYANT M MODAK | PhD (Purdue), Professor

K S NANJUNDA RAO | PhD (IISc), Chief Research Scientist

TV RAMACHANDRA | PhD (IISc), FNESA, FIE, FIEE(UK), FIH, Scientific Officer

M SUDHAKAR RAO | PhD (Pune), Professor

BV VENKATARAMA REDDY | PhD (IISc), Professor

3.5.8 DIVECHA CENTRE FOR CLIMATE CHANGE

The primary goal of the Divecha Centre for Climate Change is to understand climate variability and climate change and its impact on the environment. The Centre is working with various departments to identify technologies to mitigate/reduce the severity of climate change. The Centre frequently undertake outreach activities to create awareness among people and policy makers about climate change and its consequences especially on society.

Current Research

(A) DIVECHA CENTRE GRANT FROM THE GRANTHAM FOUNDATION (GFPE-001): Mainly, we are involved in various topics related to atmospheric science, Himalayan glaciers and basic and applied research in renewable energy. Experiments using high-altitude balloons have shown large amounts of black carbon aerosols at higher atmospheric levels. Model simulations have shown that while biomass burning and near-surface anthropogenic activities together with boundary layer dynamics can explain at least part of the lower layer, upper layer can be explained only by including emissions from high-flying aircrafts. Our studies indicate that that once black carbon aerosols are emitted at higher atmospheric levels, they can be lofted further via absorption-warming-convection cycles, which could propel them even to the stratospheric heights. Once they reach stratospheric heights, chemical reactions occurring over their surfaces could have strong implications for the ozone layer. The effect of atmospheric conditions like aerosols, temperature and water vapour on the power output has been studied using Concentrated Photo Voltaic (CPV) modules on a dual-axis sun tracker. We are also involved in research to fabricate thin film solar cells, which are semi-transparent following low cost processes. The envisaged application for these cells is for windows and skylights of buildings. We have studied various aspects of GHG inventory, mitigation and adaptation for India to meet the requirements of the Paris Agreement. They have identified requirements for modelling and measurements at the national, state, industry and municipal levels as well as research and

Core Research

Glaciers, Renewable Energy, Aerosols and their impacts on climate, Atmospheric boundary layer, Cloud Physics, Geophysical fluid dynamics, Monsoon variability and predictability, Numerical simulation of the Atmosphere-Ocean-Climate system, Paleoclimate studies, Physical-Chemical-Biological oceanography, Satellite meteorology, Space-time structure and scaling in geophysical data, Tropical convection

capacity building requirements for enabling India to meet these requirements.

(B) DST GRANT: Studies on glaciers have shown that though the rates of retreat of individual glaciers are uncertain, on the whole the Himalayan glaciers are losing mass at an increasing rate over the past few decades. With the changing climate, glaciers would continue to shrink and the rates of retreat may increase even further. This can lead to the formation of glacial lakes, which, with continued accumulation of glacier melt could burst leading to catastrophic impacts on human life, settlement and infrastructure downstream. By using glacier surface velocity, estimated using high spatial resolution satellite data and slope, we have calculated ice thickness, by applying a basic parallel flow model, subsequently outlining the bed topography and located potential lake sites in over-deepening in the bedrocks. We have also developed a model to predict the future expansion of lakes. The slide shows how the measurements go in line with the model projection. The model predictions have been validated using field investigations. A proposal to avoid flash flood has been accepted by the government of Sikkim, a north eastern state in India.

Associate Faculty

G BALA | PhD (McGill), Professor

GS BHAT | PhD (IISc), FASc, Professor

ARINDAM CHAKRABORTY | PhD (IISc), Associate Professor

PROSENJIT GHOSH | AP/CEaS, Associate Faculty

ANIL V KULKARNI | PhD (Kolhapur), Distinguished Visiting Scientist

VIRAJ KUMAR | PhD (Illinois), Visiting Professor

PP MUJUMDAR | PhD (IISc), Professor

RAVI S NANJUNDIAH | PhD (IISc), Professor

SK SATHEESH | PhD (Kerala), FASc, FNASc, FNA, Professor

DEBASIS SENGUPTA | PhD (Bombay), Professor

J SRINIVASAN | PhD (Stanford), FASc, FNAE, FNA, Emeritus Professor

RAMAN SUKUMAR | PhD (IISc), Professor

PN VINAYACHANDRAN | PhD (IISc), FASc, FNA, Professor

VENUGOPAL VURPUTUR | PhD (Minnesota), Associate Professor

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IN NUMBERS

32 Publications

Chairperson: **S K SATHEESH**

3.5.9 MATERIALS ENGINEERING

Established in 1945 as Department of Metallurgy and re-named in 2006, the Department of Materials Engineering has a rich history of accomplishments, with active groups pursuing research into materials phenomena spanning multiple length and time scales. With nearly 200 research papers published each year, and with academic programmes leading to bachelors, masters and doctoral degrees, it is recognized as a leading academic centre in materials education and research.

Current Research

The Department has active research groups working on a wide range of materials classes and phenomena covering synthesis, processing and properties of metallic alloys, structural and functional ceramics, polymers, and nanocomposites; biomaterials; design and development novel materials; electronic devices and packaging; materials for energy applications; coatings; and computational modelling. We describe below some of the research highlights from 2017.

Prof. Praveen Kumar and his team have demonstrated that passage of a high-density electric current pulse can lead to fracture of pre-cracked thin films at far lower mechanical stresses than those required to fracture films without electric current. Using numerical simulations and experiments, the group has established that the fracture in such structures occur by propagation of sharp cracks, and in certain cases, by formation and propagation of blow holes. This understanding has led to the development of the concept for a novel electro-mechanical machining technology.

Dr. Abhik Choudhury and his team reported a key advance in the theory of multiphase growth in multicomponent alloys; specifically, they have generalized the classical Jackson-Hunt theory for eutectic growth to solidification of any number of phases in a multicomponent alloy, and have shown, for the first time, that the volume fractions of the phases during coupled growth changes as a function of component diffusivities (which form a diffusivity

Core Research

Polymers and nanocomposites; Biomaterials; Structural metals and alloys; High temperature coatings; Electronic and structural ceramics; Electronic packaging materials; Mineral processing; Energy materials; Computational Modelling

matrix). They have also shown that an asymmetry in this matrix may lead to tilted growth forms during three-phase eutectic growth.

In an attempt to mimic the topography of insect wings, Prof. Kaushik Chatterjee and his team have developed nanostructured surfaces with nanoscale pillar-like structures on titanium by ion etching; they have found that these nanostructures impart bactericidal activity to titanium by mechanical rupture of the cells that contact the surface. After optimizing the surface topography, they have shown that it is also possible to avoid this type of damage to the human stem cells which may eventually be converted to bone-like cells. This study suggests that surface engineering can be used to modify the surface of metallic implants (many of which are made of titanium alloys) and opens up new avenues to minimize implant-related bacterial infections.

Professor Dipankar Banerjee and his group have studied the mechanism of recrystallization in two-phase structures of technologically interesting titanium alloys. They have discovered an unusual "epitaxial" recrystallization of the two phases in an interdependent manner and explored the consequences of this mechanisms for microstructure evolution during processing of these alloys.

The collaborative work involving the groups of Prof. Aloke Paul, Prof. Praveen Kumar and Prof. K. Chattopadhyay has shown evidence of bifurcation of the Kirkendall marker plane, a very special phenomenon discovered recently, in a technologically important Cu–Sn system. This finding has been rationalized within the framework of the physicochemical approach (established earlier by Prof. Paul's group) that relates microstructural evolution with diffusion rates of components. In another work, Prof. Paul's group has shown that the addition of small quantity of Ni has a great influence on diffusion rates of components (and the location of the marker plane), leading to exceptional increase in the growth rate of the product phases.

In functional electro-ceramics, fundamental contributions have been made by Prof. Rajeev Ranjan and his team, who have demonstrated that the extraordinary piezoelectric response in (Ba,Ca)(Ti, Sn) O3 piezoceramic is due to an unusual combination of two seemingly contrasting phenomena: increase in the spontaneous polarization, and concomitant decrease in the spontaneous lattice strain. Using an innovative experimental approach of "powder poling," the group has also demonstrated that loss of piezoelectricity in small grain size ceramics is due to the inability of the domains to switch due to mutual clamping of the grains in the ceramic body.

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Degree Programs offered **PhD, MSc (Engg), ME and BS**

IN NUMBERS

19 Academic Staff

4 Scientific Staff

119 PhD Students

2 MSc (Engg), **2** MTech (Res), **35** MTech-D

188 Publications

24 ME

16 PhD Conferments

Chairperson: TA ABINANDANAN

Associate Faculty

TA ABINANDANAN | PhD (Carnegie Mellon), Professor

GS AVADHANI | PhD (IISc), Principal Research Scientist

DIPANKAR BANERJEE | PhD (IISc), FASc, FNA, FNAE, FNASc, FIIM, Professor

SURYASARATHI BOSE | PhD (IIT Bombay), Assistant Professor

KAUSHIK CHATTERJEE | PhD (Penn State), Assistant Professor

ATUL H CHOKSHI | PhD (USC), FASc, FNASc, FNA, FNAE, FIIM, Professor

ABHIK N CHOUDHURY | PhD (Karlsruhe), Assistant Professor

SUBHO DASGUPTA | PhD (TUD, Germany), Assistant Professor

RJ DESHPANDE | MSc (Engg) (IISc), Senior Scientific Officer

GOVIND S GUPTA | PhD (Wollongong), Professor

VIKRAM JAYARAM | PhD (Stanford), FASc, FNASc, FNAE, FACerS, FIIM, Professor

S KARTHIKEYAN | PhD (Ohio State), Associate Professor

PRAVEEN KUMAR | PhD (USC), Assistant Professor

SUBODH KUMAR | PhD (London), Professor

P PADAIKATHAN | MSc (Engg) (Bangalore), Senior Scientific Officer

ALOKE PAUL | PhD (Delft), Associate Professor

ASHOK M RAICHUR | PhD (Nevada), FRSC, Professor

PRAVEEN C RAMAMURTHY | PhD (Clemson), Associate Professor

U RAMAMURTY | PhD (Brown), FNA, FNAE, FASc, Professor

RAJEEV RANJAN | PhD (BHU), Associate Professor

R RAVI | PhD (IISc), Principal Research Scientist

VIJAY SETHURAMAN | PhD (South Carolina), Assistant Professor

CHANDAN SRIVASTAVA | PhD (Alabama), Associate Professor

S SUBRAMANIAN | PhD (Mysore), FIIM, Professor

MK SURAPPA | PhD (IISc), FNAE, FNA, Professor

SATYAM SUWAS | PhD (IIT Kanpur), Professor

Honorary And Emeritus Professors

KAMANIO CHATTOPADHYAY | PhD (BHU), FASc, FNASc, FNA, FNAE, FIIM, Honorary Professor

KT JACOB | PhD (London), DSc (Engg) (London), FASc, FNASct FNA, FNAE, FIIM, Emeritus Professor

KISHORE | PhD (IISc), Emeritus Professor

KA NATARAJAN | PhD (Minnesota), DSc (IISc), FASc, FNASc, FNAE, FIIM, Emeritus Professor

S RANGANATHAN | PhD (Cambridge), FASc, FNA, FNASc, FNAE, FTWAS, FIIM, Emeritus Professor

3.5.10 MECHANICAL ENGINEERING

Mechanical Engineering activities at the Indian Institute of Science commenced with the establishment of the Department of Internal Combustion (IC) Engineering in 1945. The Mechanical Engineering section of the Power Engineering Department was established in 1951, and later became a full-fledged Mechanical Engineering department (ME). The IC Engineering Department merged with the ME Department to give it its present form in 1970. Research interests in the department have evolved to span a broad range of areas, from the traditional to emerging fields to achieve a unique balance that strives to extend the research frontiers with applications in related industries. As a result, students are exposed to international standards and current research methodologies to problems of relevance. The department offers Master of Engineering (ME/MTech), Master of Science in Engineering (MSc/MTech(Res)) and Doctor of Philosophy (PhD) degrees.

Current Research

(A) BIOMECHANICS: Nonlinear mechanics of soft biological tissues and elastomers; protein rubbers; mechanical characterization of biological cells; mechanobiology and bio-micromanipulation; bio-reactors and cell culture in scaffolds and computational design of proteins; biomaterials research and biomimetics; tissue engineering.

(B) COMBUSTION & SPRAY RESEARCH: Multi-dimensional modelling of processes involving two-phase flow, turbulence and combustion chemistry; application of laser-based diagnostic techniques in combustion and multiphase flow research; fuel spray characterization using shadowgraphy and interferometric Mie imaging techniques; trapped-vortex based combustor research, Laser-Induced Incandescence (LII) imaging for soot formation studies.

(C) FLUID MECHANICS: Stability of unsteady boundary layers; unsteady boundary layer separation; transition and turbulence; turbulence modelling; fish-like propulsion; shear flow control, stall flutter; shock boundary layer interaction; drag reduction using micro-bubbles; two-phase electro-hydrodynamics; atomization of liquid jets.

(D) FRACTURE MECHANICS AND TRIBOLOGY: Fretting friction mechanics; impact fracture and

Core Research

Biomechanics, Internal Combustion Engines and Technical Acoustics, Mechanical Systems and Design, MEMS, Semi-solid forming, Solid Mechanics, Thermal Sciences & Fluid Mechanics, Fracture Mechanics and Tribology

fragmentation dynamic, mixed mode, indentation; thin film; tribology; contact mechanics of impact and indentation; nanotribology of boundary lubrication; metal cutting, metal working; scanning probe microscopy; fracture of single crystals, polycrystalline alloys and amorphous metals, computational fracture mechanics; nano composite coatings and mechanics at small scales; effect of roughness and surface asperities on the solid-liquid interface, eco-friendly, cutting oil studies.

(E) MECHANICAL SYSTEMS AND DESIGN: Structural and dimensional synthesis of kinematic and compliant mechanisms; theoretical kinematics; multi-disciplinary design optimization; dynamics and control of robot and multi-body mechanical systems; computer-controlled mechanical systems; bio- medical devices; constructing 3D models from sketches, assembly sequence planning and evaluation, tools for early stages in design, nonlinear dynamics, vibrations, structural shape and topology optimization, kinematic assembly modelling, geometric and topological modelling.

(F) ADVANCED MANUFACTURING AND METAL CASTING: Friction stir welding and friction stir processing; semisolid forming; die casting and squeeze casting; mould design and metal flow analysis by CFD; computer aided design of nearnet shaped castings; meso-scale manufacturing with metals.

(G) MICROSYSTEMS: Modelling, design, and micro-fabrication of Micro-Electro-Mechanical Systems (MEMS); energetics of micro and nano devices; nano-mechanics; acoustic sensors, rate gyroscopes, accelerometers, ultrasound sensors, and polymer pumps; development of analysis tools for coupled multi-physics problems; optimal synthesis methods for MEMS; micromanipulation; in-situ TEM nanoindentation, deformation mechanisms of materials.

(H) THERMAL SCIENCES: Turbulent Rayleigh-Benard convection; double-diffusive convection, mixed convection, heat pipes, heat exchanges, thermal management of electronic systems; heat and mass transfer in buildings natural ventilation, spent nuclear fuel cases, heat and mass transfer in food products; two phase flows and heat transfer, heat transfer in renewable energy systems; solar thermal systems, numerical heat transfer; refrigeration and air-conditioning; automotive climate systems, adsorption coolers and gas storage; mathematical modelling and simulation of thermal systems; thermal modelling and experimentation in solidification; fluid flow and heat transfer at micro/nano scales, encapsulated nanoparticles for thermal storage.

(I) INTERNAL COMBUSTION ENGINES: Diesel Engines, Spark Ignition Engines with other small engine test beds, eddy-current dynamometers, exhaust gas analyzers, crank angle encoder, manifold and in-cylinder pressure transducers, load panels, data acquisition system, Bio-fuels, Fuels transesterification, Engine Performance, Combustion diagnostics, Emission analysis, and other engines related experimental as well as computational research work.

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IN NUMBERS

20 Academic Staff
5 Scientific Staff
121 PhD Students
13 MSc (Engg), **8** MTech (Res)
37 MTech-D, **1** ME
125 Publications
5 MSc (Engg), **17** ME
20 PhD Conferments

Chairperson: **PRADIP DUTTA**

(J) TECHNICAL ACOUSTICS: Automotive noise control; vibration diagnosis of rotating machinery; acoustics of ducts and mufflers; industrial noise control; acoustic characterization of absorbing materials. sound from turbulent flows, asymptotics in structural acoustics, nonlinear structural acoustic interactions.

Faculty & Staff

GK ANANTHASURESH | PhD (Michigan), Professor

JAYAWANT H ARAKERI | PhD (Caltech), Professor

SAPTARSHI BASU | PhD (Connecticut), Associate Professor

M S BOBJI | PhD (IISc), Associate Professor

C DHARUMAN | MSc (Engg) (IISc), Senior Scientific Officer

PRADIP DUTTA | PhD (Columbia), Professor

ASHITAVA GHOSAL | PhD (Stanford), Professor

RAGHURAMAN N GOVERDHAN | PhD (Cornell), Associate Professor

NAMRATA GUNDIAH | PhD (California), Associate Professor

M HIMABINDU | PhD (Anna), Senior Scientific Officer

CHANDRASEKHAR S JOG | PhD (Urbana), Professor

SATISH V KAILAS | PhD (IISc), Professor

PRAMOD KUMAR | PhD (IISc), Assistant Professor

R THIRUMALESWARA NAIK | PhD (IIT Delhi), Scientific Officer

GSVL NARASIMHAM | PhD (IISc), Chief Research ScientistR Narasimhan | PhD (Caltech), Professor

RAMSHARAN RANGARAJAN | PhD (Stanford), Assistant ProfessorR V Ravikrishna | PhD (Purdue), Professor

RATNESH K SHUKLA | PhD (California), Assistant ProfessorK R Yogendra Simha | PhD (Maryland), Professor

VENKATA R SONTI | PhD (Purdue), Associate Professor

GAURAV TOMAR | PhD (IIT Kanpur), Assistant Professor

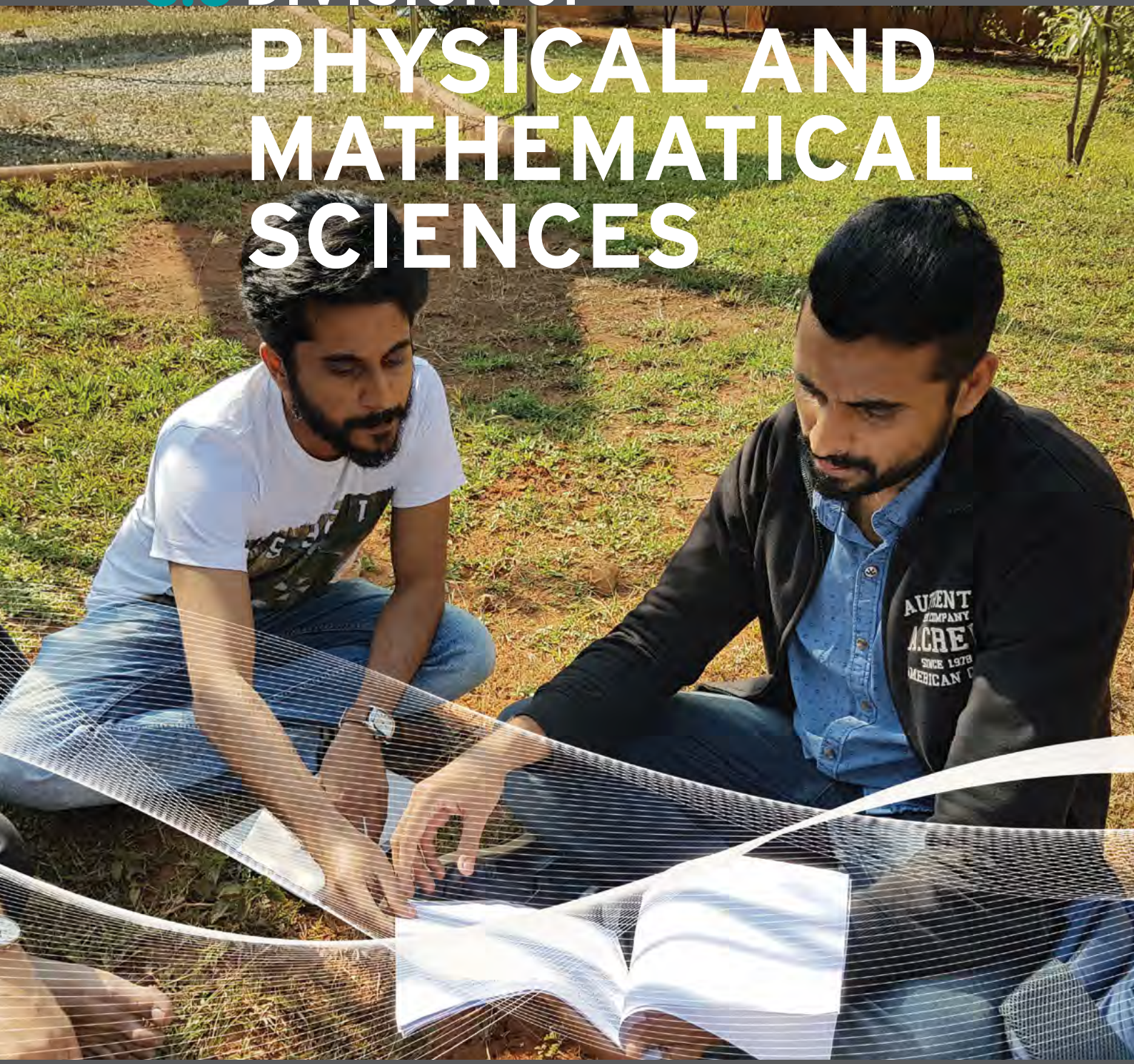
MK VENKATARAMAN | MSc (Engg) (IISc), Scientific Officer

Associate Faculty

B GURUMOORTHY | PhD (Carnegie Mellon), Professor

DIBAKAR SEN | PhD (IISc), Associate Professor

3.6 DIVISION OF PHYSICAL AND MATHEMATICAL SCIENCES



Research in the Division covers a wide variety of areas in the Physical Sciences, including fundamental investigations in String Theory, Particle Phenomenology, Field Theory, Condensed Matter Physics, both theoretical and experimental, Soft-Matter and Complex Systems, Biology-Inspired Physics, Biomolecular Structure and Biophysics, Atomic and Optical Physics, Astronomy and Astrophysics, and cutting-edge Applied Physics research including MEMS-based and Fibre-Optic Sensors, Multifunctional Materials, such as graphene and carbon nanotubes, Super-Resolution Fluorescence Microscopy, Nano-Scale Imaging, Optics and Microfluidics, Energy- and Health-Monitoring Instrumentation, and Cryogenic Technologies, including Cryocoolers, Cryogenic Instrumentation, and Cryogenic treatment on materials. Research in Mathematics covers major areas, both pure and applied, including Probability, Partial Differential Equations, Analysis, Geometry, Topology, Algebra, Algebraic Geometry, and Analytic Number Theory.

Themes

Given the diversity of this Division, there is a diversity of themes in research. These can be gleaned from the core research areas mentioned above. Many of these areas lie in the exact sciences, both theoretical and experimental. Along with these, there are growing interdisciplinary programmes, such as in Mathematical Biology and Nanoscience. Translational research is also being carried out and products, based on innovative and cutting-edge technologies, are being brought into the market by faculty entrepreneurs in the division.

DEPARTMENTS | CENTRES | UNITS

- CENTRE FOR CRYOGENIC TECHNOLOGY
- CENTRE FOR HIGH ENERGY PHYSICS
- INSTRUMENTATION AND APPLIED PHYSICS
- MATHEMATICS
- PHYSICS

IN NUMBERS

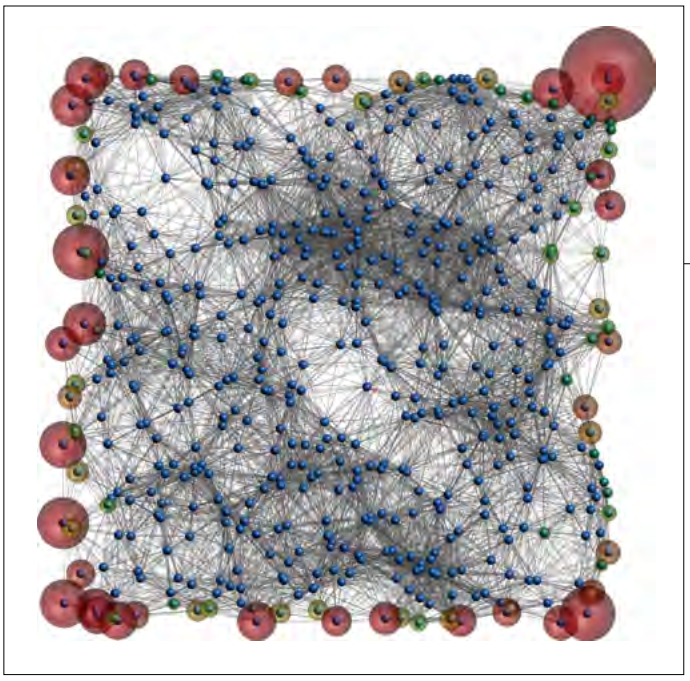
- 93 FACULTY MEMBERS
- 283 PHD STUDENTS
- 8 MASTER'S STUDENTS
- 65 INT PhD STUDENTS

Research Highlights

The Division of Physical and Mathematical Sciences comprise the Departments of Instrumentation and Applied Physics, Mathematics, and Physics, including the Astronomy and Astrophysics Programme, and the Centres of High Energy Physics (CHEP) and Cryogenic Technology (CCT)

Faculty members in this Division have received several awards and honours for their research. Their research has been supported by grants from major agencies and ministries such as the Department of Science and Technology, The Council for Scientific and Industrial Research, the Department of Biotechnology, the Defence Research and Development Organisation, the Indian Space Research Organisation, and the University Grants Commission. A brief report of their research, over the past year, is given below

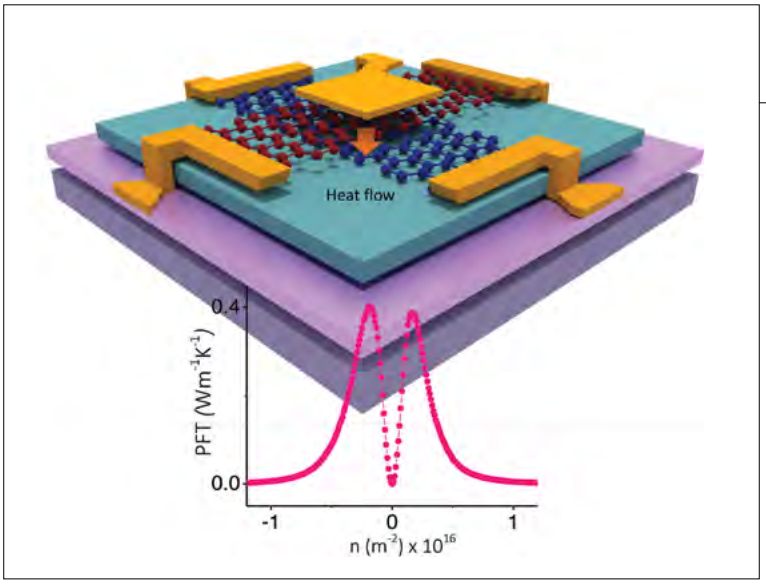
RESEARCH SNAPSHOTS 2017-18



1. Vijay Shenoy (PHY)

Theoretical work establishes that topological insulators, materials which conduct only on the surface, can be realized in glassy (amorphous) materials. The image shows one such topological surface state in a model glass, where an electronic wavefunction lives on the edge of the sites that are arranged randomly.

Reference: A Agarwala, VB Shenoy (2017) Topological Insulators in Amorphous Systems. *Phys. Rev. Lett.* 118: 236402

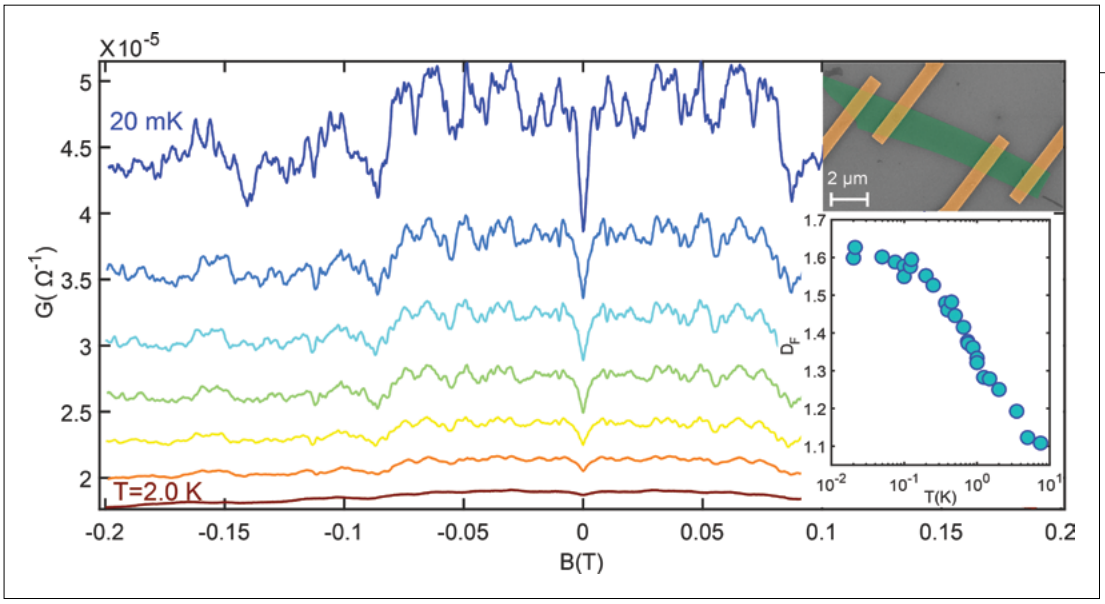


2. Arindam Ghosh (PHY)

Thermoelectricity at the atomic scale: The researchers have created a new class of thermoelectric device by placing two layers of graphene at a separation of 0.5 nanometres (the van der Waals distance). A temperature difference between the layers gives rise to several tens of microvolts of voltage difference and large power factor (PFT), making it the thinnest known thermoelectric system.

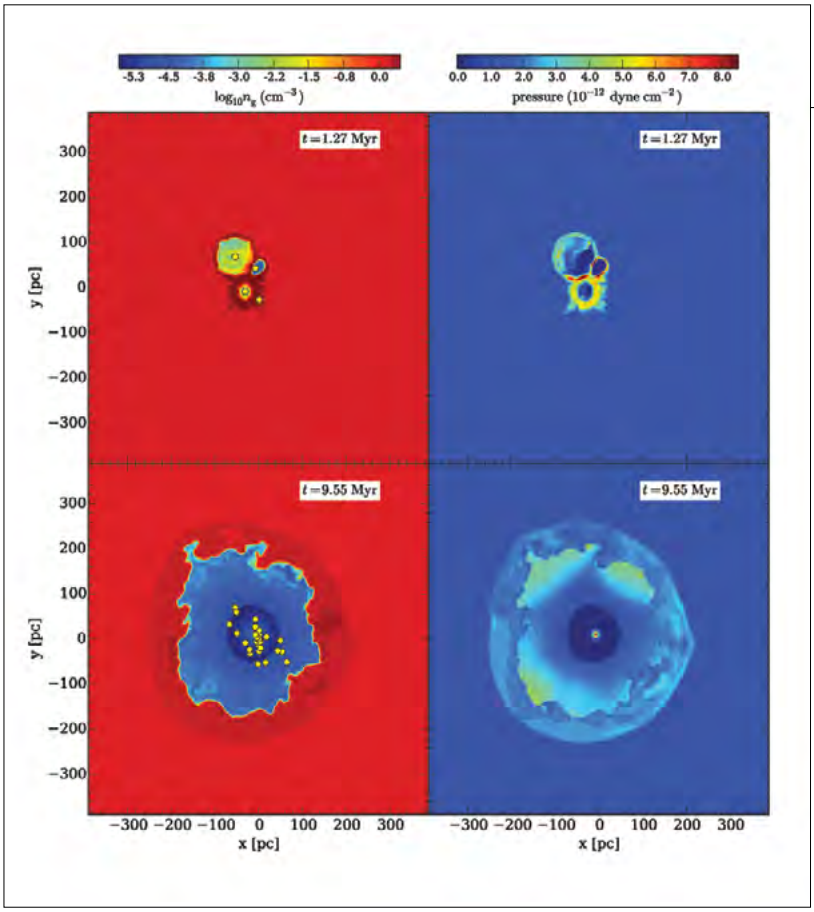
Reference: PS Mahapatra, K Sarkar, HR Krishnamurthy, S Mukerjee and A Ghosh (2017) Seebeck Coefficient of a Single van der Waals Junction in Twisted Bilayer Graphene. *Nano Letters.* 17(11):6822–6827

3. Aveek Bid (PHY)



This study reports the first observation of multifractality of electrical conductance at ultra-low temperature in single-layer graphene in the presence of a strong magnetic field. The figure shows plots of conductance of single-layer graphene device (shown in top-right corner) at different temperatures, while the bottom-right inset shows the temperature dependence of the fractal exponent.

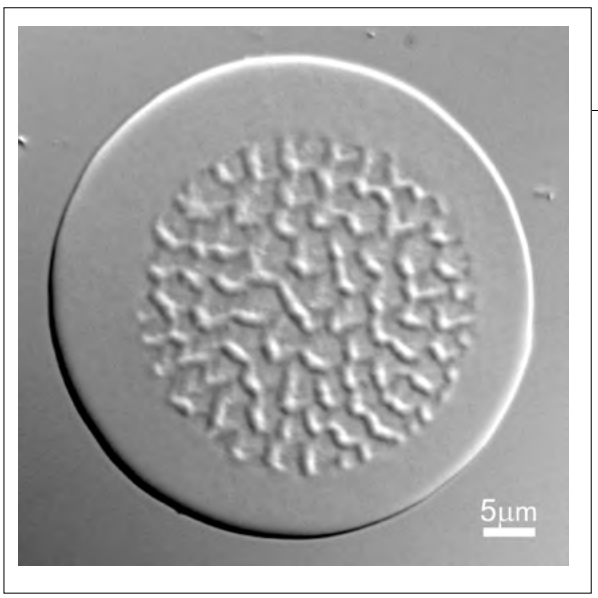
Reference: KR Amin, SS Ray, N Pal, R Pandit, and A Bid. Exotic Multifractal Conductance Fluctuations in Graphene. *Communications Physics* (in Press)



4. Prateek Sharma (PHY)

Gas density (left panels; log-scale) and pressure (right panels; linear scale) snapshots in the midplane of a 3D hydrodynamic simulation showing the transition of individual supernovae into a superbubble. The yellow circles in the left panels show the projected location of supernovae that have gone off till a given time. One can see the transition of isolated supernovae that fizzle out to a pressurized superbubble formed due to the overlap of supernovae.

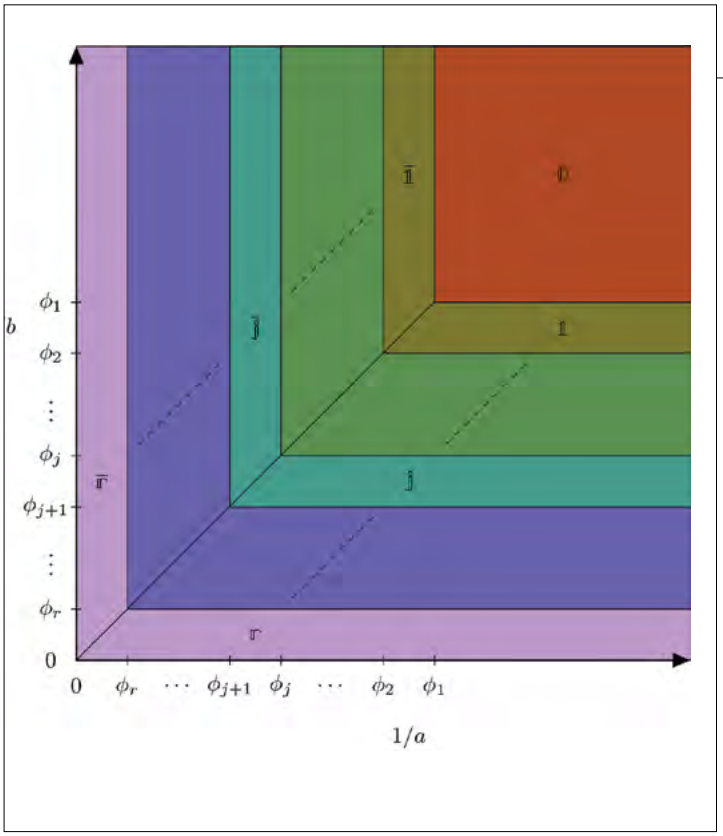
Reference: N Yadav, D Mukherjee, P Sharma, BB Nath (2017) How Multiple Supernovae Overlap to Form Superbubbles. *Monthly Notices of Royal Astronomical Society.* 465:1720



5. Prerna Sharma (PHY)

It is a major challenge to shape two-dimensional self-assembled monolayers at colloidal or molecular length scales. Unlike the usual strategies of externally applied confinement and differential strains, the authors demonstrate a novel pathway based on internal phase transition (crystallization) to induce curvature in colloidal membranes. The image shows a two-dimensional colloidal sheet of chiral rod-shaped particles undergoing spontaneous wrinkling during crystallization.

Reference: L Saikia, T Sarkar, M Thomas, VA Raghunathan, A Sain and P Sharma (2017) Curvature Instability of Chiral Colloidal Membranes on Crystallization. *Nature Communications* 8:1160



6. Arvind Ayyer (MATH)

The figure shows the exact phase diagram of a one-dimensional exclusion process with r species of positively and negatively charged particles in the presence of reservoirs and electric field in the nonequilibrium stationary state. The current of each species of particles is the same within each region of the phase diagram, and is distinct across different regions.

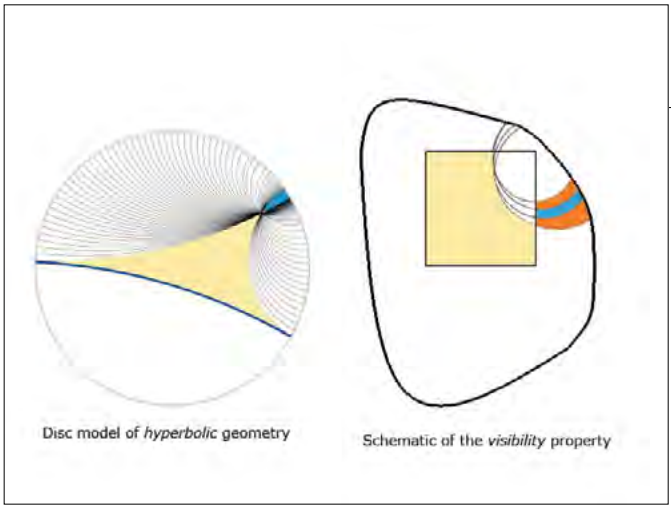
Reference: A Ayyer and D Roy (2017) The Exact Phase Diagram for a Class of Open Multispecies *Asymmetric Exclusion Processes. Scientific Reports* 7:13555

$$\bar{B}_{\alpha,\mathcal{F}} := \bar{B}_{\alpha}\left|\frac{\hat{\mathcal{F}} \cap (\mathrm{mod}_{\alpha} - \mathbf{C})}{\mathrm{eff}_{\alpha} - \mathbf{C}} : \frac{\hat{\mathcal{F}} \cap (\mathrm{mod}_{\alpha} - \mathbf{C})}{\mathrm{eff}_{\alpha} - \mathbf{C}} \to \mathcal{F}\right.$$

7. Abhishek Banerjee (Math)

A secret key to understanding abelian categories, which has been somewhat hidden in the literature is the "Auslander-formula" which shows a way of putting every abelian category inside a "nice" abelian category. I showed that this formula is even more powerful than previously thought, because it also describes structure of certain subcategories inside the abelian category, known as torsion-free classes.

Reference: A Banerjee. On Auslander's Formula and Cohereditary Torsion Pairs. *Communications in Contemporary Mathematics* (In Press)



8. Gautam Bharali (MATH)

Although Goldilocks domains need not be negatively curved, they exhibit features of hyperbolic 2-space (illustration on the left). For instance, almost-geodesic paths – the analogue of light rays – between points close to the boundary bend sharply inward. This is at the root of powerful structural results which hold true for a wide range of domains in complex Euclidean space.

Reference: G Bharali and A Zimmer (2017) Goldilocks Domains, a Weak Notion of Visibility, and Applications. *Adv. Math.,* 310

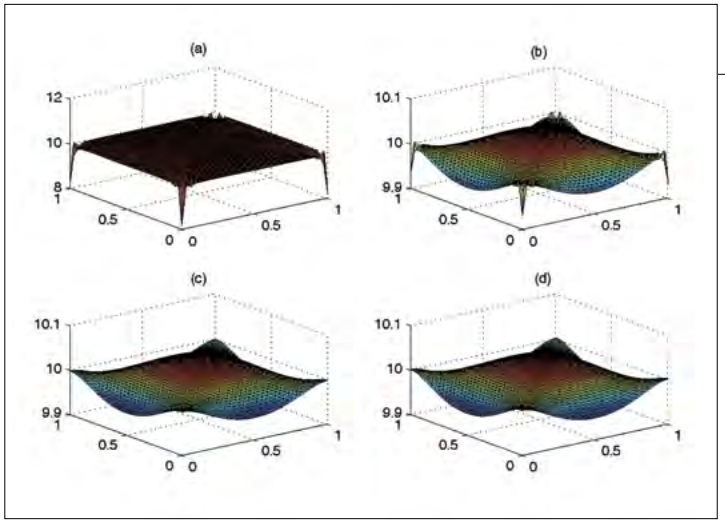
9. Soumya Das (MATH)

$a(F,T) \neq 0$ for infinitely many matrices T such that $\det(2T)$ is of the form $2^a n$, where n is odd and square-free and $a \in \{0,1,2,3\}$. More precisely, for all X large enough and any $\varepsilon > 0$ with a as above,

$$\#\{0 < n < X,\ n \text{ odd, square-free}, a(F,T) \neq 0, 2^a n = \det(2T)\} \gg_{F,\varepsilon} X^{1-\varepsilon}.$$

This study is about determination of modular forms from their Fourier coefficients indexed by arithmetically interesting objects. The main result displayed is an example of this theme in the context of Hermitian modular forms of degree 2.

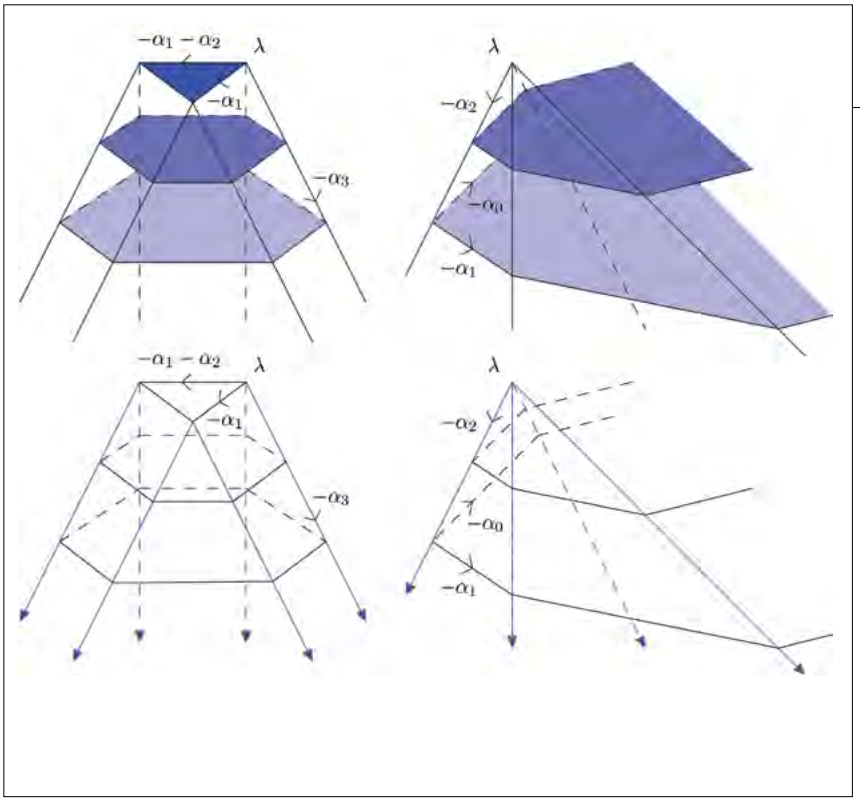
Reference: P Anamby, S Das. Distinguishing Hermitian Cusp Forms of Degree 2 by a Certain Subset of all Fourier Coefficients. *Publicacions Matemàtiques.* In Press.



10. Thirupathi Gudi (MATH)

Energy space based Dirichlet boundarycontrol [Figures (c) and (d)] proposed by our group outperforms the standard $L2$-space based Dirichlet boundary control [Figures (a) and (b)]. The regularizing parameter considered is 0.001 in Figures (a) and (c) and is 0.00003 in Figures (b) and (d). The former method exhibits high stability over the latter.

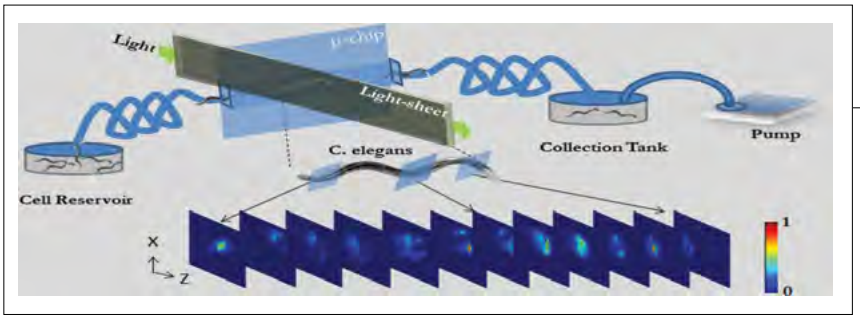
Reference: S Chowdhury, T Gudi and AK Nandakumaran (2017) Error Bounds for a Dirichlet Boundary Control Problem Based on Energy Spaces. *Math. Comp.* 86: 1103-1126



11. Apoorva Khare (MATH)

Highest weight modules (generated by a vacuum vector) are fundamental representations of semisimple, Kac-Moody, and Virasoro Lie algebras and quantum groups. The pictures describe the structure of the weights of general such modules over two Kac-Moody algebras, one each with finite and infinite integrability. The top row depicts "slices of weights", and the bottom row their convex hulls.

Reference: G Dhillon and A Khare (2017) Faces of Highest Weight Modules and the Universal Weyl Polyhedron. *Advances in Mathematics.* 319: 111–152



12. Partha Pratim Mondal (IAP)

This paper reports the development of a portable imaging cytometry system named Integrated Light-sheet imaging and flow-based enquiry (iLIFE). It can image specimens of various sizes, in 3D, and has several advantages over existing systems, such as its smaller size and cost

Reference: Chelur RK, Padmanabhan S, Shirlekar K, Rajan K, Manjithaya R, Singh V, and Mondal PP (2017). Integrated Light-sheet imaging and flow-based enquiry (iLIFE) system for 3D in-vivo imaging of multicellular organism, *Appl. Phys. Lett.,* 2017, 111).

3.6.1 CENTRE FOR CRYOGENIC TECHNOLOGY

The Centre has been functioning as the backbone of all the low temperature research activities in the Institute over many decades. The staff of the Centre has always been striving hard to maintain this reputation. This year also, the required quantity of liquid nitrogen and liquid helium was successfully supplied.

Current Research

A project to calibrate LOX and LH2 cryogenic level sensors for launch vehicles is continued. Four set of level sensors (LOX and LH2) were successfully calibrated and handed over to LPSC Bangalore, to support the launch activities of ISRO.

A multilayer planar inductor based cryogenic position centre was designed, developed and tested which requires operation below 10K. This sensor was shown to have a sensitivity of 10 ↔m in the displacement range of 0-5mm. A patent has been filed for the sensor.

A multiplexed multilayer inductor array based angular displacement sensor and its associated cold electronics was designed and tested to detect angular displacement of 1º at 4.2K. All the sensor parameters were also analysed at its operating temperature. The sensor is been reviewed for patent filing.

A sensor for measuring the electrical conductivity of thin film coated Nb samples was designed and fabricated using the principle of differential measurement using an array of planar multilayer inductors. The sensor and associated cold electronics were also tested and calibrated for operating in the range of 300K to 4.2K.

Design and development of an inductive miniature sensor for RRR and thickness measurement of RF cavities was proposed to Science and Engineering Research Board (SERB) and has been accepted for a grant by the same.

As in the past, the temperature sensor calibration support to LPSC (Mahendragiri) continues to be extended. Sensors were calibrated in 300-4.2K range using the Janis cryostat.

Core Research

The faculty and students of the Centre are engaged in niche research areas in cryogenic engineering. Some of these areas are cryocoolers, calibration of temperature and cryogenic liquid level sensors, thermal conductivity measurement systems, development of cryogenic transfer lines, helium transfer coupling, cryo-adsorption, low temperature properties of materials, etc

Further to the efforts to develop a helium re-condensation system using pulse tube cryocoolers, a novel concept of coupled two stage pulse tube cooler with cold heads at 80 K and 25 K was designed and developed.

A GM cryocooler based experimental set up has been developed for the measurement of thermal conductivity of various materials in the range of 300 K to 4.5 K. Experimental studies have been conducted on select adhesives and activated carbons for the development of cryosorption pumps.

A research project titled "Design and development of flexible transfer lines for liquid helium applications" funded by BRNS has been initiated. Towards this, a stainless steel flexible transfer line (with and without super insulation) having 19.5 mm ID and 2.5 m long has been fabricated and experimental studies on pressure drop, cool-down and mass flow rates for liquid nitrogen at different inlet pressures have been conducted. Fabrication and testing of another flexible transfer line of 32 mm ID and 5 m in length is under progress.

Under the BRFST funded project, an experimental setup has been developed for the pumping speed measurement of different type of activated carbons. The experimental setup consists of a two stage Janis GM Cryocooler, a charcoal panel, a Calibrated Leak Valve and Lakeshore Temperature Indicator. This research work is mainly helpful in estimating the pumping speeds for hydrogen and helium used in fusion applications.

The project titled "Development of adsorption based cooling system" funded by M/S Ingersoll Rand, Bangalore completed successfully. Under this project, a new experimental setup has been built and studies have been conducted for of R-134A-activated carbon pair.

A project titled "cryogenic deflashing of different types of rubber components" funded by M/s. Surface Improvements Pvt. Ltd., Bangalore has been taken up for deflashing of rubber components using liquid nitrogen. Both high and low energy machines have been used for deflashing of several rubber components. The results are encouraging.

With the financial support of IISc-ISRO Space Technology Cell (STC), the project to develop the fatigue testing machine for cryogenic temperautre zone is in progress. The designs of the cryogenic chamber and liquid nitrogen supply manifold have been completed. The fabrication of the machine with cryogenic chamber is nearing completion.

The project funded by LPSC, ISRO continues to cryotreat the pressure transducer diaphragms machined from APX4.These diaphragms are cryotreated at 98K for 36 hours. More than 1500 diaphragms were cryotreated and delivered to ISRO which are being used for measurement of propellant pressures of launch vehicles.

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1 Academic Staff

2 Scientific Staff

7 Publications

Chairperson: **V VENKATARAMAN**

Faculty & Staff

UPENDRA BEHERA | PhD (IISc), Principal Research Scientist

R KARUNANITHI | PhD (IISc), Associate Professor

DS NADIG | MTech (IIT Kharagpur), Principal Research Scientist

Associate Faculty

V VENKATARAMAN | PhD (Princeton), Professor

3.6.2 CENTRE FOR HIGH ENERGY PHYSICS

The Centre for High Energy Physics was carved from the erstwhile Centre for Theoretical Physics in 2004. Faculty in CHEP carry out research in the general area of particle physics field theory, and condensed matter physics

Current Research

The Centre has recently finished a five year project under the IRPHA program of the Department of Science and Technology, starting from January 2012 and ending in January 2017. The project brought together the common theme of all the theoretical researchers in the Centre: Quantum field theory and its applications. Several new directions have been pursued in this Centre in almost all the spheres of theoretical physics. The new research conducted by each faculty is summarised by their individual research highlights.

It was shown that the parameters which determine the 3 point functions of stress tensor and that involving 2 currents and a stress tensor lie on disc. The electromagnetic charge radius of the pion was determined at high precision using methods of unitary and analyticity, as well as the theory of optimization and high precision data from time like region and using a sophisticated Monte Carlo technique. The effects of periodic driving on a variety of quantum systems were studied with an without interactions between the particles. It was shown that periodic driving can lead to the

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IN NUMBERS

13 Academic Staff
19 PhD Students
15 Int. PhD Students
44 Publications
3 Int. PhD Conferments
1 PhD Conferments

Chairperson: **B ANANTHANARAYAN**

phenomenon of dynamical localization. An efficient algorithm for measurement of k-local operators in a quantum state, which scales logarithmically both in the system size and the output accuracy, was constructed. It was shown how it can be combined with (a) Hamiltonian evolution to make quantum simulations efficient, (b) The Newton-Raphson method based solution of matrix exponentials to efficiently evaluate thermal expectation values. The decay of 125 GeV Higgs boson to a pair of lightest neutralinos in the phenomenological minimal super symmetric standard model in the context of collider searches and astrophysical experiments was studied.

Investigations were carried out of the complementarity between the reach of Direct Detection experiments for the SUSY dark matter (DM) and invisible decay of the Higgs at the future electron-position colliders, focussing on the low mass DM particle, in the framework of phenomenological Minimal Super symmetric Standard Model (PMSSM). The low-energy dynamics of a non-Abelian Yang-Mills theory on S^3 x R can be approximated by a finite-dimensional gauge matrix model. The properties of this model coupled to fermions and it was found that this mode admits a surprising quantum phase structure. Signatures of lepton-flavour violation were studied in novel models of unification and the newly introduced "Clockwork Theory". In the informal-bootstrap context the power of Mellin space in simplifying several calculations in the large spin limit was investigated. The possibility of holography at finite-N, specially in the context of a (potentially) solvable gauged tensor model that has large-N features analogous to the SYK model, were investigated. Studies of the performance of Tau Lepton identification at LHC Run-2: Jet-> Tau Fake Rate measurement in W+jet and di-jet production were carried out. This work forms part of the Tau Identification paper which is approved in the CMS collaboration and to be submitted to Journal of Instrumentation (TAU-16-003).

A novel idea was suggested to look for the long-lived particles at the LHC: an area at the forefront in LHC studies. Contributions were made to bringing DeepCSV b-tagger (new b-tagging algorithm based on Deep Learning) from offline to online at High Level Trigger and to retraining super combined MVA based b-tagger (cMVAv2) for Phase-II CMS upgrade. The OCD equation of state was calculated at finite chemical potential. These results have implications for the on-going beam energy scan (BES) program at the RHIC collider in the USA.

Core Research

The core research areas of the Centre are quantum field theory and its applications, and experimental high energy physics. The theoretical research areas include lattice gauge field theory, conformal field theory, quantum chromodynamics, beyond standard model physics, higher spin field theories, phenomenology of standard model and its extensions, string theory, astro particle physics, quantum field theory applications to condensed matter physics, non-commutative field theory and quantum information and quantum computing. The experimental high energy physics is a part of the CMS experiment at CERN, Geneva

Associate Faculty

B ANATHANARAYAN | PhD (Delaware), Professor

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SOMNATH CHOUDHURY | PhD (CEA Saclay), Assistant Professor

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ROHINI M GODBOLE | PhD (Stony Brook), FASc, FNA, FNASc, FTWAS, Professor

PRASAD SATISH HEGDE | PhD (Stony Brook), Assistant Professor

JYOTHSNA RANI KOMARAGIRI | PhD (TIFR), Assistant Professor

CHETHAN KRISHNAN | PhD (Texas), Assistant Professor

APOORVA PATEL | PhD (Caltech), Professor

DIPTIMAN SEN | PhD (Princeton), FASc, FNA, FNASc, Professor

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SACHINDEO VAIDYA | PhD (Syracuse), Associate Professor

SUDHIR KUMAR VEMPATI | PhD (Gujarat), Associate Professor

Emeritus Faculty

N MUKUNDA | PhD (Rochester), FASc, FNA, Professor

J PASUPATHY | PhD (Rochester), FASc, Professor

3.6.3 INSTRUMENTATION AND APPLIED PHYSICS

The Department of Instrumentation and Applied Physics pursues a wide area of interdisciplinary research activities in the domain of applied physicsand provides post-graduate degrees in this area. With 17 faculty members teaching 18 courseand having spinned-off 4 startups during the last year, the department is making a dent in creating social impact.

Current Research

• Fiber Bragg Grating Bite Force Recorder (FBGBFR) has been developed for the dynamic measurement of the bite force generated by an individual tooth. A novel optical ballistocardiography technique, which is non-invasive, for the simultaneous measurement of cardiac and respiratory activities using a Fiber Bragg Grating Heart Beat Device (FBGHBD), has been developed.

• canning Probe Microscopy, High-Speed Atomic Force Microscopy, Magnetic Tweezers, Multi-axis Motion Measurement and Control.

• Energy Harvesting by the Crumpling of Large polymer Piezoelectric sheets, understanding how the mechanics of buckled substrates influences the device physics of thin film transistors, Development of an active dielectric based low power ESD protection device.

Core Research

Amorphous Semiconductors, Phase Change Memories, Fiber Optic Sensors, Nanometrology and Precision Motion Control, Nano Science,Super Resolution Microscopy, Nanolithography, Biophysics, Cell Biology, Imaging Cytometry, Optical Traps, Sensors, Nanostructured Materials, Vacuum and Thin-Film technology, Plasma Science and Technology, Semiconductor Devices and Integrated Circuits, Flexible Electronic Systems, Optofluidics, Microfluidics and Lab-on-a-Chip, Optical Metrology, Non-linear Ultrafast Laser Spectroscopy and Biomedical Spectroscopy Applications, Quantum Dots, Nanosystems for Sensing and Detection

• Studies on the effect of plasma treatment on vertically aligned graphene nano walls demonstration of superhydrophobicity in the structures, application of GNWs to anodes in microbatteries, thin-film strain gauges for the health monitoring of compressor blades in turboengine.

• Matched filter techniquefor detection of a periodic structure in a random surface was developed. Raman-Nath scattering was used for detection of wave front. Numerical simulation of light scattering from a rough surface. Analysis of the data collected using DECT (Dual Energy Computed Tomography), for medical diagnosis.

• In-Vitro Point of Care Diagnostics: Developed Innovative Optofluidic Point-of-Care Devices for conducting Molecular and BioChemical Diagnostics.

• Novel Carbon-Nanostructures using plasma techniques, Thin-Film Microbatteries, Exfoliated Graphite for Environmental Applications

• Novel low dimensional heterostructures for next-generation nanoelectronic devices, 2D tunnel transistors, piezoelectricity and piezotronics, sensors and energy harvestors using layered materials

Single Molecule Microscopy, Imaging and Quantum Optics: NanoBioImaging laboratory carries out both fundamental and Applied Physics research. This includes, single molecule studies,Impact of Two-dimensional van der Waals interfaces on self-powered detection and energy harvesting in nanoscale systems: Chemical sensing for environment monitoring, self-biased optical detection in a wide-range of wavelengths, development of self powered energy storage systems at nanometer scale.Quantum Dots (QDs), Controlled precipitation of QDs in silicate glass, QD based fibers for laser applications, fiber drawing, Self assembled monolayers. Nanosystems for Sensing and Detection: Environmental monitoring through optoelectronic sensors based on 2D interfaces, Self powered energy storage systems, Flexible bolometer, Tropological insulators for wideband optical detection, Optically powered electrochemical energy generation, self powered energy storage systems, Robotic actuation in nanosystems.

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ASHA BHARADWAJ | PhD (IIT Delhi), Assistant Professor

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IN NUMBERS

12 Academic Staff
5 Scientific Staff
71 PhD Students
2 MSc (Engg) and **6** MTech Students
51 Publications
3 MSc (Engg), **7** MTech
13 PhD Conferments

Chairperson: S ASOKAN

SAI SIVA GORTHI | PhD (EPFL), Associate Professor

K R GUNASEKHAR | PhD (IISc), Principal Research Scientist

G R JAYANTH | PhD (Ohio State), Associate Professor

ABHA MISRA | PhD (IIT Bombay), Associate Professor

ATANU K MOHANTY | PhD (Polytechnique Univ.), Associate Professor

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Associate Faculty

K RAJAN | PhD (IISc), Professor

S UMAPATHY | PhD (Otago), Professor

Honorary & Distinguished Faculty

KONANDUR RAJANNA | PhD (IISc), Honorary Professor

3.6.4 MATHEMATICS

The Department of Mathematics comprises 24 faculty and over 60 affiliated researchers. Its research profile represents diverse interests, ranging from pure to applied mathematics, and collaborations with related fields. It has a vibrant atmosphere in which members with different interests collaborate with each other, and with mathematicians internationally.

Core Research

Algebraic and combinatorial topology, automated theorem-proving, combinatorics, commutative algebra and algebraic geometry, complex geometry, differential geometry, functional analysis, harmonic analysis, mathematical physics, nonlinear dynamics, numerical analysis, partial differential equations, probability and stochastic processes, representation theory, several complex variables, statistical mechanics, time-series analysis, Teichmüller theory.

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IN NUMBERS

24 Academic Staff
58 PhD Students
10 Int PhD Students
36 Publications
1 Int PhD Conferments
7 PhD Conferments

Chairperson: **GADADHAR MISRA**

Current Research

The research work of note carried out at the Department of Mathematics in 2017 falls into the broad categories listed below.

(A) FUNCTIONAL ANALYSIS: Research in this area has been devoted to diverse problems pertaining to in-depth understanding of classes of operators in terms of their interaction with complex-analytic objects.

The term "Toeplitz operator", classically, refers to very specific compressions of a sufficiently "nice" waveform Đi.e., a periodic function Đ transformed by a multiplier. However, this procedure makes sense even in multiple variables. In this paradigm, new Toeplitz operators were studied in domains in the complex plane as well as in several complex variables. This has led to significant new results in Hilbert space operator theory.

The relationship between waveforms and complex-analytic objects can be further refined, to gives us complex-analytic vector bundles. Hermitian homogeneous vector bundles arise through a process of induction from the representations of certain symmetry groups on finite-dimensional inner-product spaces. A condition was discovered under which such a bundle and the direct sum of its irreducible constituents are intertwined by a particularly natural constant-coefficient differential operator.

(B) HARMONIC ANALYSIS: A form of Hardy's inequality, for conformally invariant fractional powers of certain operators on H-type groups, was established. Loosely speaking, a Hardy-type inequality provides information on the behaviour of certain operators, such as the gradient Đ and is closely related to the Uncertainty Principle. In recently-completed research, the operators considered were sub-laplacians on H-type groups.

(C) MATRIX ANALYSIS: Being able to characterize functions that, applied entry-wise, preserve positivity of positive-definite matrices of a fixed rank is vital in data science. However, there are still many open questions in this context. Several long-standing questions on preservers of positivity and total positivity were resolved. Another outcome of this research was the discovery of new results on weak majorization.

(D) NUMERICAL ANALYSIS: An energy-space-based Dirichlet-boundary optimal-control problem was proposed and analysed. Such an approach Đ contrasted with the standard method Đ is desirable because of the potential advantage it confers on numerical methods for differential equations. With a new approach, both the control and the state gain sufficient regularity, which benefit the associated numerical method. In particular, the method gains stability with respect to the regularizing parameter and improves over the corner singularities.

(E) SEVERAL COMPLEX VARIABLES: Research in this area has focused on using invariant metrics, which are special types of distance-functions that are preserved by invertible complex-analytic mappings, to probe the geometry of domains in complex Euclidean space.

Bounded domains in complex Euclidean space whose boundaries are reasonably "nice" are expected to exhibit several of the complex-analytic properties of the unit disc endowed with the hyperbolic metric. This expectation is based on geometric results known about convex domains. But the former are not, in general, negatively curved in the same way as the well-known hyperbolic spaces. In recent research, a very wide range of domains were identified (and named "Goldilocks domains") that have a weak form of negative curvature and exhibit many of the conjectured, and some unexpected, properties.

(F) TOPOLOGY: One of the approaches to understanding a topological space and to understand whether two such spaces are dissimilar is to look at polyhedral models. Given such a model, one seeks to classify all transformations of the space that respect the polyhedral structure in some sense (although the classification is frequently challenging). In recent work, it was shown that every semi-equivelar map on the torus is a quotient of an Archimedean tiling on the plane.

Associate Faculty

ARVIND AYYER | PhD (Rutgers), Assistant Professor

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GAUTAM BHARALI | PhD (Wisconsin), Associate Professor

TIRTHANKAR BHATTACHARYYA | PhD (ISI), Professor

SOUMYA DAS | PhD (HRI, Allahabad), Assistant Professor

BASUDEB DATTA | PhD (ISI), FASc, FNASc, Professor

SIDDHARTHA GADGIL | PhD (Caltech), Professor

MK GHOSH | PhD (TIFR-IISc), FASc, FNASc, Professor

SUBHOJOY GUPTA | PhD (Yale), Assistant Professor

APOORVA KHARE | PhD (Chicago), Assistant Professor

SRIKANTH KRISHNAN IYER | PhD (UC Santa Barbara), Professor

MANJUNATH KRISHNAPUR | PhD (UC Berkeley), Associate Professor

GADADHAR MISRA | PhD (SUNY Stony Brook), FNA, FASc, FNASc, Professor

AK NANDAKUMARAN | PhD (TIFR-IISc), Professor

EK NARAYANAN | PhD (ISI), Associate Professor

DILIP P PATIL | PhD (TIFR Mumbai), Professor

VAMSI PRITHAM PINGALI | PhD (Stony Brook Univ), Assistant Professor

G RANGARAJAN | PhD (Maryland), FASc, FNASc, Professor

HARISH SESHADRI | PhD (SUNY, Stony Brook), Associate Professor

POOJA SINGLA | PhD (IMSc), Assistant Professor

S THANGAVELU | PhD (Princeton), FASc, FNA, Professor

THIRUPATHI, GUDI | PhD (IIT Bombay), Assistant Professor

R VENKATESH | PhD (IMSc), Assistant Professor

KAUSHAL VERMA | PhD (Indiana), FASc, Associate Professor

Emeritus Professors

ALOKNATH CHAKRABARTI | PhD (Calcutta), Professor (NASI Honorary Scientist)

PHOOLAN PRASAD | PhD (IISc), Professor (NASI Senior Scientist Platinum Jubilee Fellow)

Distinguished Professor

MS NARASIMHAN | PhD (TIFR BU), FRS, FNA, FASc, FNASc

KB SINHA | PhD (Rochester), FNA, FASc, FTWAS

VS BORKAR | PhD (Berkeley), FNA, FASc, FNASc, FNAE, & FIEEE, FTWAS, FAMS

3.6.5 PHYSICS

The Department of Physics was established in 1933 by the Nobel Laureate C.V. Raman and several other illustrious names of Indian Science such as Homi Bhabha, Vikram Sarabhai, R.S.Krishnan, G.N.Ramachandran, S.Ramaseshan and T.V. Ramakrishnan have been associated with this Department. It is now well-established research centre for condensed matter physics and astrophysics.

Current Research

(A) THEORETICAL CONDENSED MATTER PHYSICS: The general principles for building the Langevin equations for active systems were formulated. Further work led to the discovery of new instabilities, defect-ordered steady states, and chiral turbulence in active cholesterics and established the scaling properties of density and orientational correlations in a 2D active nematic within a dynamic renormalization-group treatment. In the area of topological materials, it was shown how a new type of interaction phase, namely spin-orbit density wave, can introduce a topological phase in the band structure. A new density-functional theory for fractional quantum hall effect was proposed. The physics of the fractional quantum Hall effect calls for fractionally occupied Kohn-Sham orbitals. In this approach, the grand canonical potential is expressed and minimized in terms of the composite fermion variables. This provides a natural resolution of the fractional-occupation problem because the fully occupied orbitals of composite fermions

Core Research

- Astronomy and Astrophysics: Cosmology, black holes, Nuclear astrophysics, Galactic dynamics, interstellar matter, solar physics, and plasma physics
- Atomic and Optical Physics: Laser cooling and atom trapping, laser tweezers
- Experimental condensed matter physics: Spectroscopy, Electrical Transport, Bulk and Thin films, Low-temperature physics
- Theoretical condensed matter physics: Strongly correlated electrons, topological insulators, soft matter, biophysics, and nonlinear physics

automatically correspond to fractionally occupied orbitals of electrons. In the field of computational fluid dynamics, it was shown how the Cahn-Hilliard-Navier-Stokes system of equations can be used to understand various statistical properties of binary-fluid turbulence. This work has brought together several studies of two-dimensional turbulence in fluids, conducting fluids, fluids with polymers and superfluids.

(B) EXPERIMENTAL CONDENSED MATTER PHYSICS: Vertically stacked few-layers MoTe2(p)–single-layer MoS2(n) heterojunction were fabricated and characterized. Over and above the anti-ambipolar transfer characteristics observed similar to other hetero p–n junction, these experiments reveal a unique feature as a dip in transconductance near the maximum. It was observed that the modulation of the dip in the transconductance depends on the doping concentration of the two-dimensional flakes and also on the power density of the incident light. These findings may pave the way for a good understanding of atomically thin interface physics and device applications. In other work, femtosecond pump-probe differential reflectivity measurements were carried out on single crystals of Sb2Te3 as a function of temperature from 3 to 300 K to determine the temperature dependence of coherent optical and acoustic phonons along with the dynamics of the photoexcited carriers. Anomalous temperature dependence of the parameters associated with vibrational and electronic relaxation in the narrow temperature range of 200–250 K were clearly found. It was shown that the observed anomalies can be explained by a mechanism of formation of stacking faults stabilized by vibrational entropy above 200 K. In the area of multiferroics interlayer magneto-electric coupling in BiFeO3/SrRuO3 heterostructures was investigated by impedance spectroscopy over a temperature range of 80 K–260 K. In-plane impedance measurements were performed using interdigitated gold electrodes fabricated on the BiFeO3 layer. The Nyquist plots at different temperatures were fitted with an equivalent circuit model of the heterostructure. A pronounced dip in the temperature coefficient of equivalent-capacitance and a distinct increase in the temperature coefficient of equivalent-resistance of the BiFeO3 layer were observed on cooling across ferromagnetic TCof the bottom SrRuO3 layer. Temperature dependent capacitance (at 0 T magnetic fields) and magneto-capacitance (at 5 T magnetic fields) plots showed anomalies near 160 K. A shift of the hysteresis loop along the magnetization axis in field cooled M-H measurements was also found, which indicates the presence of pinned SrRuO3 moments due to the magnetic interaction at the interface. These observations suggest a strong magneto-electric coupling between the BiFeO3 and SrRuO3 layers of this heterostructure. In the field of topological materials, a weak topological insulator (WTI), BiSe, of the Bi-chalcogenide family with an indirect bandgap of 42 meV was discovered. Its structural unit consists of a bismuth bilayer (Bi2),

FACT FILE

Established **1933**

Phone **+91-80-2293 2315**

Fax **+91-80-2360 2602**

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URL **physics.iisc.ernet.in**

Degree Programs offered **PhD, Int. PhD and BSc (Research)**

IN NUMBERS

31 Academic Staff

5 Scientific and **1** Technical Staff

135 PhD Students

40 Int PhD Students

155 Publications

6 Int PhD Conferments

22 PhD Conferments

Chairperson: **V VENKATARAMAN**

a known quantum spin hall insulator sandwiched between two units of Bi2Se3 which are three dimensional strong topological insulators. The density-functional theory calculations confirm the WTI phase and ARPES measurements carried out on cleaved single crystal flakes show Rashba states that closely agree with the theoretical predictions.

(C) SOFT MATTER PHYSICS: A study on understanding curvature instabilities in colloidal membranes was completed and followed up with experiments on sculpting the colloidal membranes through phase separation. The group has also made significant progress in determining the internal force distribution of cilia as it beats in an oscillatory manner. In other work, enhanced photoluminescence of quantum dots in close proximity to graphene field effect transistor devices was demonstrated, which are electrically and spectrally tunable. The enhanced emission originates from super-radiance between closely packed quantum dots placed close to single-layer graphene, which overcomes the strong nonradiative quenching observed earlier.

(D) ASTROPHYSICS: With collaborators from SKA-India EoR science working group, a novel technique of power spectrum estimation from radio interferometric data was successfully developed and implemented. This method was applied on the TIFR-GMRT Sky Survey data to study the properties of the low frequency diffuse Galactic synchrotron emission.

Faculty & Staff

SUMILAN BANERJEE | PHD (IISC), ASSISTANT PROFESSOR

JAYADEEP KUMAR BASU | PHD (CALCUTTA), PROFESSOR

AVEEK BID | PHD (IISC), ASSOCIATE PROFESSOR

PRASAD VISHNU BHOTLA | PHD (IISC), CHIEF RESEARCH SCIENTIST

ARNAB RAI CHOUDHURI | PHD (CHICAGO), FASC, FNASC, FNA, PROFESSOR

ANINDYA DAS | PHD (IISC), ASSISTANT PROFESSOR

TANMOY DAS | PHD (NORTHEASTERN), ASSISTANT PROFESSOR

SUJA ELIZABETH | PHD (IISC), CHIEF RESEARCH SCIENTIST

R GANESAN | PHD (IISC), PRINCIPAL RESEARCH SCIENTIST

ARINDAM GHOSH | PHD (IISC), FASC, FNASC, PROFESSOR

MANISH JAIN | PHD (MINNESOTA), ASSISTANT PROFESSOR

RAJEEV KUMAR JAIN | PHD (ALLAHABAD), ASSISTANT PROFESSOR

CHANDA J JOG | PHD (NEW YORK), FASC, FNASC, FNA, FTWAS, PROFESSOR

PS ANIL KUMAR | PHD (PUNE), PROFESSOR

ANIMESH KULEY | PHD (IIT DELHI), ASSISTANT PROFESSOR

PRABAL K MAITI | PHD (IIT KANPUR), FASC, PROFESSOR

RAMESH CHANDRA MALLIK | PHD (IIT MADRAS), ASSOCIATE PROFESSOR

REGHU MENON | PHD (IISC), PROFESSOR

SRIMANTA MIDDEY | PHD (CALCUTTA), ASSISTANT PROFESSOR

SUBROTO MUKERJEE | PHD (PRINCETON), ASSOCIATE PROFESSOR

BANIBRATA MUKHOPADHYAY | PHD (CALCUTTA), ASSOCIATE PROFESSOR

DV SUVISESHA MUTHU | PHD (IIT KANPUR), PRINCIPAL RESEARCH SCIENTIST

VASANT NATARAJAN | PHD (MIT), PROFESSOR

RAHUL PANDIT | PHD (ILLINOIS), FASC, FNA, FTWAS, PROFESSOR

K RAJAN | PHD (IISC), PROFESSOR

SRIRAM RAMASWAMY | PHD (CHICAGO), FASC, FNA, FRS, PROFESSOR

K RAMESH | PHD (IISC), PRINCIPAL RESEARCH SCIENTIST

KP RAMESH | PHD (BANGALORE), PROFESSOR

KSR KOTESWARA RAO | PHD (IISC), PROFESSOR

NIRUPAM ROY | PHD (NCRA-TIFR), ASSISTANT PROFESSOR

TARUN DEEP SAINI | PHD (PUNE), ASSISTANT PROFESSOR

PRATEEK SHARMA | PHD (PRINCETON), ASSOCIATE PROFESSOR

PRERNA SHARMA | PHD (TIFR BOMBAY), ASSISTANT PROFESSOR

VIBHOR SINGH | PHD (TIFR), ASSISTANT PROFESSOR

VC SRINIVAS | BE (BANGALORE), TECHNICAL OFFICER

V VENKATARAMAN | PHD (PRINCETON), PROFESSOR

Associate Faculty

AMBARISH GHOSH | PHD (BROWN), ASSOCIATE PROFESSOR

Honorary & Distinguished Faculty

TV RAMAKRISHNAN | PHD (COLUMBIA), FNASC, FASC, FNA, FTWAS, FRS, FOREIGN ASSOCIATE, ACADEMIE DES SCIENCE (PARIS), DISTINGUISHED ASSOCIATE

AK SOOD | PHD (IISC), FASC, FNASC, FNA, FTWAS, FRS, PROFESSOR

3.6 CENTRES UNDER THE DIRECTOR


MEMORIAL LIBRARY

3.7.1 J.R.D. TATA MEMORIAL LIBRARY

Librarian: **ANANDA T BYRAPPA**

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 Financial year 2017-18, the Library added 4914 documents including 1599 books, 2550 bound volumes 723 donated books and 12 eBooks. eBook cataloguing service is being continued. The total holdings of the Library is now increased to about 5 lakh plus physical documents which includes other materials like Technical Reports, Standards, Theses & Dissertation. Library continues to primarily subscribe electronic-only journals and over 750 e-journals are being subscribed spending nearly Rs.13.10 crores. The 'Electronic Theses Repository' contains about 3600+ theses.

The Circulation section has registered 828 new members. A total number of 19,698 transactions were carried out by the Circulation section during the period. 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. American Institute of Physics - Journals and Archive
3. American Physical Society Journals, including Physical review Online (PROLA) Collection
4. American Society for Microbiology - ALL Journals
5. ASCE Journals
6. ASME Journals
7. Association of Computing Machinery Journals
8. ASTM Journals and Standards
9. Elsevier collection
10. Emerald full-text
11. IEEE / IEE Journals
12. Institute of Physics Publishing - Complete collection including its Archive
13. JSTOR Archive
14. Oxford University Press - Complete Mathematics, Physical and Life Science Collections
15. Royal Society of Chemistry - ALL Journals and its Archive
16. Society for Industrial and Applied Mathematics (SIAM) - Complete journal collection and Archive
17. Springer collection
18. Wiley collection

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
• OUP Archive

E-SHOD SINDHU CONSORTIUM

Ministry of HRD, Government of India has formed a new Consortia merging erstwhile consortiums such as INDEST-AICTE, UGC Infonet and N-List Programme. The new consortium is named as e-Shod Sindhu (ess) and is managed by INFLIBNET head quartered at Ahmedabad. Apart from several other resources, following is the list of e-resources subscribed under ess indicating the substantial savings to the Institute in 2017-18.

	Publisher	**Approx. savings in Rupees**
	List of e-resources procured under e-Shodh Sindhu in 2017-18	
1	ACM Digital Library	446,652
2	American Institute of Physics	664,802
3	American Physical Society	621,09
4	Annual Reviews	212,599
5	ASCE Journals Online	440,726
6	ASME Journals Online	348,40
7	JSTOR	81,74
8	Nature	152,275
9	Oxford University Press -262 titles	354,325
10	Project Muse	435,50
	Sub Total	**37,58,109**
	Databases	
1	Economic & Political Weekly	4,20
2	Institute for Studies in Industrial Development (ISID) Database	17,826
3	JGate Plus (JCCC)	89,765
4	MathSciNet	794,461
5	Web of Science	797,066
	Sub Total	**17,03,318**
	Grand Total	**54,61,427**

LIBSYS SOFTWARE / DATABASE

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.

HARDWARE-SOFTWARE RELATED

The Library has 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 Consortium, the Library provides document delivery to other Consortium 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 site has been redesigned to disseminate up-to-date information from the Library. The website provides comprehensive information on the collections, e-resouces, databases, 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 36% 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.

ePRINTS & ETD DIGITAL REPOSITORIES

ePrints@IISc (eprints.iisc.ernet.in) is one of the earliest and largest Institutional Repositories in the country. The ePrints@IISc was started by the erstwhile National Centre for Science Information. It is currently being managed by the J.R.D. Library. The repository collects, preserves, and disseminates in digital format the research output created by the IISc research community. The repository content can be accessed through the search and browse functionalities. As on date, the total number of publications in the repository is about 46,000+.

etd@IISc (etd.iisc.ernet.in) is the digital repository of Theses and Dissertations of IISc, Bangalore, India. This repository has been developed to capture, disseminate and preserve the research theses of IISc. The repository content can be accessed through the search and browse functionalities. As on date, the total number of records in the repository is about 3600+.

NEW INITIATIVES

• Membership and borrowing facility to Library Alumni (retired staff members)

The Librarian In-charge brought to the notice of the SLC that since several years, retired staff members have been requesting borrowing facility as applicable to alumni members may be considered favorably. The committee discussed the issue and approved, as a special gesture, that retired Library staff may avail the library borrowing facility on the lines of Alumni members.

• Migration of email server to cloud platform resulted in new email IDs with the domain name@iisc.ac.in from iisc.ernet.in

• Upgradation of all computers in the Library to latest OS and MS office and thus implementing uniform OS and MS office tools to all the staff members PCs.

• Re-arrangement of book shelves for better look and feel and more lighting in reading area and lobby.

• Apart from displaying regular books and journals on every Monday and Thursday celebration of special occasions by displaying books with a theme which creates curiosity in our readers to read more is also being organised.

• Faculty Profiles: The Library is in the process of developing Faculty Profiles listing the details of Faculty publications, citations and metrics like h-index which will be updated live. The software developed by INFLIBNET is being used for this purpose.

• The Library website (library.iisc.ac.in) has been redesigned and new website has been launched in March 2018. The website has been developed using content management software Drupal and it acts like a one-stop-shop providing access to all e-resources subscribed, services and facilities available to the users.

• Binding of old volumes of Journals has been almost completed as the Library is now subscribing to only electronic versions there will not be any additions to Bound volumes collection in the future.

• The Lighting in the Library has been augmented by replacing tube lights with LED array lights with longer life providing better illumination and also saving the running costs considerably.

• ORCID ID initiative: The Library has taken initiative to create awareness and register all Faculty members to obtain their ID's to have recognition and also avoid duplication of their profiles. We could enroll about 200 members through this marketing initiative.

EVENTS ORGANIZED / CONDUCTED BY THE LIBRARY

• Dr. T B Rajashekar's Memorial Lecture Series was organized in assopciation with NCSI-Net Foundation on How the Libraries and the Library schools can re-position themselves in meeting the expectations of the society? By Dr. Prahalad G Tadasad, Professor and Chairman, Dept. of Library and Information Science, Special Officer to Vice Chancellor and Director Gandhi Studies Center, Akkamahadevi Women's University (Formerly: Karnataka State Women's University), Jnanashakti, Torvi, Vijayapura on Friday, 16th June, 2017 at JRDTML

• Celebrated Librarian's Day to commemorate the birth anniversary of Late Dr S R Ranganathan on 11th August 2017.

• The International Open Access Week 2017, was observed during 24-30 October 2017 in collaboration with the DST-CPR, APC, IISc

• 13th Dr. TB Rajashekar Memorial Seminar (2017): CORAL – Open source electronic resource

management tool on Saturday, 18th Novemebr, 2017 at Choksi Hall, IISc

• In collaboration with M/S Taylor and Francis Publishing, an author workshop was organized for the benefit of students and faculty members of IISc. The workshop was held on 18th August 2017 at the Choksi Hall, IISc

• In collaboration with M/S Elsevier Science Publishing, an author workshop was organized for the benefit of students and faculty members of IISc. The workshop was organised on 5th October, 2017 at the SERC auditorium

• In collaboration with M/S John Wiley Publishing, a publishing workshop was organized for the benefit of students and faculty members of IISc. The workshop was organised on 13th October, 2017 at the SERC auditorium.

• A workshop on Plagiarism detection software Turnitin was organized on 8th November 2017 at the SERC auditorium

PUBLICATIONS

The Library staff published three articles during the period

1. Jayakanth, Francis and Madhan, Muthu (2017). Open Access for Engineers and Engineering. In: IEEE India Council Newsletter, 12(4), Oct-Dec 2017

2. Kavi, Pradeep. P. (2017) Library Services in ICT era: New Avenues and ways. National conference on Libraries and Transformation held at DLIS, Tumkur University on December 30, 2017

3. Balutagi, Suresh, Lamani, Manohar B. & Kumbar, B. D. (2018, Jan-Mar.). Use of Electronic Information Resources by Faculty Members of Engineering and Technology Institute Libraries in Gujarat State: A Survey. Journal of Advances in Library and Information Science, VII(1),81-88

OTHERS

Staff recruitment

Following staff have joined the Library

• Dr. Anand T. Byrappa, Librarian
• Dr. Suresh Balutagi, Deputy Librarian
• Mr. Pradeep P. Kavi, Assistant Librarian
• Mr. Ashish Kumar Ahirwal, Assistant Librarian

PROJECTS

A consultancy Project has been sanctioned by Postal Training Centre, Madurai, Tamilnadu.Title: Setting up Integrated Digital Library and Training Information Management System

Consultants: Dr. Ananda T. Byrappa & Francis Jayakanth

Amount: Rs. 3.48 Lakhs

INVITED TALKS

List of invited talks delivered by Library staff

Sl.No	Name of the Faculty Member	Name of the University/ Organization where the Talk was Delivered	Title of the Talk	Date(s)
1	Dr.Ananda T. Byrappa	BMS College of Architecture, Bangalore	Keynote address. Ranking Framework for Libraries	
2	Dr.Ananda T. Byrappa	IIT Madras	Panel Session 2: Academic and Research Libraries: Vision 2022, International Conference on Knowledge Orgabnization - http://srr125.org/	August 2017
3	Dr.Ananda T. Byrappa	Bangalore University	Innovation and libraries	October 17, 2017
4	Dr.Ananda T. Byrappa	Indian Staticial Institute, Bangalore	SMAC and Next Generation Libraries	November 14, 2017
5	Dr.Ananda T. Byrappa	Department of Public Libraries. karnataka	Conference Director for 6th IOS at Gandhi Bhavan Bangalore -	November 16, 2017

6	Dr.Ananda T. Byrappa	St. Thomas' College, Thrissur, Kerala	Future Academic Libraries	December 7, 2017
7	Dr. Francis Jayakanth	St. Thomas' College, Thrissur, Kerala	An overview of the electronic resources management	December 7, 2017
8	Dr. Francis Jayakanth	Department of Library and Information Science, University of Madras	Web technologies: Web servers: Apache & Internet Information Server CGI Programming: Introduction to Java Scripts and PHP, Protocols: SOAP, Open URL, OAI-PMH	March 2018

AWARDS

Dr. Anand T Byrappa has been awarded Fellowship of LIS Academy, Bangalore in December 2017.

3.7.2 ARCHIVES AND PUBLICATIONS CELL

Chairperson: **KAUSHAL VERMA**

The Archives Cell was established in 2007 with a mandate to collect, catalogue and preserve all documents, images, and other articles of relevance to the Institute. It became Archives and Publications Cell (APC) in 2008 with the additional responsibility to coordinate and facilitate the publication activities of the Institute through the IIScPress. APC also hosts the DST- Centre for Policy Research devoted to research on policies related to science and technology research in Indian universities and R&D centres and now it has moved to a new building.

ARCHIVES

The Institute's original correspondences and land documents, administrative manuals and bye-laws, schemes of instruction, building committee reports, faculty profiles and speeches of Sir M. Visveswaraya have been uploaded to D-Space, the digital archiving platform.

The IISc Archives organized an exhibition on "Glimpses from IISc's Past" in the Reception Hall, Main Building during Open Day – 2018 and it had also set up two stalls for selling books published by IIScPress, Key chains, Mugs, Pens, Calendars, Diary, Jute bags, Picture Post Cards and so on.
To help commemorate the 75th Anniversary of the Aerospace Engineering Department, APC curated two exhibitions on Satish Dhawan and the growth of the AE department since its inception. Two titles in the series 'Snippets from the IISc Archives' on Satish Dhawan and the AE department were also released.

APC Lecture Series

APC had organised the following Lecture Series with an aim to bring experts in communication, history, archiving, policy and publishing to the Institute.

1. 'The Art of Science Communication' by T. V. Venkateswaran, Vigyan Prasar, Dept. of Science and Technology, Govt. of India on 4th April, 2017.
2. 'Thirteen Ways of Seeing – Building diverse stories from interconnected science archives' by Venkat Srinivasan, NCBS on 19th April, 2017.
3. 'Conservation Science and Artifacts of the Past' by Dr. V. Jeyaraj, Director, Hepzibah Institute of Heritage Conservation on 2nd May, 2017.
4. 'Seeing Science' by Shraddha Nayak on 21st November, 2017.
5. 'Acquisition, Documentation and Representation: Archives and Museums as Repositories of Memories' by Monalisa Behera on 5th December, 2017.

Maps Exhibition

APC along with the Centre for Contemporary Studies (CCS) and Kalakriti Archives had organised an exhibition on maps, SPACE-TIME AND PLACE, The Culture of Indian Maps - "INDIA ON OUR MIND" from 19 March to 20 April 2018 at IISc Main building. It also organised different talks related to this by different eminent people. These were collectively called 'The Conversations'.
1. Climbing Mt. Everest: an experience of a lifetime by S. Prabakaran, Deputy Conservator of Forests (9th April).
2. Around the world: a journey 5 months, 23000 nautical miles by Cdr. Abhilash Tomy, the first Indian and the second Asian to circum-navigate the globe under sails-solo (16th April).
3. The Artist in the World by Bose Krishnamachari and Riyas Komu, most acclaimed artists and founders of the Kochi Biennale Foundation (17th April).
4. On the Geology of the Indian Subcontinent by Prof. D. Chandrasekharam, former Chair Professor at IIT Hyderabad (19th April).

Madhubani Workshop on Introduction to "Madhubani Folk Art" by a folk artist, Shamli Das was organised on 7th and 8th April.

IN-HOUSE PUBLISHING

APC coordinates the design, copy-editing and printing of KERNEL (the annual magazine of IISc), Mini Kernel 'IISc at a Glance', Connect (quarterly magazine of IISc), and four issues of the Journal of the Indian Institute of Science, co-published by Springer. In addition, the following IISc documents are published: Annual reports (English and Hindi), Annual Accounts

(English and Hindi), Budget Estimates and Revised Estimates, Directory and Planner, Student Information Brochure, Undergraduate Scheme of Instruction, Quarks (a magazine of the undergraduate students), Desk Calendar and Wall Calendar, Faculty Information Brochure, Certificates and Transcripts.

IISc PRESS

A new committee for IIScPress has been formed with effect from January 2017:

Chair: Amaresh Chakrabarti
Members: **Diptiman Sen,** Series Editor, Lecture Notes Series
Prabal Kumar Maiti, Series Editor, Research Monographs
S P Arun, Series Editor, Popular Science Series
Ex-officio Chair, APC: **Kaushal Verma**
Admin.: **Kavitha Harish**

Publishing Agreement for Book Series with Springer was signed

IIScPress was established in 2008, with a mission to bring quality books at affordable prices for helping Indian post-graduated education in science and engineering.

Besides self-publishing, IIScPress publishes a variety of books with its co-publishing partners, and brings out research monographs, collected works of distinguished scientists, lecture notes, text books, biographies, popular science books, general books and also other books.

The IIScPress has been publishing books in collaboration with World Scientific Publishing Company (WSPC) since 2008. In 2013, IIScPress signed a co-publishing agreement with Cambridge University Press (CUP).

Series published with co-publishers are:

IIScPRESS – WORLD SCIENTIFIC PUBLISHING COMPANY

IISC – CAMBRIDGE RESEARCH MONOGRAPHS SERIES (ICRMS)

The monographs published in this series will address contemporary topics of science and engineering.

IISc – Cambridge Centenary Lecture Series (ICCLS)

As part of the 2009 Centenary celebrations, IISc instituted a series of lectures by eminent scientists. In this series, books are based on lectures delivered at IISc by distinguished books speakers.

IISc-Cambridge Lecture Notes Series (ICLNS)

This series fulfils an important need in higher education in science and engineering, particularly in India. These books are authored by distinguished scholars.

IIScPRESS –CAMBRIDGE SERIES

Cambridge-IISc Research Monographs
Cambridge-IISc Centenary Lectures
Cambridge-IISc Lecture Notes

The following books have been published under these series:

• IIScPress-CUP – "Biomaterials Science and Tissue Engineering: Principles and Methods" by Bikramjit Basu on 7th September, 2017
• IIScPress-World Scientific – "The Story of Numbers" by Asok Kumar Mallik on 7th September, 2017
• IIScPress – "Doing Science in India: My Second Innings" by Prof. G. Padmanaban on 23rd March 2018
• IIScPress-CUP – "Knowledge Driven Development – Bridging Waterfall and Agile Methodologies" by Manoj Kumar Lal on 19th June, 2018
• IIScPress-World Scientific – "Ultrafast Optics and Spectroscopy in Physical Chemistry" by Atanu Bhattacharya on 19th June, 2018

JOURNAL OF THE INDIAN INSTITUTE OF SCIENCE

A new committee for Journal has been formed with effect from January 2017:

Editor-in-Chief: T. N. Guru Row, SSCU

Members: G. K. Ananthasuresh (P/ME)
E. Arunan (P/IPC)
Dipshikha Chakravortty (P/MCBL)
Jagadeesh Gopalan (P/AE)
Kaushal Verma (P/MA)
Namrata Gundiah (P/ME)
Prabal K Maiti (P/PHY)
Santanu Mukherjee (P/OC)
K. J. Vinoy (P/ECE)

Executive Editor: Kaushal Verma, Chair, APC

Editorial Assistant: Kavitha Harish

The Journal of the Indian Institute of Science has been published by the Institute since 1914. Previously, the Journal published original research work carried out by the faculty and students of the Institute as well as other institutions around the world. Since 2007, however, the Journal format has been changed. It became a quarterly Journal and publishes only invited review articles, each issue being guest edited by eminent researchers. Since 2017, the Journal has been co-published by Springer.

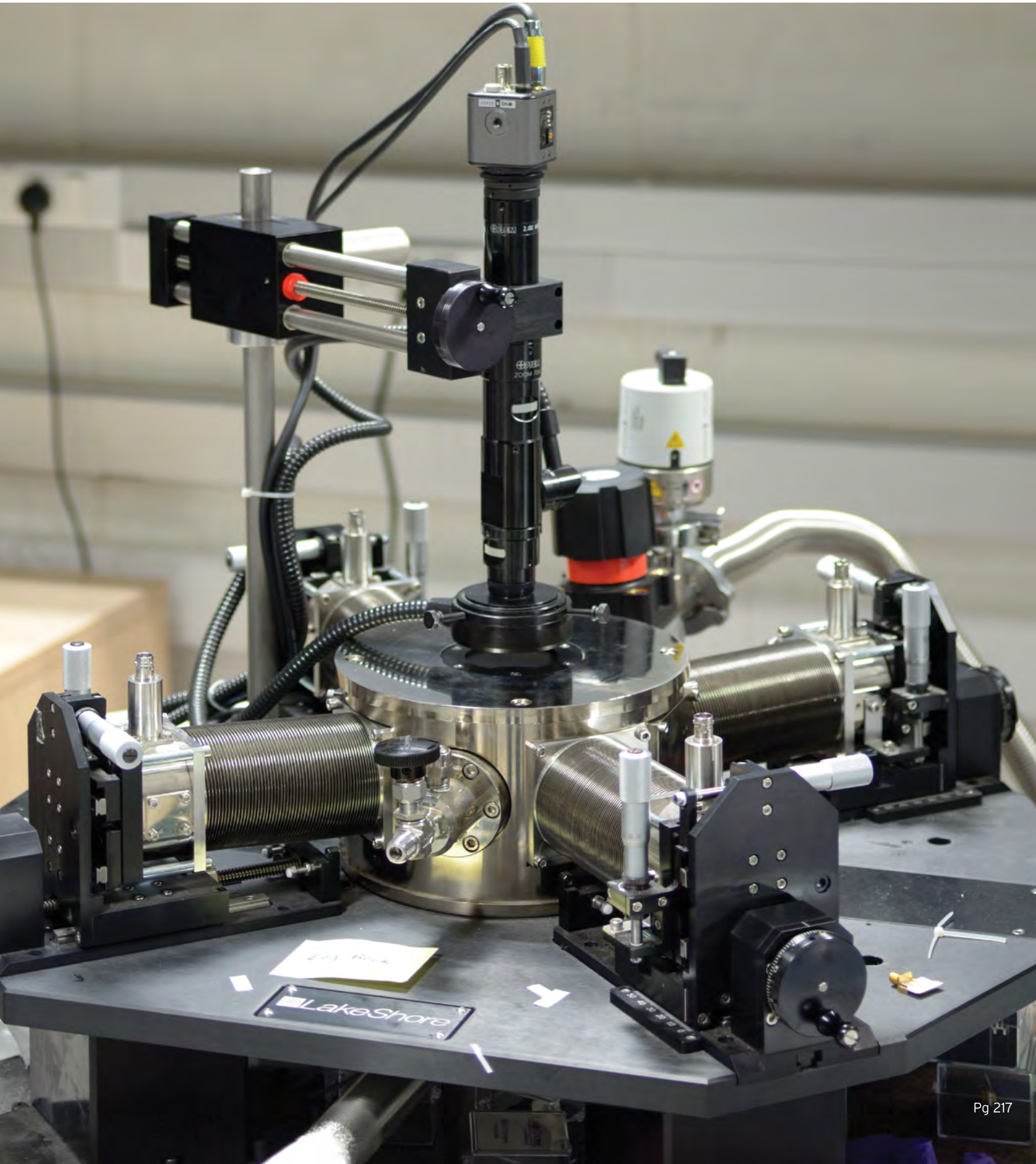
The following special issues appeared in the Journal during 2017 (Volume 97):

1. Vol. 97(1), January-March 2017
"Signalling Across Space and Time"
Guest Editor: Sandhya S. Visweswariah

2. Vol. 97(2), April-June 2017
"Crystallography as a Probe of Structure and Function"
Guest Editor: Gautam R. Desiraju

3. Vol. 97(3), July-September 2017
"Applied Computational Science and Engineering"
Guest Editor: Phaneendra K Yalavarthy

4. Vol. 97(4), October-December 2017
"Brain and Cognition Reviews"
Guest Editor: Aditya Murthy



3.7.3 OFFICE OF INTERNATIONAL RELATIONS

Chairperson: **USHA VIJAYRAGHAVAN**

Establishment of the Office of International Relations (OIR) at the Indian Institute of Science (IISc) reflects the Institute's commitment to facilitate global cooperation and association through various programmes and opportunities. The OIR acts as a liaison to oversee and coordinate international programmes of the Institute including:

- Admission of full-time international students to the M. Tech. research program in Engineering and Ph.D. programmes of the Institute.
- Facilitate academic and industrial collaboration through international cooperation in research and education and students/researcher exchange.
- Formulate Memoranda of Understanding (MoU) between participating Institutes and Organizations.
- Coordinate academic collaborations, student/faculty exchange programmes and mobility, including that of incoming and outgoing students, at the Institute with institutions and universities abroad.
- Identify international funding opportunities and promote collaborative research at the Institute.
- Organize visits of representatives from international universities and delegations of public bodies to the Institute.
- Facilitate special lectures of internationally acclaimed scientists in association with international agencies.
- To act as an advisory body to the growing number of foreign students and visitors at the Institute.

During the past year, OIR has coordinated various activities to strengthen the Institute's International profile that included the following major activities:

VISITING ACADEMIC/INDUSTRIAL DELEGATIONS: The academic visits by foreign delegations, dignitaries and diplomatic staff from various parts of the world were primarily aimed at learning about the Institute activities, identifying possible areas for mutual collaboration in research and education, and exploring modes to establish new collaborations or continue the existing ones. Chair, OIR or faculty members associated with the OIR interacted with international visitors, provided a brief overview of the Institute, academic programmes, and discussed possible mechanisms of collaboration/hosting visitors. About 53 such meetings were hosted by the OIR in the period April 1, 2017 to March 31, 2018. A few of the prominent international delegations in this duration included the French Minister of Higher Education, Research and Innovation, the President of Imperial College, London, the Vice Chancellor of Australian National University, the President of University of Cote d'Azur, France, and the Chancellor of University of Massachusetts, Amherst.

In addition to these visits, the OIR coordinated 3 special lectures/talks that were delivered by visiting faculty/delegates and included Prof. Brian P Schmidt, Australian National University, Prof. Phillip Low as a part of India-Purdue Lecture Series 2018 in honour of Prof. CNR Rao, and a student interactive session with the coordinator of Stanford University's Knight Hennessey Scholarship program for graduate studies.

Professor Brian Paul Schmidt, Vice-chancellor, Australian National University during his talk on "The Accelerating universe" on June 2, 2017.

SPECIAL EVENTS/PROGRAMS: This year, OIR organized the first Orientation program to newly admitted international students and provided an overview of the Institute, OIR activities, and general guidelines. Based on the success of this meeting and discussion, we hope to continue the orientation program each year to International students in the coming years, who will be admitted to the Institute. Two joint meetings/workshops were coordinated to enhance our bilateral academic interactions with Australia and Netherlands. The 'IISc-Australia Educational meet' included a round-table discussion to explore the Institute's approach in international collaboration and explore industry sponsored research and interdisciplinary research between the representatives of IISc and 12 Australian education/ industrial sectors. The 'IISc-Netherlands Climate Science workshop' used a series of technical talks and in-depth discussions to explore mutual areas of research and bilateral collaboration between climate scientists at the Mechanical Sciences division at the Institute and visitors from Netherlands which included Technical University of Delft, Wageningen University, and Royal Netherlands Meteorological Institute. In addition, OIR helped enable the nomination process for the postdoctoral Schmidt Science fellow, launched in association with the Rhodes Trust; IISc is a participating Institute through this program and will receive 5 nominees in STEM areas to encourage new ways of thinking and innovation.

MOU/AGREEMENTS WITH ACADEMIC/ INDUSTRIAL PARTNERS: To enhance the international cooperation, the OIR helped with the formulation of 22 MoUs/agreements with various foreign Universities/Institutes. The OIR also coordinated the Larvol fellowship for women Ph.D. students in science through nominations at the Institute based on existing agreements. We are also pleased to report that the joint Ph.D. supervision programme, one of the Institute's noteworthy bilateral initiatives, is progressing as planned with our long-term partner, the Technical University of Delft, Netherlands. During this current year, two IISc students and two TUD students, were enrolled for joint-PhD through this programme.

INTERNATIONAL STUDENTS AT IISC:
Full-time International Students: As of March 2018, IISc has 45 full-time foreign students from different parts of the world, who are pursuing their M. Tech. (Research) or Ph.D. studies. Most of the international students come from Asia (28) and Africa (16). During the academic year 2018-19, a large number of students applied to the Institute seeking admissions to the Master's and Ph.D. programs; 77 candidates were shortlisted and interviewed by the admissions committees at various departments to assess suitability. Based on the recommendations of these committees, 16 applicants were offered positions for Ph.D. (10) and M. Tech. (Research) in Engineering (6). We look forward to receiving them during the academic year beginning in August, 2018.

Short-term Students/Visitors: A majority of the short-term students and researchers visited the Institute and performed collaborative work under an agreement with a partner university or for semester long course study. A total of 70 students/visitors from Europe (21), Africa (7), USA (13), Asia (22), UK (5), and others (2) were at the Institute in this year. Among the incoming students, a few availed fellowships through bilateral funding programmes like Newton-Bhabha, S N Bose, or others to facilitate their visit to the Institute.

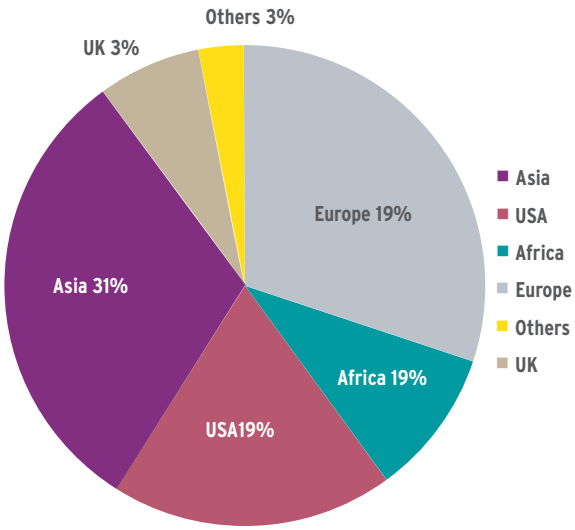


Fig. 2: Global distribution of Short-term international students/visitors at IISc (2017-18).

3.7.4 CENTRE FOR CONTINUING EDUCATION

Chairperson: **G L SIVAKUMAR BABU**

In the view of rapid advancements in science and technology, continuous education of teachers and working professionals is required and enables them to update their knowledge with regard to latest trends. The Centre for Continuing Education has completed more than 45 years and is a pioneer in the area of continuing education in the country. It has organized several refresher/specialized courses for teachers/working professionals from different target groups ranging from high school science teacher to research scientists/engineers of the industries/ institutions. Summary of the programs for the last year is given below.

SUMMARY OF PROGRAMMES

Sl.No.	Programme Type	Details	Students/ Participants benefited
1	National Programmes	a) QIP: Degree program (Ph.D./ME/M.Tech)	17
		b) QIP Short Term Courses: (Engineering College Teachers)	435
2	Industry Oriented programmes	a) CCE - Proficience: 37 Semester long courses	472
		b) Industry sponsored short term/full term courses:	394

PROGRAMMES IN DETAIL

1. National Programmes:

a) QIP (Quality Improvement Programme)

Programmes Leading to Award of Degrees: During the current year, under this programme, 3 teachers were admitted for Ph.D. and 1 for M.E/M.Tech. Apart from this, 7 persons were given advance admission for Ph.D. for during 2017

During the year 2013 - 14	PhD	ME/MTech
Students admitted	3	1
On Roll	15	2

b) QIP – Short Term Courses

These courses are sponsored by Government agencies such as AICTE- QIP. and are primarily for teachers from engineering/science colleges. During the year, 17 one week and 1 two week short-term courses were organised with a total participation of 435 faculty members from Engineering colleges and other Pvt. Organisations.

2. Industry Programs

a) CCE – PROFICIENCE PROGRAM

The programme is the first of its kind and unique in India. Under the CCE - PROFICIENCE programme in 2 semesters during the year 2016, 35 evening courses were conducted and 682 students/professionals attended and 472 successfully completed the program. Under this programme a sum of Rs. 94 lakhs has been received, towards application and course fee.

b) Self-supporting Intensive Courses:

The CCE organises various refresher/extension programmes to enable the participation of scientists and engineers working in different organizations. During the year, 12 such courses were organized for different organizations with a total participation of 394. Under this programme a total sum of Rs. 7.00 lakhs has been received as overhead to the Institute:

c) Curriculum Development Cell:

The Curriculum Development Cell provides financial assistance for book writing, Preparation of Laboratory Manuals, Holding of Conference, 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 for 95 faculty members for Book Writing, out of which, 53 books have been published/ completed. The CCE is using CCE-FACE funds for this purpose.

3. Extension Lecture Programme

This programme is also the first of its kind and unique in the Country. Under the Continuing Education Program Extension Lectures have been organized by the Institute faculty since 1990 in institutions of higher learning at the technical level, in Engineering and science colleges and in schools, public/cultural organizations, Doordarshan and All India Radio at the popular level. These extension lectures are expected to be of great help in the transfer of information on the latest scientific developments in this Institute and other organization in India and abroad.

These lectures are arranged not only in Bangalore, but also in centres 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 demonstration, slides, and models.

One day training programme for science teachers was conducted on 24 March 2017at the Institute. About 100 teachers participated in the training programme.

Two-day training programme for science teachers was conducted at PES College, Mandya during 23rd and 24th September, 2017 and about 120 teachers benefitted by this training. Another two-day training programme for science teachers was conducted at Mahaveer Jain College, KGF during 13th – 14th October, 2017 and about 130 teachers were benefitted by this training.

4. Hoysala Guest 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 the participants of the programmes conducted under CCE, like short term courses and invitees to the Institute. During the year 198 faculty from other universities/research laboratories/colleges who visited the Institute, 998 participants for short term courses and workshops/seminars. Revenue of about Rs.40.00 lakhs is received through Hoysala Guest House.

3.7.5 CENTRE FOR SPONSORED SCHEMES AND PROJECTS

In Charge: **V RAJARAJAN, REGISTRAR**

Most of the research contributions come from research and development sponsored by over a hundred agencies, comprising a total of 986 projects with an outlay of Rs. 1458.69 Crores and an annual cash in flow of Rs.386.43 Crores during 2017-2018.

The primary sponsors are the Department of Science and Technology, Aeronautical Research and Development Board, Department of Biotechnology, Indian Space Research Organization, Space Technology Cell, Council of Scientific and Industrial Research, Department of Atomic Energy, Ministry of Information Technology, Defence Research Development Organisation, Ministry of Human Resources and Development, UK-India Education and Research Initiative and Ministry of Non-Conventional Energy Source.

The International Sponsors include Boeing Company, European Union, Welcome Trust, IBM, Asian Office of Aerospace Research and Development, Indo-French Centre for Promotion of Advanced Research, Korea Institute of Science and Technology,Tokyo Electron Limited, Nokia, Rufford Small Grants Foundation.

The Private Sponsoring Agencies include Robert Bosch Centre for Cyber Physical Systems, Jamshetji Tata Trust,Shakti Sustainable Energy Foundation, Sonata Software Limited, St. Johns Research Institute,GE, Intel, Microsoft.

DIVISION WISE RESEARCH PROJECTS

DIVISIONS	NO. OF SCHEMES	Outlay (Rs. in Crores)
A. Science Divisions:		
Division of Biological Sciences	231	363.58
Division of Chemical Sciences	148	201.98
Division of Physical & Mathematical Sciences	112	77.47
Total	**491**	**643.03**
B. Engineering Divisions:		
Division of Electrical, Electronics, and Computer Sciences	142	76.74
Division of Interdisciplinary Research	116	454.91
Division of Mechanical Sciences	230	232.46
Division-Centres under the Director	7	51.55
Total	495	815.66
GRAND TOTAL	**986**	**1458.69**

In 2017-2018, Science Divisions received a total of 491 Projects with a total outlay of Rs. 643.03 Crores. The Engineering Divisions received 495 Projects with a total outlay of Rs.815.66 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 from the initial stages, are partially funded, indentify technology transfer terms and mutually agree on when the research should mature. The table (1) below show the Division-wise breakup of projects and the financial outlay and the table (2) shows the details of each sponsored agency.

AGENCY WISE RESEARCH PROJECTS

S.No.	Code and Name	Funding Agency Name	No Of Schemes	Total Budget (Crores)
1	ADAO	AERONAUTICAL DEVELOPMENT AGENCY	2	1.32
2	AMDO	ADVANCED MICRO DEVICES	1	0.44
3	AOAD	ASIAN OFFICE OF AEROSPACE RESEARCH & DEVELOPMENT	1	0.65
4	ARDB	AERONAUTICS RESEARCH & DEVELOPMENT BOARD	7	10.87
5	ARGO	ARGHYAM	1	0.53
6	BCOO	BRITISH COUNCIL,	1	0.01
7	BOCO	BOEING COMPANY	7	8.04
8	CDAC	CENTRE FOR DEVELOPMENT OF ADVANCED COMPU	1	0.09
9	CIST	CENTRE FOR INFRASTRUCTURE TRANSPORTATION & URBAN PLANNING	6	17.36
10	COLO	THE COMMONWEALTH OF LEARNING	1	0.15
11	CPRI	CENTRAL POWER RESEARCH INSTITUTE	2	4.65
12	CSIR	COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH	21	5.28
13	DAEO	DEPARTMENT OF ATOMIC ENERGY	19	8.16
14	DBTO	DEPARTMENT OF BIOTECHNOLOGY	109	187.96
15	DEOO	DEPARTMENT OF ENVIRONMENT	1	0.88
16	DMOO	DEPARTMENT OF MINES	1	0.20
17	DRDL	DEFENCE RESEARCH & DEVELOPMENT LAB.	2	1.37
18	DRDO	DEFENCE RESEARCH & DEVELOPMENT ORGANISATION	51	105.71
19	DSTO	DEPARTMENT OF SCIENCE & TECHNOLOGY	502	591.00
20	EDNO	ELECTRON DEVICE NEWS	1	0.05
21	EPFO	ECOLE POLYTECHNIQUE DE FEDERAL	1	0.21
22	EUOO	EUROPEON UNION	2	0.23
23	FSIP	FREESCALE SEMICONDUCTOR INDIA PVT. LTD,	1	0.29
24	GEIT	GE INDIA TECHNOLOGY CENTRE	3	0.45
25	GFPE	THE GRANTHAM FOUNDATION FOR THE PROTECTION OF THE ENVIRONMENT	1	35.67
26	GKOO	GOVERNMENT OF KARNATAKA,DEPARTMENT OF SCIENCE	1	8.50
27	GMOO	GENERAL MOTORS TECHNICAL CENTRE INDIA PVT. LTD.	1	0.10
28	HALO	HINDUSTAN AERONAUTICS LIMITED	1	0.43
29	IBMC	INTERNATIONAL BUSINESS MACHINE CORPORATION	3	0.22
30	ICAR	INDIAN COUNCIL OF AGRICULTURAL RESEARCH	1	1.28
31	ICMR	INDIAN COUNCIL OF MEDICAL RESEARCH	2	0.39
32	IFCP	INDO-FRENCH CENTRE FOR THE PROMOTION OF ADVANCED RESEARCH (IFCPAR)	16	6.49
33	IGCA	INDIRA GANDHI CENTRE FOR ATOMIC RESEARCH	4	9.94
34	IIIS	INDIAN INSTITUTE OF SCIENCE	3	0.66
35	INAE	INDIAN NATIONAL ACADEMY OF ENGINEERING	1	0.19

S.No.	Code and Name	Funding Agency Name	No Of Schemes	Total Budget (Crores)
36	INCO	INDIAN NATIONAL CENTRE FOR OCEAN INFORMATION SERVICES	1	0.98
37	INRA	INRA BIOTECHNOLOGIES, FRANCE	1	0.15
38	INSA	INDIAN NATIONAL SCIENCE ACADEMY	3	0.44
39	INTL	INTEL TECHNOLOGIES INDIA PVT., LTD.,	2	0.70
40	IRDO	INSTITUT DE RECHERCHE POUR LE DEVELOPMENT, FRANCE	4	4.54
41	ISRO	INDIAN SPACE RESEARCH ORGANISATION	12	5.47
42	ISTC	ISRO-IISC SPACE TECHNOLOGY CELL	40	8.32
43	IUCR	INTERNATION UNION OF CRYSTALLOGRAPHY	1	0.03
44	IUSF	INDO-US SCIENCE & TECHNOLOGY FORUM	7	57.51
45	JATP	JOINT ADVANCED TECHNOLOGY PROGRAMME	7	0.61
46	JTTO	JAMSETJI TATA TRUST	1	87.82
47	KFDO	KARNATAKA FOREST DEPARTMENT	1	0.01
48	KIST	KOREA INSTITUTE OF SCIENCE & TECHNOLOGY (KIST)	1	0.17
49	KSTE	KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY & ENVIRONMENT	1	0.05
50	LANS	LOS ALAMOS NATIONAL LABORATORY	1	1.94
51	MDWS	MINISTRY OF DRINKING WATER AND SANITATION	1	2.79
52	MERK	MERCK & Co., INC	1	0.98
53	MESO	MINISTRY OF EARTH SCIENCES	7	22.69
54	MHRD	MINISTRY OF HUMAN RESOURCE DEVELOPMENT	1	5.00
55	MITO	MINISTRY OF INFORMATION TECHNOLOGY	11	82.88
56	MNRE	MINISTRY OF NEW & RENEWABLE ENERGY	3	11.65
57	MRIL	MICROSOFT RESEARCH INDIA LTD.,	1	0.07
58	MSCI	MICROSOFT CORPORATION INDIA (p) LTD.	1	0.26
59	MSME	MicroSmall Medium Enterprises	7	5.09
60	MWRO	MINISTRY OF WATER RESOURCES	2	1.36
61	NBRC	NATIONAL BRAIN RESEARCH CENTRE	1	0.88
62	NIHO	NATIONAL INSTITUTES OF HEALTH, USA	1	2.01
63	NKIO	NOKIA	3	0.29
64	NRBO	NAVAL RESEARCH BOARD	2	1.00
65	OPSA	OFFICE OF THE PRINCIPAL SCIENTIFIC ADVISER	6	16.54
66	RBCO	ROBERT BOSCH ENGINEERING & BUSINESS SOLUTIONS LIMITED	32	47.71
67	RNTB	RENAULT NISSAN TECHNOLOGY & BUSINESS CENTRE INDIA PVT LTD	1	0.72
68	RROO	ROLLS ROYCE	1	0.41
69	RSGF	RUFFORD SMALL GRANTS FOUNDATION	3	0.12
70	TIPL	TEXAS INSTRUMENTS PVT LTD	1	0.56
71	TOEL	TOKYO ELECTRON LIMITED	2	0.95
72	UGCO	UNIVERSITY GRANTS COMMISSION	12	12.28
73	USCO	UNIVERSITY OF SOUTHERN CALIFORNIA	1	0.17
74	UUOO	UPPSALA UNIVERSITY	1	0.20
75	VSSC	VIKRAM SARABHAI SPACE CENTER	1	0.15
76	VTSK	VETENSKAPSRADET	1	0.04
77	WELT	THE WELLCOME TRUST,UK	21	63.39
		Grand Total	**986**	**1458.69**

3.7.6 OFFICE OF DEVELOPMENT AND ALUMNI AFFAIRS

Divisional Chairperson In-Charge:
GOVINDAN RANGARAJAN | PROFESSOR, MATHEMATICS

The Office of Development and Alumni Affairs (ODAA) was established at the Indian Institute of Science in 2015 to build a vibrant Industry-Institute-Alumni ecosystem, and raise funds for various special projects from corporates, philanthropists and alumni. In addition, the ODAA provides support for alumni-related activities and engagement programmes at the Institute.

Chief Development Officer
Ram Turaga

Development Officer
Ranjini Raghunath

PROJECTS

Some major projects that the ODAA pursued for fundraising during 2017-18 include:

- New women's hostel blocks
- Endowed Young Investigator positions supporting young Assistant Professors or new faculty candidates, and Chair Professorships supporting senior faculty members
- Teachers' training programme at IISc Challakere
- Support for research, education and outreach initiatives at the department level
- Student travel funds for international conferences

CORPORATE PARTNERSHIPS

In addition to ongoing projects, many organizations and individuals have funded several new projects this year through Corporate Social Responsibility (CSR), philanthropy and research grants.

NEW PROJECTS FUNDED UNDER CSR

- Bharat Petroleum Corporation Limited: New women's hostel block on IISc campus
- Adventz Finance Private Limited: Endowed Young Investigator position
- L&T Technology Services: Support towards the teachers' training programme conducted in IISc Challakere
- Amazon Internet Services: Supporting research in foundations and applications of Artificial Intelligence
- Broadcom Communications Technologies: Support for students to attend the EMEA workshop on "Brain inspired computing and technologies" as well as for other workshops & travel support
- Triveni Turbine: Research equipment in the area of turbomachinery at the Interdisciplinary Centre for Energy Research, as well as support for other educational initiatives
- Hewlett-Packard: Support for education, to engage in understanding fundamental issues in deep learning

NEW PHILANTHROPIC CONTRIBUTIONS AND GRANTS

- Jindal Aluminium Group: New women's hostel block on IISc campus
- AVRA Labs: Furnishing of new auditorium in the Division of Chemical Sciences building
- Mr. SV Narasaiah: New auditorium in the Department of Instrumentation and Applied Physics
- Microsoft Research India: Unrestricted grant to support research and encourage collaborations, workshops and conference travel
- Vanguard Charitable Trust:Donor-advised fund for research in data science platforms and algorithms that make use of distributed computing resources such as cloud computing and IoT
- Intuit, Tesco, Target, Cargill, Wipro-GE Healthcare: M. Tech. scholarships at CDS

ALUMNI RELATIONS

Since 2015, the ODAA has maintained an exclusive alumni portal to help alumni connect with each other and with the Institute (www.alumni.iisc.ac.in). More

than 4000 alumni have currently registered for this free website and receive periodic newsletters and announcements through this portal. The ODAA has also built a large network of alumni and corporates through Linkedin (~6000).

ALUMNI CONTRIBUTIONS

The Institute has been receiving generous funding from alumni towards several projects. Contributions were made by alumni towards the following initiatives in the current year:

- Dr. Brij Seth endowed UG scholarships in Materials Engineering
- Bio Engineering Summer Training programme (BEST)
- D Nagarajachar Fund for supporting student travel to international conferences
- PV Lakshmi Narayana Grant for supporting student travel to international conferences
- Chemical Engineering Summer Internship programme
- ECE Alumni Research Fund for Students
- CSA Research Endowment Fund
- KPA Chair in Materials Engineering
- Furnishing of new classrooms in Civil Engineering
- Support for Student Amenities Centre

ANNUAL ALUMNI REUNION

The ODAA, with support from IISc Alumni Association and IISc Alumni Association of North America, organizes an annual reunion to encourage alumni to return to campus, and connect with the Institute and their departments.

The second alumni reunion was organized during December 16 & 17, 2017. More than 400 alumni registered for the 2-day event, which began with a talk by the Director, a panel discussion on "Artificial Intelligence" and invited talks by alumni who have contributed to or supported various initiatives at IISc. The event also included get-togethers at the departments, a cultural programme, the Distinguished Alumnus Awards ceremony, a Sunday morning campus walk & games, and breakfast at the mess.

Philanthropist Mr. SV Narasaiah making a contribution for construction of IAP auditorium

Signing of MoU with Jindal Aluminium Group for philanthropic support to construct a new women's hostel block

IISc's second annual alumni reunion held on December 16 & 17, 2017

3.7.7 OFFICE OF INTELLECTUAL PROPERTY AND TECHNOLOGY LICENSING

Chairperson: **SRINIVASAN RAGHAVAN | ASSOCIATE PROFESSOR, CENSE**

1. DEPARTMENT PROFILE:
IPTeL (Intellectual Property and Technology Licensing) is the Institute's gateway to filing for intellectual property protection and technology licensing. This mandate of this office is to ensure that the knowledge being generated at the Institute is protected and then leveraged, by responsible licensing, for the benefit of the Institute and thereby to the society at large. IPTeL strives to enable rapid filing for IP protection, so that it does not unduly delay the submission of results to academic journals.

The activities at IPTeL thus fall in two large buckets. One is IP management that includes all the processes from IP disclosure by IISc staff and students to maintaining the patent till its point of expiry. Two, licensing of the IP so generated in the form of know – how and patents. During the calendar year 2017 IPTeL embarked on the process of automating the IP management system, so that more emphasis could be placed on licensing. Towards this end, IPTeL has planned in 2018 to increase its interface with industry by various licensing modes.

2. PATENT LICENSING:
IPTeL is getting increasingly involved in licensing and pursuing transfer of technologies to various companies. We have, in the past one-year, entered into exploratory agreements with many companies. A sample list of such engagements is as follows:

IISc Patents licensed from IISc Start – ups:
- Superwave Technologies
- Pathshodh
- Mynvax
- In Scientific
- Sickle
- Open Water
- Mimyk

Industy/Company	Technology
Antsceramics	Indegenous Ceramic Femoral Head development
Jiva Sciences Pvt Ltd	Multidimensional Fluid Focusing Device
Remidio	Automated Fundus Image Processing Techniques for Glaucoma Prescreening
Reva technologies, Pune	H2S Scrubbing Technology
M/s Praj Industries Ltd	H2S Scrubbing Technology
Superwave Technologies	Novel Technique for Hypersonic Drag Control Using Heat Addition in the Shock Layer
Mynvax	Protein Model Discrimination Using Saturation-Suppressor Mutagenesis
Mymic	A Haptic Device for Endoscopy
Sickle Innovations	A Harvesting Machine
Open Water	Fluid Filtration Device
PathShodh Healthcare Pvt Ltd	Device and Method for Non-Enzymatic and Electrochemical Detection of Glucose Bioanalyte
Aricent Technologies	
APE Research	Micro-Scale Ball-and-Socket Joint

Industy/Company	Technology
Ducom	A Dental Implant Assemble for Dental Prosthesis
Zydus Cadila	Novel Inhibitors of Antiapoptotic Bcl-2 Protein
Agrinnovate	Pest Control
NRDC	Pest Control
Monsanto	Pest Control
Anton Parr	A Device for Measuring Rheological Properties Of Granular Materials
Rane Group	Method of Manufacturing Composite Solid Propellent Grains
Ray Pharma	Antibacterial Antimicrobial Composition and Method of Preparation Thereof
Phoenix Medical Systems Pvt Ltd	Reduced Graphene Oxide Nanomaterial Coated Cotton Fabric as a Heating Device and a Method Thereof
Tata Motors	Switched Reluctance Device
FeatherLite	A Compliant Hinge Mechanism
Vector Technologies Pvt Ltd	NOVA Power Electronic Converter Platform
Vector Technologies Pvt Ltd	Power Amplifier for Power Hardware-in-Loop Simulations

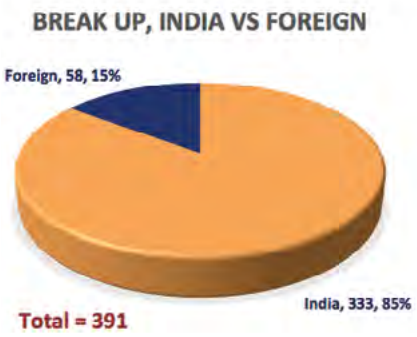
3. BASIC PORTFOLIO INDEX (1995-2018): In 2017 the IPTeL embarked on the process of compiling our existing portfolio in soft format to aid subsequent automation and make the licensing procedure easier. This portfolio is now available online and is being updated on a monthly basis. The current portfolio is as follows

• Patent Families (1995-2018): (A family is a set of patents filed in different countries against the same disclosure. Family does not include patents filed only in India)

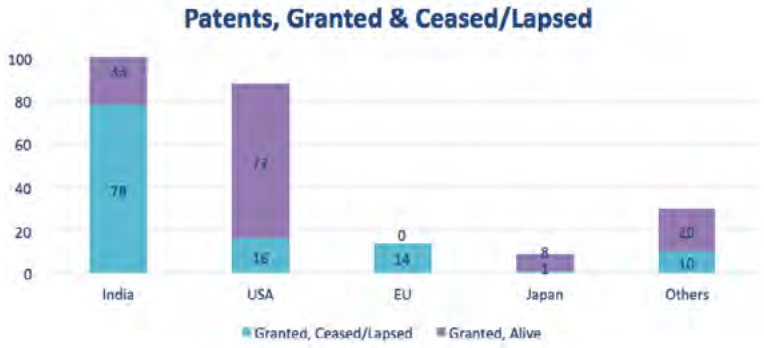
Number of Families: 182
Number filed directly to PCT/USPTO: 23 (No Indian Patent was filed)
Number of Indian patents filed in the family bucket: 159

• Total disclosures submitted by IISc faculty to IPTeL (1995 – 2018): 535

• Total number of Indian and Foreign patents filed and under prosecution (1995-2018): 391
a) Indian: 333
b) Foreign: 58



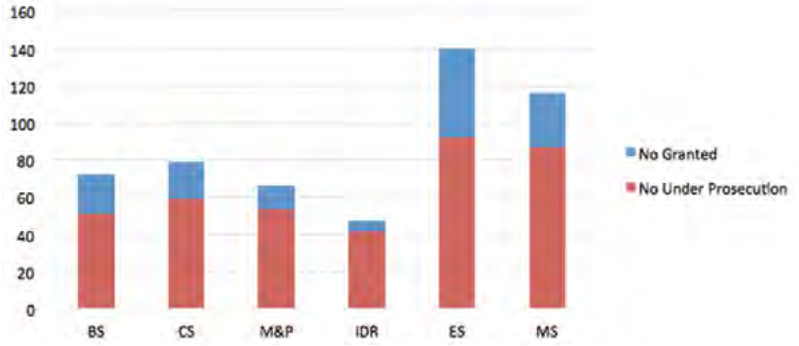
• Break-up of granted patents into "Alive" and "Lapsed/Ceased":



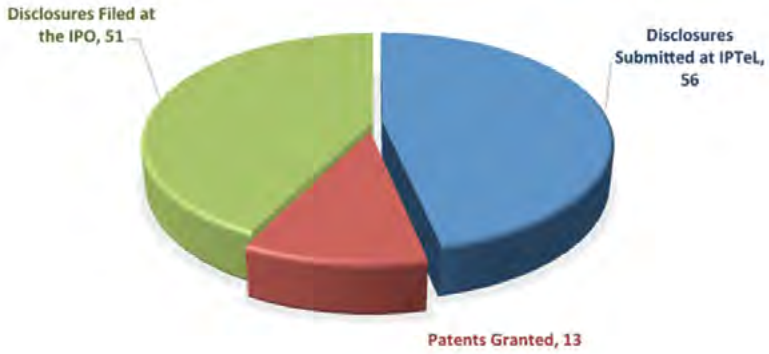
• Foreign patents under prosecution: 58

• Year wise break-up (1995-2018) of patents granted and under prosecution

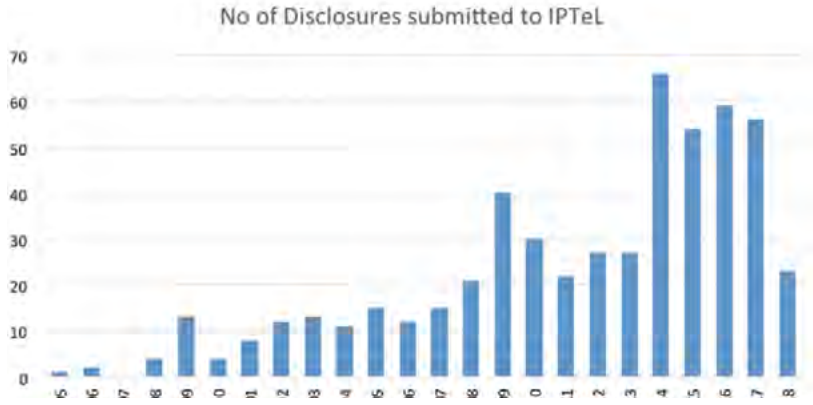
• Division wise break-up of number of disclosures filed & submitted (1995-2018)



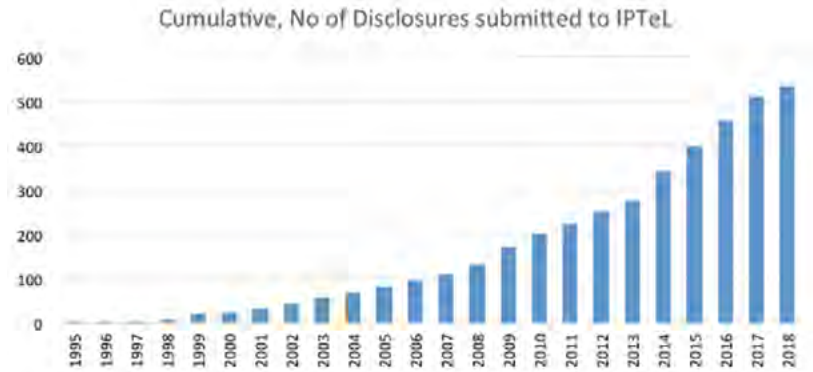
• IP filing status for the year 2017-18



• Year Wise Break-up of Disclosures Submitted to IPTeL



•Year Wise Break-up of Disclosures Submitted to IPTeL Cumulative:



3.7.8 CHALLAKERE CAMPUS/ TALENT DEVELOPMENT CENTER, KUDAPURA

Advisor Of Challekere Empowered Committee:

B N RAGHUNANDAN| PROFESSOR (RETIRED), AEROSPACE ENGINEERING

The construction of Skill Development Centre and Hostel Blocks, which was taken up for construction in October 2016 has progressed satisfactorily. During the year, the Water Supply System was taken up through CPWD. The supply of raw water from Vani Vilas Sagar is now available at our door step thanks to the project executed by KUWSSB. The proposed internal water supply system includes providing raw water sump at 3 locations and purified water at one location, pump house, automated water filtration plant, water distribution network, pump sets, etc. In addition to this, HT Power supply along the peripheral road in the first arc of development has been initiated through CPWD. This project includeswidening of existing WBM Road, laying of RCC trench for utility cables, drawing HT cables and street lighting.

Hindustan Aeronautics Limited, Bangalore has released the funds under CSR Act for smooth passage of construction of Skill Development Centre and Hostel Blocks. The Skill Development Centre proposes to extend the training to engineering disciplines, especially to address the needs of mechanical and electronics manufacturing sectors. The involvement of HAL has given a boost to this scheme both in terms of support to establish the Centre and the hostel complex and also in terms of partnering the training schemes particularly those that may impact the future of aerospace sector. Discussions are in progress to start some of the training modules even as the SDC construction work is in progress.

The High School Science Teachers Training programme, which was started in 2011, continues to be a major activity at Challakere Campus. The Talent Development Centre continues its activities of providing training for high school and pre-university teachers in Science and Mathematics. This training programme has alsobeen extended to UG/ PG Lecturers under Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching sponsored by MHRD. The Kendriya Vidyalaya and JNV have also deputed its teachers for training programme. So far around 11500 teachers across the country have benefitted from this programme. There has been a growing demand for teacher training and also for providing experimental kits to selected schools for promoting science education.

3.7.9 CENTRE FOR SCIENTIFIC AND INDUSTRIAL CONSULTANCY

Chairperson

K J VINOY | PROFESSOR, ELECTRICAL COMMUNICATION ENGINEERING

N C SHIVAPRAKASH (ASSOCIATE CHAIRMAN)

During the year under review, the Centre for Scientific and Industrial Consultancy (CSIC) has strengthened the faculty-industry interactions in the form of informal discussions and advice to formal projects, involving design, development and transfer of technology. The Centre has strived 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 of 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, 2017 to March 31, 2018, 239 consultancy project proposals costing Rs 2415.47 lakhs were communicated to the clients. In the above said period 140 consultancy projects with an outlay of Rs. 2002.25 lakhs materialised. Receipts from consultancy projects and consultancy test projects amounted to Rs. 2031.23 lakhs.

3.7.10 DIGITAL CAMPUS AND INFORMATION TECHNOLOGY SERVICES OFFICE

Chairperson: **Y. NARAHARI, CSA**
Chair, OPERA: **K.V.S. HARI, ECE; CHAIR, TINA: JOY KURI, ESE**
Chief Information Technologist: **GANESH GOPALAKRISHNAN, DIGITS**
Information Technology Consultant: **AMIT C. CHAKRABORTY, DIGITS**

DIGITS (Digital Campus and IT Services) Office is a unit set up by the Institute to conceive, plan, and create a best-in-class information technology (IT) and networking system, and implement agile IT and networking services for operational excellence in the Institute. The DIGITS office has the mandate of consolidating and coordinating all digital campus activities and services for better execution of the following earlier initiatives in IISc:

- OPERA (Operational Excellence for Research Advancement)
- CCIT (Committee on Computerisation and Information Technology)
- TINA (Telecom, Internet, and Network Access)
- VISE (Video Security Equipment for IISc)
- MMCR (Multimedia Class Rooms Initiative)
- Video archives and streaming
- IISc webpage maintenance and enhancement
- Campus infrastructure data acquisition and analytics (including the Challakere Campus)
- Provide an interface between vendors and IISc administrative units, addressing short-term and long-term measures

During April 2017-March 2018, the activities of DIGITS have resulted in the following outcomes.

ERP PROJECT

RFP for ERP Selection

The IISc ERP project was decomposed into two processes: (a) Selection of ERP product and Hosting Solution (b) Selection of the System Integrator for Implementation and Support & Maintenance of the selected ERP product. For the Selection of ERP product and Hosting Solution, the RFP was prepared by a professional team from a reputed company and an Infosys team was commissioned to prepare the RFP at an affordable cost. The team prepared the RFP in a record time of two months and this formed the basis for the Selection of ERP product and Hosting Solution.

ERP Product & Hosting Solution Selection

The second step was to use the above RFP to select an ERP product. The ERP purchase committee, headed by Chairman, DIGITS, undertook an elaborate tecno-commercial bidding process at the end of which SAP ECC was selected as the product. It was ensured that the product is a hosted one and not on-premise. This was a major strategic decision that took away the onerous task of maintaining an on-premise data centre in the IISc campus. This was followed by a protracted negotiation for two months with SAP during which SAP was persuaded to offer the latest product SAP S/4 HANA at the same price that was quoted for SAP ECC. This was a strategic decision that immensely benefited IISc. The product will be hosted on a cloud-based platform with the cloud infrastructure provided by an established Indian company, Ctrl-S.

ERP Implementor/ System Integrator Selection

During October-December 2017, the ERP purchase committee undertook another detailed techno-commercial bidding initiative to identify an implementation partner (also known as System Integrator). Four companies participated in this exercise: Accenture, Infosys, TCS, and Wipro. Wipro was identified as the System Integrator through this selection process.

ERP Implementation

Master service Agreements (MSAs) were signed with SAP as OEM License Provider, Ctrl-S as Hosting Partner, and Wipro as System Integrator during December 2017 – January 2018. From February 15, 2018, the SAP S/4 HANA implementation commenced. The project has been code named ISTAR (Implementing SAP for Transforming Administration and Research). An ExeCom was formed with Prof. Jayant Modak (Deputy Director, Admin and Finance) as Chair and Prof. Y. Narahari (Chair, Division of EECS) as co-chair. An operational committee, OpsCom,

with the IISc Registrar as Chair and IISc Financial Controller as Co-Chair looks into the detailed implementation aspects.

MAINTENANCE OF THE CURRENT IT AND NETWORKING OPERATIONS

Since it would take another one year or more for making the implementation of a new ERP system fully operational at the Institute, there is a need to strengthen and maintain the current IT and network services. DIGITS has commissioned the services of a team from an IT services company Integra Micro Systems since September 2016 for this purpose. This team is helping DIGITS to run the existing operations in a more reliable and robust way, and in implementing additional applications. In particular, Integra has taken over the maintenance of the following applications in cooperation with DIGITS:

- Admissions
- Post-admissions Academic operations
- Stores & Purchase
- CSSP
- Health Centre
- Hostel & Mess Management
- IISc website.

ENHANCEMENTS TO IT SERVICES AND LAUNCHING NEW APPLICATIONS

Online Thesis Processing

DIGITS, with the help of its staff and outsourced team, launched in October 2017 a completely automated online Ph.D. thesis processing system on the ScholarOne platform of Clarivate Analytics. The processing of more than 150 Ph.D. theses submitted since October 2017, has been initiated through this system; in fact, end-to-end processing has been completed for many theses.

Online Course Feedback System

An automated online course feedback system which was launched in December 2016 is now fully stabilized with multiple online reports and graphical trend analysis of the courses and the instructors available at multiple levels (Instructors, Chairs, Divisional Chairs, Deans and Director).

Online Course Registration and Course Grading

Commencing January 2018, registration as well as dropping of all the PG courses and UG courses moved to an online platform. Entry of grades to these courses has also been automated. The application needs to be stabilised.

INTERNET AND NETWORKING SERVICES

This is being handled by the TINA (Telecom, Internet, and Network Access) group. Active Directory implementation has been completed for all the departments and centres in the Institute. This was a major effort. The IISc website has been moved to the Azure cloud with the help of an Integra team. TINA has effectively taken care of all day-to-day issues arising in the networking and Internet infrastructure in the Institute. The website has just been moved to Azure cloud.

PLANS FOR 2018-19

SAP S/4 HANA ERP IMPLEMENTATION

Project ISTAR (Implementing SAP S/4 HANA for Transforming Administration and Research) for ERP implementation commenced on February 15, 2018. Project ISTAR will be executed in two waves:

o WAVE 1: Finance & Accounts; CSSP; HR & Payroll; Stores & Procurement (scheduled to go live in January 2019)
o WAVE 2: Academics; CCMD; Hostel, Mess, and Guest House (scheduled to go live in June 2019)

PORTAL FOR FACULTY RECRUITMENT

An online portal has been designed, developed, tested and made ready for deployment for receiving applications from prospective faculty candidates. The portal is expected to be launced by end of May 2018.

PORTAL FOR RECRUITMENT OF NON-TEACHING STAFF

An online portal is currently under development for recruiting permanent administrative and technical staff at various levels. The portal is expected to be launched by end of May 2018

OTHER PORTALS

The following portals will be developed: Portal for annual reporting by faculty; portal for students to upload grievances; portal for feedback on amenities, etc.

INTERNET AND NETWORKING INFRASTRUCTURE AND SERVICES

Single sign-on for all IT applications is being implemented. It has now been implemented for WiFi services, VPN connection, and for online course feedback. Eduroam services are being implemented. A detailed plan has been drawn up for procuring equipment for a modern networked campus. The equipment is being procured through NICSI, a subsidiary of NIC and a Govt. of India company.

MAINTENANCE AND STABILISATION OF IT APPLICATIONS

DIGITS will continue to maintain and stabilise the following IT applications: admissions, post-admissions operations (course registration and course grade entry), online thesis processing, online course feedback, purchase, CSSP, health centre, hostel, etc.

VISE

The planning for Phase II of Video security equipment (VISE) has been completed. This covers more than 70 locations and more than 100 cameras. The implementation of this project is expected to be completed by December 2018.

3.7.11 SOCIETY FOR INNOVATION AND DEVELOPMENT

Chief Executive: **B GURUMOORTHY | PROFESSOR, MECHANICAL ENGINEERING**

PROJECTS SANCTIONED: During the period under review SID got 24 projects sanctioned covering different departments of the Institute involving the participation of more number of faculty.

INDUSTRY R&D CENTRES IN SID/IISC CAMPUS:
- Pratt and Whitney – Aerospace
- Tata Motors – Automotive
- Robert Bosch Center – Cyberphysical Systems
- Gubbi Labs LLP – Science Media
- i2n Technologies Private Limited - Nanotech

OTHER CENTRES:
- SATF (Spectroscopy Analytical Test Facility)
- CiSTUP
- ESSI (Energy Storage Systems Initiative)
- Centre for Brain Research

COMPANIES/INDUSTRIES WITH WHICH AGREEMENTS/ MOU'S SIGNED DURING 2017-18

1. Thalesat Innovations Private Limited
2. Karnataka Biotechnology and Information Technology Services (KBITS)
3. WIPRO Limited (Collaboration Agreement)
4. Wipro Enterprises (P) Limited
5. Shell India Markets Private Limited,

INTERACTION MEETINGS

SID has regularly been connecting with private industries, public sector, government of India entities across segments to scale sponsored research collaboration for establishment of I-HUB R&D Centers and projects. SID continues to organize the interact sessions between the scientists/technologists from industries and faculty of IISc to showcase the capabilities of the Institute and facilitations that would provided in the growth of applied research. The following organizations participated in the interact sessions.

S. No.	Company
1	Toyota Kirloskar Motors
2	YESKAWA
3	Wipro Consumer Care
4	LERC
5	FLIPKART
6	QUALCOMM
7	INDIAN NAVY
8	Johnson & Johnson
9	MERCK
10	MNRE
11	Ashok Leyland
12	Duracell
13	Swiss Re
14	GATES Foundation
15	Tata Steel
16	Tata Chemicals

UCHHATAR AVISHKAR YOJANA

IISc has submitted 19 project proposals in response to the second call for proposals under this scheme and 4 proposals approved have been approved

Sl. No	Project Title	Chief Project Executive	Duration of the Project	Industry Partner	Participating Ministry	Total Budget in Rs
1.	Ecosystem Development for aircraft health management and forecasting using deep learning	Ambedkar Dukkipati and Prof. R. Venkatesh Babu	36 months	JFWTC division of GEIIPL (GE India Industrial Private Limited	Department of Space	250
2.	Machine learning methods for automatic surface defect inspection and characterization		36 months	GE INDIA INDUSTRIAL PVT. LTD	Ministry of Science and Technology / Ministry of Civil Aviation	220
3.	3D Printing of Metallic Orthopaedic Implants	Dr. Kaushik Chaterjee	36 months	INTECH DMLS Private Limited	Ministry of Health and Family Welfare	120
4.	Development of stem immunogens for a broadly protective influenza vaccine	Prof. Raghavan Varadarajan	36 months	Mynvax Private Limited	Ministry of Health and Family Welfare	314.5
5.	Development of EMI shielding material for aircraft	Prof. Suryasarathi Bose	24 months	Log 9 Materials Scientific Pvt. Ltd	Department of Space	115.03

STEM CELL

Companies currently being incubated:

Sl No	Incubation MM/YY	Company	Incubatee	Technology Area	Status	Impact Area
1	Jan/2018	Shono Research Pvt Ltd	Joydeep Maitra	Low Cost Medical Device	Prototype in Progress	Rural Health
2	Jan/2018	Protein Design Pvt Ltd	Dr Rajan Dighe	BioSciences	Yet to begin	Healthcare
3	May/2017	General Aeronautics	Dr Kota Harinarayana	Aerospace	Developmental phase	Aerospace industry
4	May 2017	Mimyk Heathcare	Shantanu Chakraborty	Laproscopy Simulator	Prototype Developed	Healthcare
5	Jan/2017	Bellatrix Aerospace	Mr. Rohan M. Ganapathy	Orbital launch vehicles	Signed Contract with ISRO	Aerospace Industry
6	Jan/2017	Lab to market innovations	Prof. S. K. Sinha	IoI based applications	Development phase	Transportation Industry (Railways)
7	Aug/2016	SIAMAF Healthcare Pvt Ltd	Dr. Subhasis Sarangi	Nano technologybased diagnostics	Clinical Trials in Progress	Health care

Sl No	Incubation MM/YY	Company	Incubatee	Technology Area	Status	Impact Area
8	Jan/2016	Astrome Technologies	Ms. Neha Satak	Satelite Based Internet Services	Developmental phase + Testing to beging	Digital India
9	Apr/2014	Azooka Life Sciences	Ms.Fatima Benazir	DNA Stains	Developmental phase	Societal
10	Jan/2014	Pratimesh Labs	Mr. Prakhar Jain	Low- Cost Medical Devices	Developmental phase	Rural Health

Companies incubated under the Faculty entrepreneurship programme:

Sl No	Incubation MM/YY	Company	Incubatee	Technology Area	Status	Impact Area
1	Aug 2017	Mynvax Pvt Ltd	Prof Raghavan Vardharajan	Vaccines for local diseases	Early Stage	Healthcare
2	May 2017	Simyog	Prof. Dipanjan Gope	Computational tool for modelling and simulation in electromagnetics	Product Development; Strategic investor on board	Electric vehicle
3	Jan 2017	OpenWater	Prof Sanjiv Sambandan	Water Purification	Beta Testing with Customers in progress	Water / Societal / Industries
4	Aug 2016	Shanmukha innovations Private limited	Dr. Sai Siva Gorthi	Optics and Microfluidics Instrumentation	Developmental Phase	Medical Diagnostics
5	Aug 2016	Bio-Synth	Prof. B. Gopal	Enzyme engineering	Product Development	Biotechnology, Chemicals, Pharma
6	Sep 2015	Pathshodh Healthcare Pvt Ltd	Prof. Navakanta Bhat	Diabetes Diagnostics	Product Testing	Societal
7	Apr 2015	Equine Biotech Pvt. Ltd.	Prof. Utpal Tatu	Veterinary Diagnostics	Field Testing	Animal Health
8	Sep 2014	Superwave Technology Pvt. Ltd	Prof. K.P.J Reddy/Prof. Jagadeesh	Shock Wave Dynamics	Revenues	Petroleum, Tea Industry and Healthcare

SID has received new proposals on faculty entrepreneurship and these are in various stages of evaluation and processing.

INCUBATION PIPELINE:

Domain	Product / Initial Offering
Industrial IOT	1. Industrial IOT based Machine Diagnostic Solution; 2. IOT Based Home Switches 3. LPG Sensors
Mechanical	Micro Electro Mechanical System (MEMS)- Viscosity-Density Sensor for Industries
Govt / Finance	Blockchain framework for multiple usecases in Financial/Govt Industries
Healthcare (Devices)	Prosthetic Wearable Arms; Simulators for training doctors and nurses; Dry blood transport
Bio-Tech	Antibody design

• Selected by NitiAayog for a 10cr grant towards upgradation of Incubation Center. More details awaited.
• 2 new startups incubated – Shono Research and Protein Design Pvt Ltd
• 1 new term sheet offered – Meduplay – Nursing Station Trainer.
• 23 Proposals for Incubation Received; 1 formal review done
• Formal Mentoring for Startups initiated – One Mentor on board for Shanmukha Innovations.
• Visits by investors / VC firms – Kaaj Ventures, Lakshmi Narayanan, Univ of Tokyo Venture Fund etc.

AWARDS WON:
• Astrome Technologies have won the Prestigious National Technology Award by GoI as a startup whose technology has commercial potential.

MANUFACTURING EXCELLENCE PROGRAMME:
Below is the list of companies which are collaborated with SID-TIME2 in developing products jointly.

Sl. No.	Company	Product area	Status
1	Electronics Relay India Pvt Ltd, Bengaluru	Motor controller	Platform prototype done
2	Sadhana Enviro Engineering Solutions, Bengaluru	Desilting Machine	Platform prototype done
3	Volga instruments, Thane	Warehouse Robot	Platform prototype done
4	Inhouse Interior, Bengaluru	Smart furniture	Platform prototype done

Received partial funds from above industries.

PRODUCT INNOVATION CENTER:
Vikas Composites has signed an MoU with SID for participating in the collaborative design program to develop a product in the personal thermal management space. The PI has been identified and lab has been setup.

Three companies expressed their interest in collaborating under PIC programme.

FOCUSED PRODUCT INNOVATION CENTER:
Discussions underway with strategic sector to support Defense PIC. The DEFPIC will collaborate with 10 industries towards technology and product development of defense requirements.

INDUSTRY INTERACTION
• 28 industries participated in the Time 2 Leap summit
• 20 industries showed interest to participate in different programs of TIME2
• Had one on one meeting with all the 20 industries and selected 8 industries for day long brainstorming workshop
• Visited these 8 industries and finally selected 4 industries for MxP program

SUMMIT
Organized TIME 2 LEAP summit, a one-day summit to disseminate information about TIME2 activity among SME industries.

Industry Sector	**Counts**
Electronics	7
Robotics	3
Sheet metal	1
Solar	3
Solid waste Management	2
Automotive	2
Aerospace & Defence	2
Furniture	2
Plastics	3
Medical	1

WORKSHOPS/ CONFERENCES
• Represented SID, IISc at the roundtable at the Festival of Innovation & Entrepreneurship, FINE-2018 at Rashtrapati Bhavan
• Represented SID, IISc at Electronic Warfare Symposium at Indian Airforce 12 BRD
• Represented IISc and exhibited in Industry Expos namely India Manufacturing Show 2017 & Bangalore Tech Summit 2017
• Visited the Hannover Messe Trade Show, focused on Industry 4.0, Industrial Automation, Energy, IoT
• Attended IMTEX 2018 & India Defense Expo 2018

3.7.12 CENTRE FOR BRAIN RESEARCH

Convenor: **VIJAYALAKSHMI RAVINDRANATH | PROFESSOR, CENTRE FOR NEUROSCIENCE**

The Centre for Brain Research (CBR) was established in 2014 at IISc to focus on research on ageing brain with a goal to identify risk and protective factors that contribute to pathological aging leading to disorders, such as dementia. CBR has been established through a generous gift from Pratiksha Trusts founded by Mr. Kris Gopalakrishnan, co – founder of Infosys and Mrs. Sudha Gopalakrishnan. This is a unique initiative in the current research environment in India, wherein, conventionally, most of the academic research has been carried out through public funding. The funding of CBR by philanthropy offers unprecedented flexibility in faculty and staff recruitment and operation that is necessary for large scale scientific endeavor with long term goals.

CBR activities are currently carried out in a temporary location within IISc. A state-of-the-art Brain Research Laboratory is being established in the IISc Campus with the built up area of 1,10,000 sq.ft to house a unique world class facility.

The faculty of CBR are actively involved in the study of a population cohort initiated by the centre to prospectively follow-up subjects to identify protective and risk factors for neuro-degenerative diseases. These include genetic factors, like, the allele frequency distribution of APOE epsilon alleles for association with dementia in the Indian population. Other projects are aimed at better understanding the shared genetic architecture between metabolic disorders, aka, diabetes and abdominal adiposity with neurodegenerative disorders, including genetic overlap between different disorders (i.e. pleiotropy) and genetic and phenotypic heterogeneity within disorders in Indian population. Another focus is the optimization of machine learning algorithms (ML) for cognitive impairment classification in order to evaluate the performance of various machine learning approaches in predicting the healthy/mild cognitive impaired (MCI)/Alzheimer's dementia (AD) status for a set of individuals depending on their cognitive scores, gender, age, and education level. Apart from these, animal models are also being studied to understand the dysfunction in specific neural circuits underlying dementia including Alzheimer's disease (AD).

RESEARCH PROJECTS AT CBR

Srinivaspura Aging Neuro Senescence and COGnition (SANSCOG)

CBR, in collaboration with National Institute of Mental Health and Neurosciences (NIMHANS), Sri Devraj Urs Medical College Kolar, and the Indian Institute of Science (IISc) has started the Srinivaspura Aging Neuro Senescence and COGnition (SANSCOG) study, which is a large-scale prospective community based cohort study of 10,000 individuals with long-term follow-up over many years for comprehensive evaluation and identification of risk and protective factors associated with cognitive changes due to normal and pathological aging. The study cohort comprises of individuals aged 45 years and above. These individuals will be phenotyped for several parameters including anthropometry, clinical biochemical analysis, cognition, cardio-metabolic parameters, brain MRI- PET scans, along with genetic studies. This study will generate a database comprising of genetic, biochemical, clinical, neuroimaging and cognitive data that can help in further understanding of the pathophysiology of normal and pathological aging.

At least, a dozen awareness camps were held in Dalasnuru (near Srinivaspura) and surrounding areas in order to sensitize and impart information about the public health benefits of the study in the long run. The subject recruitment has already started and actively gaining momentum at the study site in Srinivaspura. More than 200 subjects have undergone neuropsychological tests for cognitive assessments, clinical cognitive assessments, blood biochemical investigations, and anthropometric measurements.

Genome India

CBR is currently spearheading the GenomeIndia initiative, with collaboration from several national institutes across India – a first of its kind in the country aimed at cataloguing the variation in Indian individuals by information from whole genome sequencing of thousands of individuals representing diverse ethnic and linguistic groups across various geographical regions of the country. Since genetic variations play a major role in health and disease, a systematic study of the genetic heterogeneity of

the Indian population and numerous sub-populations is crucial to identify the complex and rare disease risk factors in Indian population. The availability of a comprehensive catalogue of genetic variations from India will serve the immediate purposes of (i) developing a genome wide association chip to carry out comprehensive genetic diagnosis inexpensively in India (ii) develop a reference panel for imputation for comprehensive genetic studies and (iii) help perform genetic studies on monogenic disorders as the comprehensive list of genetic variation obtained from healthy individuals will act as filter for non-causal mutations.

After the formal launch of the project, the standard operating procedures for sample collection with background information after an individual has consented to participate in the study has been clearly laid out. These include collection of brief demographic and epidemiological details of the participants, including age, gender, and education, and marital status, occupation, past history of illness/ infections, medication use checklist, and exposure to hazardous chemicals. Detailed anthropometric and physical examination (including height, weight, waist circumference, hip circumference, head circumference and blood pressure) are being collected. CBR has optimized the pipeline for data analyses from whole genome sequencing (WGS) of individuals. Altogether, five working group meetings have been held at various collaborating institutes across the country, and this is pioneering collaborative endeavour from more than twelve research institutes of India, spearheaded by CBR.

AWARDS

Dr. Ganesh Chauhan and Dr. Bratati Kahali has been awarded the Ramalingaswami Fellowship, DBT for the year 2016-2017.

LECTURES

CBR has organized several lectures delivered by eminent scientists and clinicians from India and other countries during the academic year 2017-2018. Some of the notable ones are:

1. Our Footprints on the Sands of Time. Speaker: Prof. Partha P Majumder, Indian Statistical Institute Kolkata & National Institute of Biomedical Genomics Kalyani INDIA on June 22, 2017.

2. Population Neuroscience: How Epidemiology helps us Understand the Brain. Speaker: Prof. Mary Ganguli, University of Pittsburgh, Pennsylvania, USA on November 23, 2017.

3. The Global Challenge of Alzheimer's disease: Setting the Research Compass. Speaker: Prof. Howard Feldman, Professor, University of California, San Diego, and Director, Alzheimer's Disease Cooperative Study, University of California, San Diego, La Jolla, USA on June 12, 2017.

4. Influence of life style on Neurodegenerative Disease and Aging. Speaker: Prof. Michael J Zigmond, University of Pittsburgh, Pennsylvania, USA on February 21, 2018.

3.7.13 KISHORE VAIGYANIK PROTSAHAN YOJANA

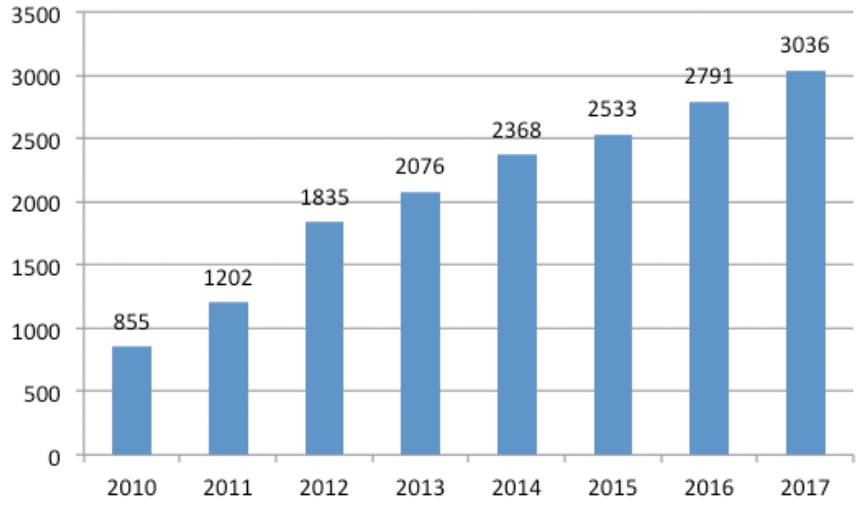
Convenor: **G MUGESH | PROFESSOR, INORGANIC AND PHYSICAL CHEMISTRY**

PROFILE

The Kishore Vaigyanik Protsahan Yojana (KVPY) is a programme established in 1999 by the Department of Science and Technology, Government of India to encourage students to take up research career in Basic/Natural Sciences. The Department of Science and Technology, the nodal agency of the Government has entrusted the overall responsibility for organizing and running the KVPY Program to the Indian Institute of Science, Bangalore and set up a KVPY Management Committee which oversees all the aspects of implementing KVPY program including declaration of results. The National Advisory Committee (NAC) oversees proper implementation of the program and a Core Committee looks after both the day-to-day and academic aspects of the KVPY Program. The aim of the programme is to identify and encourage talented students with an aptitude for research. This programme strives to assist the students to realise their potential and ensure that the best scientific talent is tapped for research and development in the country.

KVPY programme is open to Indian Nationals studying in India. Students enrolled in an undergraduate course in Basic Science subjects such as Chemistry, Physics, Mathematics, Statistics, Biochemistry, Microbiology, Cell Biology, Ecology, Molecular Biology, Botany, Zoology, Physiology, Biotechnology, Neurosciences, Bioinformatics, Marine Biology, Geology, Human Biology, Genetics, Biomedical Sciences, Applied Physics, Geophysics, Materials Science or Environmental Science, in their degree courses leading to B.Sc./B.S./B.Stat./B.Math./ Int. M.Sc./Int. M.S., during the academic year in which the fellows awarded are made, are eligible to apply for the KVPY fellowship under various streams – SA, SX and SB. Since 2010 there is more than 350% increase in the number of KVPY Fellowships offered under various categories as depicted in the bar chart.

NUMBER OF KVPY FELLOWSHIPS AWARDED DURING 2010 – 2017



EMPOWERMENT INITIATIVE IN THE KVPY PROGRAM:

i. A certain number of fellowships under the various streams as stated above are available for the students belonging to SC/ST community.

ii. A certain number of fellowships under various streams as stated above are available for the students under the category of Person With Disability (Physically and Visually Challenged).

APPLICATION FEE: General Category Rs. 1000/-
SC/ST & PWD Rs. 500/-

Fellowships (Rs.5000-Rs.7000 p.m and a contingency grant equal to 4 months of fellowship per year) are given up to the Pre-Ph.D level or for a period of five years whichever is earlier to the selected students.

FELLOWSHIP DETAILS

Fellowship Value	Qualifications
Rs. 5000/- p.m.	I to III year B.Sc/B.S/B. Stat/ B. Math/Int. M.Sc/Int. M.S
Rs. 7000/- p.m.	I/II year M.Sc IV/V year B.S/Int. M.Sc/Int. M.S
Contingency Grant	Equivalent to four months of Fellowship per year

KVPY Fellows SA/SB/SX are eligible to attend the Interview/Counselling for admission to the five year Integrated B.S./M.S. Programme conducted by the Indian Institute of Science Education and Research (IISER) Kolkata/Pune/Mohali/Bhopal/ Thiruvananthapuram/Tirupathi/Berhampur.

KVPY fellows SA/SX/SB are also eligible to apply for Undergraduate degree programme conducted by IISc Bangalore.

NATIONAL SCIENCE (VIJYOSHI) CAMP:

The aim of the annual National Science (Vijyoshi) Camps is to provide a forum for interactions between bright young students and leading researchers in various branches of science and Mathematics. With boundaries between disciplines fast disappearing, these camps serve as an ideal platform for the young participants to get an exciting global viewpoint of questions relating to Basic Sciences as well as application oriented themes.

As in the previous meetings, a comprehensive programme has been designed for the participants. This includes thought provoking lectures followed by a round of discussion at the end of each day's programme. In addition, the previous meetings have ultimately served to motivate and inspire the participants by bringing them together, in what is hoped will be their first step towards a career in research in the Basic Sciences and Mathematics.

During 2017 the National Science (Vijyoshi) Camp was held at Bangalore and Kolkata, the details of the camp along with number of students called and attended are as specified below:

Sl.No.	Place	Date	Venue	No. of students called	No. of students attended
1	Bangalore	8th–10th Dec 2017	JN Tata Auditorium, IISc, Bangalore	744	552
2	Kolkata	10th-12th Dec 2017	IISER-Kolkata	780	488

During 2018 it is proposed to organise National Science (Vijyoshi) Camp at two places for KVPY/INSPIRE Fellows as detailed below:

Sl.No.	Place	Date	Venue
1	Bangalore	7th-9th Dec 2018	JN Tata Auditorium, IISc, Bangalore
2	Kolkata	9th-11th Dec 2018	IISER-Bhopal

ASIAN SCIENCE CAMP-2017:

The Department of Science and Technology sponsors 20 students to the Asian Science Camp which will normally be held during the month of August every year. The responsibility of selecting the students for the Asian Science Camp was vested with HBCSE till 2011. From 2012 onwards the selection of students for the Asian Science Camp was entrusted to KVPY. The KVPY had readily accepted this challenge and taken appropriate actions for selecting the students to represent India at the Asian Science Camp. Requests have been sent to IISER's/IISc and other reputed institutions in the country to nominate the students to take part at the Eleventh Asian Science Camp scheduled to be held at Universiti Tunku Abdul Rahman, Kampar, Malaysia during August 20-26, 2017. The students to be nominated should be KVPY/INSPIRE Fellows pursuing Basic Science course in the 1st year B.Sc./B.S./B.Stat./B.Math./ Int. M.Sc./M.S. program during the academic year 2017-18. In response to the KVPY request 43 students have been nominated by the various institutions across the country.

The Selections committee after scrutinizing the eligibility and other aspects had selected 20 students to represent India and take part in the Eleventh Asian Science Camp-2017 held at UTAR, Kampar, Malaysia during August 20-26, 2017. The delegation of students from various institutions across the country were led by Prof. Dipshikha Chakravortty, Department of Molecular and Cell Biology, IISc, and Prof. P. Thilagar, Department of Inorganic and Physical Chemistry, IISc to the Eleventh Asian Science Camp-2017. The student delegates actively participated in the Asian Science Camp and secured various prizes during camp. A feedback session was conducted at IISc after the camp, to know the responses from various students who had taken part in the Eleventh Asian Science Camp. The students were very much excited to be part of a camp at an international level and were proud at having represented our country.

3.7.14 KARNATAKA STATE COUNCIL FOR SCIENCE AND TECHNOLOGY

Secretary: **S SUBRAMANIAN | PROFESSOR, MATERIALS ENGINEERING**

PROFILE

Karnataka State Council for Science and Technology (KSCST) an autonomous S&T organization under Department of Science & Technology, Government of Karnataka established in the year 1975 is one of the first State S&T Councils to be set up in the country. During the last 42 years of its existence, KSCST has been pro-actively engaging itself to identify, propose and implement S&T based solutions to locale specific needs / problems in the broad areas of Agriculture, Water, Education, Energy, Ecology and Environment, Habitat, Health, Solid and Electronic waste and Infrastructure. In co-operation with the Indian Institute of Science and several other premier R&D institutions, KSCST has been executing many projects and programmes aimed at improving socio-economic conditions of the people of the state.

Over the years, a number of technologies have been translated, from research and demonstration phase to the implementation and operational phase. KSCST provides support to the State Government in formulation of S&T based policies and to both Central and State Governments in scientific surveys, project implementation, evaluation, co-ordination & monitoring, organization of scientific meets and awareness campaigns.

VISION: Application of Science & Technology for the management of resources, improvement of environment, quality of life and socio-economic conditions of the people of Karnataka.

MISSION: Co-ordinate R & D activities for generation of knowledge for scientifically based interventions, development and popularization of appropriate technologies for adaptation by the civil society to overcome local-specific problems and, inspire and improve human resources of the S&T sector in the state.

MAJOR PROGRAMMES

• Natural Resources Data Management System (NRDMS) - A Repository of Natural Resources and Socio-economic database to support local level development, planning.

• Karnataka State Spatial Data Infrastructure (KSSDI) - Karnataka Geoportal is a web portal to find and access spatial information, metadata and associated geographic services/applications via the Internet.

• Student Project Programme (SPP) - Support to under-graduate and post-graduate engineering students for nurturing innovation and development of new technology.

• Rainwater Harvesting (RWH) - Awareness and technical support for implementation of rooftop Rainwater Harvesting

• Biofuel Programme - Demonstration and dissemination of technology and process for biofuel production and use in rural setup.

• National Science Day& National MathematicsCelebration - In order to expose, encourage, strengthen scientific temper amongst school children.

• State Awards for Scientists and Engineers - Provide support to state government to recognise and reward eminence in S&T.

• Patent Information Centre - Awareness creation in Intellectual Property Rights and provision of technical support for securing IPR.

• Sir M. Visvesvaraya Geospatial Chair - To promote and encourage R&D in Spatial Data Techniques / Technology.

ONGOING PROJECTS

(Supported by DST - GoK and GoI)

• Implementation of Virtual Laboratory to Improve the quality of education in the backward taluks of Karnataka.

• Digital Geospatial Data Generation and Terrestrial Scanning for 3D Reconstruction of Heritage Site at Hampi.

• Assessment of Hydrological and Physical Status of Traditional Water Harvesting Systems in Karnataka for developing Measures for Restoration and Rejuvenation using Geo-Spatial Technologies.

• Karnataka –Israel Industrial Research & Development Programme (KIRD) to promote industrial research leading to product development - Contisphere System and Aviation Hose with Titanium End Fitting.

Development of geospatial web applications on Karnataka Geoportal for G-governance

Demonstration of Portable Fire Extinguisher using Acoustic Waves – developed by Engineering Students under 40th Series of Student Project Programme

3.7.15 IISc ALUMNI ASSOCIATION

President: **M. P. RAVINDRA**

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 to other alumni across various batches, branches, and interests. Following report summarizes the activities of IIScAA during the financial year 2017-18.

Lecture Series

1. IISCAA SCIENCE FORUM - POPULAR LECTURE SERIES:

a) Prof. K.R. Padiyar (Emeritus) IISc delivered the 57th Lecture on the topic - **Innovations on the HVDC Transmission Technology and Applications"** on April 1, 2017 at Faculty Hall, IISc. This Lecture was dedicated to the memory of Late Shri. M. S. Vasudeva of Electrical Communication Engineering Department, IISc.

b) Dr. K Govind Babu, Professor of Medical Oncology, Kidwai Memorial Institute of Oncology, delivered the 58th Lecture, on the topic – **"Lifestyle and Cancer"** on June 10, 2017 at the Faculty Hall, IISc.

c) Sri Vinay Rao, Climate Change and Sustainability Advisor, delivered the 59th Lecture on the topic - **"Climate Change and The Road Ahead",** on July 29, 2017 at the Faculty Hall, IISc.

2) PROF. M. VIJAYAN LECTURE SERIES:
IIScAA organised the 3rd lecture in this series by Professor Eleanor Dodson, FRS, York Structural Biology Laboratory, Dept. of Chemistry, University of York, UK, on the topic - **"Cross Fertilisation: How Crystallography Is Built On Mathematics"** on August 17, 2017, at the Faculty Hall, IISc.

Honours and Award Functions

1) DR. SRINIVASAN RAJAGOPALAN AWARD FUNCTION – APRIL 8, 2017
IIScAA hosted the second Dr. Srinivasan Rajagopalan award function on 8th April, 2017 at 4.00 p.m. at the Faculty Hall of IISc. Prof. Anurag Kumar, Director, IISc and Patron, IIScAA along with the president of the IIScAA Dr. L. N. Satapathy presented the award to Dr. Anshu Pandey, Assistant Professor, Solid State and Structural Chemistry Unit of IISc. Dr. Anshu Pandey received the cash award of Rs.1 Lakh and a citation from the Director, for his significant contribution in Chemistry of optoelectronic materials. Many alumni, faculty and students of IISc attended this function. On this occasion, Dr. Pandey delivered a short talk on the topic **"Quantum Dots: Customizable Artificial Atoms".** Quantum dots are semiconductor particles of a few nanometers in size exhibiting unusual properties. Their behavior cannot be described either as atom like or as bulk-like and is distinct from both. The new physical properties that emerge in quantum dots offer several opportunities and challenges. A few examples of the unusual phenomena that are observed in these materials were described. The quantum dot compounds resemble ionic solids with very large atoms and exhibit unusual, counterintuitive chemical and physical properties. Further, he showed how these novel properties can be tailored to suit particular applications, giving rise to unnatural and seemingly paradoxical materials. Opportunity in considering quantum dots as artificial atoms for building still more unusual structures was detailed.

2) PROF. N. APPAJI RAO – BEST MENTOR AWARD & PROF. S. K. CHATTERJEE AWARD - SEPT. 1, 2017
IIScAA organised the following Awards Function on September 1, 2017, 4.00 p.m., at the Faculty Hall, IISc. Prof. Anurag Kumar, Director and Patron, IIScAA, presented the awards to the recipients.

a) "Prof. N. Appaji Rao - Best Mentor Award 2017" to Prof. Yogendra Singh, University of Delhi
b) "Prof. S. K. Chatterjee Award 2017" to Prof. Tulika Mitra, National University of Singapore

Subsequently, Prof. Yogendra Singh delivered a talk on **"Deriving Happiness from Academic Mentoring"** and Prof. Tulika Mitra on **"Behind the Scenes of The Internet of Things Revolution".**

3. DISTINGUISHED ALUMNUS AWARDS – DECEMBER 17, 2017:

The Distinguished Alumnus Award is the recognition of alumni of the Indian Institute of Science that are well known and respected in their chosen field and have made significant contributions in academia, industry and other fields around the world. It is awarded by the IISc Alumni Association. A selection committee, chaired by IIScAA President, with members from both IISc and IIScAA along with Industry representative and eminent personality reviews the nominations and shortlist the candidates. A total of 50 nominations including the pending nominations of 2015 and 2016 were reviewed and finally two names were shortlisted and later approved by the Director of IISc.

For the first time, IIScAA organised the Presentation of Distinguished Alumnus Awards-2017 on IISc Alumni Day on December 16, 2017 at J. N. Tata Auditorium.

Prof. Anurag Kumar, Director, IISc, chaired the Awards Function and presented the Distinguished Alumnus Awards-2017 to the following awardees:

1. Sri S Ramadorai
Former Vice-Chairman of TATA Consultancy Services and
Former Chairman of National Skill Development Corporation-NSDC

2. Smt. Sudha Murthy
Chairperson and Trustee of INFOSYS Foundation

Both the awardees elaborated their stint at IISc and how the experience at IISc had helped them in their successful journey so far. The Director, IISc in his address highlighted the importance of alumni contribution to the growth of IISc. The award function was well attended by about 450 members including alumni, faculty, staff and students of IISc.

WiSER 2017 – August 19, 2017

IIScAA organised the WiSER 2017 Talk by Prof. D. P. Sengupta on the topic - "SISTER Nivedita: She gave her all to India", scheduled on August 19, 2017, 3.00 p.m. - 6.00 p.m. at the Faculty Hall, IISc. This was followed by a "WiSER 2017 Panel Discussion:Women in Education - WiSER Redefined".

The Panelists were:
a) Ms. Neha Satak, Serial Entrepreneur – Astrome (IISc SID), SPACE (Isle of Man) and ECAPS (USA)
b) Mr. Ganesh Shankar, Founder & Managing Director of FluxGen Engineering Technologies Pvt. Ltd.
c) Ms. Protima Sharma, Co-founder, PeopleWiz Consulting and Advisor, NCL's Innovation Centre
d) Ms. Lipika Sahoo, Founder & CEO, Lifeintelect Consultancy Pvt. Ltd.
e) Mr. Chandra Sen Mazumdar, Assistant Professor, Faculty of Management and Commerce, Ramaiah University of Applied Sciences
f) Mr. Sujit Kumar Chakrabarti, Assistant Professor, IIITB and Cartoonist
g) Ms. Ipsa Jain, Ph.D. Student and Science Illustrator and Founder, Ipsawonders

WiSER 2018 – March 13, 2018

IISc Alumni Association in collaboraiton with the Indian Academy of Sciences organized WiSER ('Women in Science, Engineering and Research') 2018, an interactive session with Prof. Jennifer Graves, Distinguished Professor and Vice Chancellor's Fellow, La Trobe University, Australia on 13th March 2018. This year the session focused on 'Women in Science'. The discussion was chaired by Prof. Rohini Godbole and the other panelists were Prof. Dipshikha Chakravorty and Prof. Namrata Gundaiah. The discussion brought to light the fact that institutions must frame policies that ensure it is gender-friendly and provide facilities that can support the career of women, like day care and crèche facilities on campus. This would encourage applicants when they know that the institutions are building an ecosystem that supports academicians and scientists to balance their research and their personal commitments. Prof. Jennifer highlighted how a maternity leave policy is a double edged sword, where the woman availing the policy is completely cut off from communication and has to work very hard to get back into the system. The need is for a level playing ground, because women who make it to the top have a burning desire to do so and work against all odds within and outside the system.

Alumni Network Meetings

1. Alumni Network Meeting – July 9, 2017:
IIScAA organised Alumni Network Meet over Breakfast on July 9, 2017 at the Lawns of the Main Guest House, IISc. On this occasion, Membership Drive for Graduated Students in 2017 was initiated. About 120 members attended this meet.

Annual General Body Meeting (AGBM) – September 24, 2017

The 42nd Annual General Body Meeting was held on Sunday, September 24, 2017 at 11.00 a.m. at the Faculty Hall, IISc, which is the significant activity of IIScAA. About 81 members attended the meeting and actively participated in the

proceedings of the meeting. Mr. K. S. Mukunda, General Secretary, IIScAA read out the AGBM Notice and presented the report of the activities of the IIScAA for the period 1st April 2016 – 31st March 2017. Sri V. Gopalakrishna proposed and Dr. R. K. Dham seconded. Treasurer Mr. C. Ravindranath presented the Balance Sheet for the year ending 31st March 2017. Mr. Shivanna proposed and Dr. Kirti Malhotra seconded. The outgoing President Dr. L.N.Satapathy briefly shared his experience during his tenure at IIScAA and wished the Incoming President Dr. M. P. Ravindra, the office bearers and the executive committee members, the very best for their future endevaours. Lt. Col. G. Rajaram, Election Officer, presented a brief report on Online Election and its process and finally announced the results of IIScAA Executive Committee for the term 2017-2019. Members actively participated in the Open House Discussion and gave valuable suggestions. Dr. H. K. Anasuya Devi, outgoing Vice President, IIScAA, gave Vote of Thanks. The meeting was followed by the Group Photo Session near J. N. Tata Statue, Main Building, IISc and Lunch at the Lawns of the Main Guest House, IISc.

CURRENT OFFICE BEARERS (2017-2019):

President:	Dr. M. P. Ravindra
Vice President 1:	Dr. B. Ashok
Vice President 2:	Sri Omprakash Subbarao
General Secretary:	Mr. K. S. Mukunda
Joint Secretary:	Dr. H. K. Anasuya Devi
Treasurer:	Sri G. S. Ravishankar

CURRENT MEMBERS (2017-2019):

Dr. K. Gnanamurthy; Dr. Madhurima Das; Prof. Kalluri Subba Rao; Mr. Atul Kumar Malik; Mr. V. Narayanan; Dr. Sreevalsa Kolathayar; Dr. Chinnia Subramanian; Mr. Raj Kumar Dham; Mr. M. S. Rameshaiah; Dr. Saroj Kanta Mishra

IIScAA NEWSLETTERS:

The IIScAA Newsletters of Issues - April 2017, July 2017, October 2017 were released. Dr. H Saroja Devi, Dr. H K Anasuya Devi and Dr. S Ramachandra are the Editorial Committee Members.

For the Issue – March 2018, Sri Omprakash Subbarao, Dr. Madhurima Das and Dr. Sreevalsa Kolathayar are the Editorial Committee Members.

Alumni Day (December 16 – 17, 2017)

It was the second year, after the start of the Office of Development and Alumni Affairs that the Alumni Reunion was organised. The primary focus of the 'Reunion' is to share with the alumni the strategic pursuits of IISc and seek their inputs and suggestions apart from exploring funding options for the various projects on the anvil. A few major changes were made at the instance of the Alumni Association. They were merging the Distinguished Alumni Award distribution with the alumni reunion schedule on 16th December, 2017 and the walkathon on the 17th December 2017 with family events. The President of Alumni Association is a member of OC of the Alumni Reunion.

We received generous contributions from various members for the walkathon and the surplus created was used to support the following student events.

- Travel Assistance to IISc PhD Student
- Financial support for the students attending Winter Youth assembly at the United Nations, New York, USA between Feb 14 to 16, 2018
- Support to students for organizing SPECTRUM, annual cultural and sports meet

The IIScAA along with ODAA organized the fourth edition of the SnT Run on 17th December 2017. More than 120 Alumni participated enthusiastically this year to make it a successful event. Generous contributions from alumni helped to organize the event. This year the event included insect walk, Tree walk and many traditional and interesting games that kept the participants occupied- adults and children alike. The run culminated with a sumptuous breakfast at the Institute mess that brought back fond memories for many of the alumni who lived on campus as students. Participants tried out a round or three of Pallanguzhi, AaduHuliAata, ChowkaBhara, Pachisi and a bunch of others and travelled across Ð me, culture and continents as they marvel at the profound ease.

Picnic to Challakere – February 25, 2018

IIScAA organised a one dayprogramme on 25th February 2018 to the second IISc campus at Challakere about 220 kms from Bangalore. 22 members along with their family participated. Dr. Raghunandan Advisor, Challakere Campus made excellent arrangements to make the picnic extremely enjoyable and useful. Dr. Hegde, Convenor, Talent Development Centre (TDC), took the Alumni around the various under graduate labs explaining in detail the experimental lab setup designed for the teachers training programme to train Govt. School Teachers in core subjects, Physics, Chemistry, Mathematics and Biology. Such residential programmes are run in batches all through the year and in the opinion of Dr. Hegde the response has been great and there is also a marked improvement in the performance of the students of the schools over the last couple of years. The Alumni were also shown around the campus;

1. Detailing focus on the central building and civil construction in progress.
2. The experimental mini solar unit of about 100 Kw capacity.

Prof. Raghunandan shared all his experiences in the making of the campus. His attention to details with regard to the lunch, evening tea and the hospitality extended by his enthusiastic team deserves special mention. The participants also enjoyed a short trek to the more than 120 years old Vani Vilas Sagar Dam (famously known as Mari Kanive), which supplies Vedavathi river water to the campus and the surrounding villages of Challakere and Hiriyur.

OUTCOME:
• IIScAA will have a much larger role to play in the years to come in the development and growth of the Challakere campus.

• To begin with IIScAA has to initiate dialogue with Dr. Hegde to explore the possibility of funding young entrepreneurs who can scale up the fabrication of Lab equipments and off er the development to Government as well as Public Schools on a mass scale.

• There is scope for a still larger number of participating Alumni to visit on a Quarterly / Half Yearly basis and become partners to the growth / development agenda of the campus, in the field of Science, Engineering, Technology and Medicine.

• IIScAA generated a surplus of Rs.20,000/- This has been donated to SPECTRUM, a social / cultural evening program organised by the Chairman of IISc Gymkhana Club, between 31st March to April 6th, 2018.

IIScAA gratefully acknowledges the initiative of Dr. Hegde, Prof. Raghunandan, and their team of dedicated staff who made the picnic memorable.

Floral Tributes to the Founder – March 3, 2018

Dr. M. P. Ravindra, President, IIScAA, paid the floral tributes to the founder, J. N. Tata, on the occasion of Founder's Day on March 3, 2018.

SPONSORSHIPS / CONTRIBUTIONS:
a) Travel Assistance to IISc Research Students
IIScAA sponsored Rs.35,000/- each to the following IISc research students towards the Travel Assistance for attending the International Conferences as mentioned below.

Name: Ms. Sudipta Dutta
Organiser: International Centre for Theoretical Physics Title: Trends in Nano Tribology 2017
Venue: Trieste, Italy,
Date: June 26-30, 2017

Name: Mr. Ravi Verma
Organizer: Cryogenic Engineering Conference - ICMC 2017
Title: International Cryogenic Material Conference Venue: Madison, Wisconsin
Date: July 9-13, 2017

b)IIScAA supported the event "IISc Startup Meet" with the sponsorship of Rs.12000/-, organised by EntIISc, scheduled on August 3, 2017 from 2 pm onwards @ the Faculty Hall, IISc.

c)IIScAA gave a financial support of Rs.20,000/- to SPECTRUM, a social / cultural evening program organised by the Chairman of IISc Gymkhana Club, between 31st March to April 6th 2018.

d) Student delegation to UN
Circa November 2017, the Chairman of the Students Council approached IIScAA for financial support to make it possible for a 10 member student delegation from IISc to participate in the Winter Youth Assembly at United Nations, New York, USA from 14th to 16th February, 2018. Immediately, a communication was sent out to all members of the alumni association for contributions. We were able to raise funds to the tune of Rs. 1,30,000 which we topped up with Rs 70,000 from the surplus generated from the Walkathon and gave a support grant of Rs. 2,00,000 to the delegation. This has helped in boosting the morale of the students and they have started seeing us as someone who cares for them and more and more students have started becoming student members and promoting the cause of the AA. We hope to see a positive impact on the membership drive and student engagement in our activities. Before their departure, a session was organised at the faculty hall when the delegation presented their plan for the event and how they plan to pursue the goals post their return.

Student Connect

The office of Career Counselling and Placement was contacted to identify departments where students are encountering challenges in career planning and placement. Aero, Civil and Biosciences were identified as three departments, where the challenges

are maximal and they wanted IIScAA to help them. The Association has met Chairs of Aero and a few professors in Biosciences and Student Coordinator of Civil Engineering. One session was organized on 17th March 2018 for the ME students of Civil Engg with the industry experts (Prof. M N Sreehari and Mr. D Prasad, Infrastructure designer). Over 30 students participated. The student have agreed to revert with their Internship and other project needs. Once we hear from them, we will take it forward. Good news is that we have over 450 CE Alumni in Bangalore itself and we will start connecting with them. Similarly, for Aero, we have contacted some senior Alumni in pivotal positions to help our graduates. The Chairman, Prof. Gopalakrishnan is very enthusiastic and has agreed to partner with us in the initiative to help the students.

Membership Status:
IIScAA has Members as on 31st March 2017: 9817
Total number of members enrolled during the period 2016-2017: 268

3.7.16 OFFICE OF CAREER COUNSELLING AND PLACEMENT

The Office of Career Counselling and Placement (OCCaP) was established in 2016 to support students graduating from IISc secure a job of their interest. In addition to managing campus placement activities, OCCaP has organized events to facilitate interaction between students and industries through special meetings (pre-placement talks) in IISc and helped students hone up their skills to meet industry requirements. In addition, OCCaP plans to support graduating students secure teaching and research jobs as well. This office is managed by a Placement Officer, who is supported by temporary staff for routine activities and by a committee of four professors for policy matters.

Highlights of Placement Activities in Year 2017 (April 2017 to March 2017)

A. Hiring of Placement Officer
B. Completion of Campus Placement Batch 2016-17
C. Soft Skills session for Batch 2016-17 and Batch 2017-18
D. Alumni Connect
E. Campus Placement for Batch 2017-18
F. Internship Placement for Batch 2018-19
G. Special Efforts for Undergraduate and PhD students

A. HIRING OF PLACEMENT OFFICER
After getting necessary approvals, we advertised for the position of the Placement Officer in late 2016. Based on the response to our advertisement, we shortlisted and interviewed several candidates on January 9th, 2017 and subsequently made the offer to Ms. Bhagyalaxmi M. She has reported for duty on 29th May 2017 and has since been leading the OCCaP activities.

B. COMPLETION OF CAMPUS PLACEMENT BATCH 2016-17
The Campus Placements for batch 2016-17 was continued during the year and closed in May 2017.
Overall Placement Statistics-Batch 2016-17 [2015-16 figures in brackets]
o Highest annual salary (CTC) offered: Rs 30 Lakhs [27.6 from India; 75 from abroad]
o Number of offers with CTC above 20 LPA: 32 [17]
o Number of offers with CTC in the range 15-20 LPA: 78 [60]
o Number of recruits in top (first) 10 companies: 51
o Total offers during the full season (October 2016-May 2017): 225 [150]

C. SOFT SKILLS SESSIONS
Many students expressed interest to get professional training to upgrade their personal attributes during our interactions with them. It is generally felt that many of our students require help on improving their soft skills. The Placement Officer interacted with all students seeking campus placements in 2017-18 during the months of July 2017 to identify those necessarily requiring attention. Appropriate training programs was arranged with external support.

• **August 2017 – Career Confidence Workshop**
Professional training by a vendor Career Confidence was arranged for training students. This session was conducted in the campus on 19th August 2017 for batch 2017-18. A group session followed by one on one interaction was arranged for these students. 43 students participated in this workshop.

• **January 2018 – English Proficiency Programme**
An English Proficiency Programme was organized along with Prof. Dasgupta from IIT Kanpur. This was a cost free test for the students and staff of IISc. More than 60 people attended the talk and took up the test on 18th January 2018 to gauge their language skills.

• **February 2018 – Fluency in English and Public Speaking**
A workshop was conducted by the English Language Academy for students/staff in IISc. 2 separate cost free presentations were held on 26th February 2018. 265 students and staff registered for this event.

• **Invitation to Alumni to mentor the students**
The alumni of the Institute were contacted to explore the possibility of their contributions towards the student development in terms of mentoring and guidance to make them Industry-ready. An email was sent out to

recent alumni using the database from ODAA. Those who showed interest to mentor the students were invited to interact with the students. Some of them visited the campus and interacted with the students and helped them understand the needs of industries to make them more competitive.
An approach to connect with Alumni through LinkedIn was also attempted. Response from some of the alumni was received who expressed their interest to extend their support in different ways to the current batch students.

E. CAMPUS PLACEMENT FOR BATCH 2017-18
The campus placement activity for batch 2017-18 was commenced from August 2017. Companies were invited in campus for pre-placement talks which were later followed by the interviews.

(i) Pre-Placement Talk (PPT)
Many companies from across all the sectors were invited in the campus to address the students and explain about the opportunities available with them for the students. More than 75+ companies visited the campus till date for PPT and interacted with the students from UG/ Masters and Ph.D programme. They discussed opportunities in terms of prospective final placements and internships available for campus season 2017-18.

Our decision of inviting the companies for PPT well before the final placements gave the students an insight about the needs of the companies in general, and they (students) could use this time gap between the PPT and final placements for better preparation with the knowledge about the needs of companies hiring. These PPT's were open to students of all departments and programs and many companies opened their opportunities to other departments beyond their initial interests areas and also came up with additional opportunities, after these interactions with students.

(ii). Schedule of Campus Interviews
Campus Season 2017-18 for placements are divided into 2 phases, Slot A and Slot B. Slot A commenced from 23rd October 2017 to 29th October 2017 and Slot B commenced from 4th November 2017 onwards. 4 Companies with a comparatively better CTC and high brand value were invited during the month of January 2018 as a part of Dream Job Slot.

(iii) Placement Statistics-Batch 2017-18 – (Statistics till April 2018)
• Highest Salary offered: 45.05 LPA (last year: 30 LPA)
• Average salary in CS/ES increased by ~2 LPA
• Number of jobs >25LPA: 39 (last year: 15)
• Number of recruiters at >25LPA: 12 (4 last year)
• New recruiters in 2017-18: 37
• Nearly all M. Tech. students of CS/ESE/ Mechanical/ Electrical have been placed for jobs in respective core sectors
  o CSA 46 Students @ 21.7 (median) & 22.1 (average)
  o CDS 16 Students @ 21.25 (median) & 21.4 (average)
  o EE/SSA 23 Students @ 22.0 (median) & 22. (average)
  o ESE 24 Students @ 18.1 (median) & 19.4 (average)
  o ECE 13 Students @ 17.5 (median) & 18.0 (average)
  o Mechanical 11 students @ 9.0 (median) & 11.9 (average)
  o Aerospace 12 students @8.2 (median) & 8.4 (average)

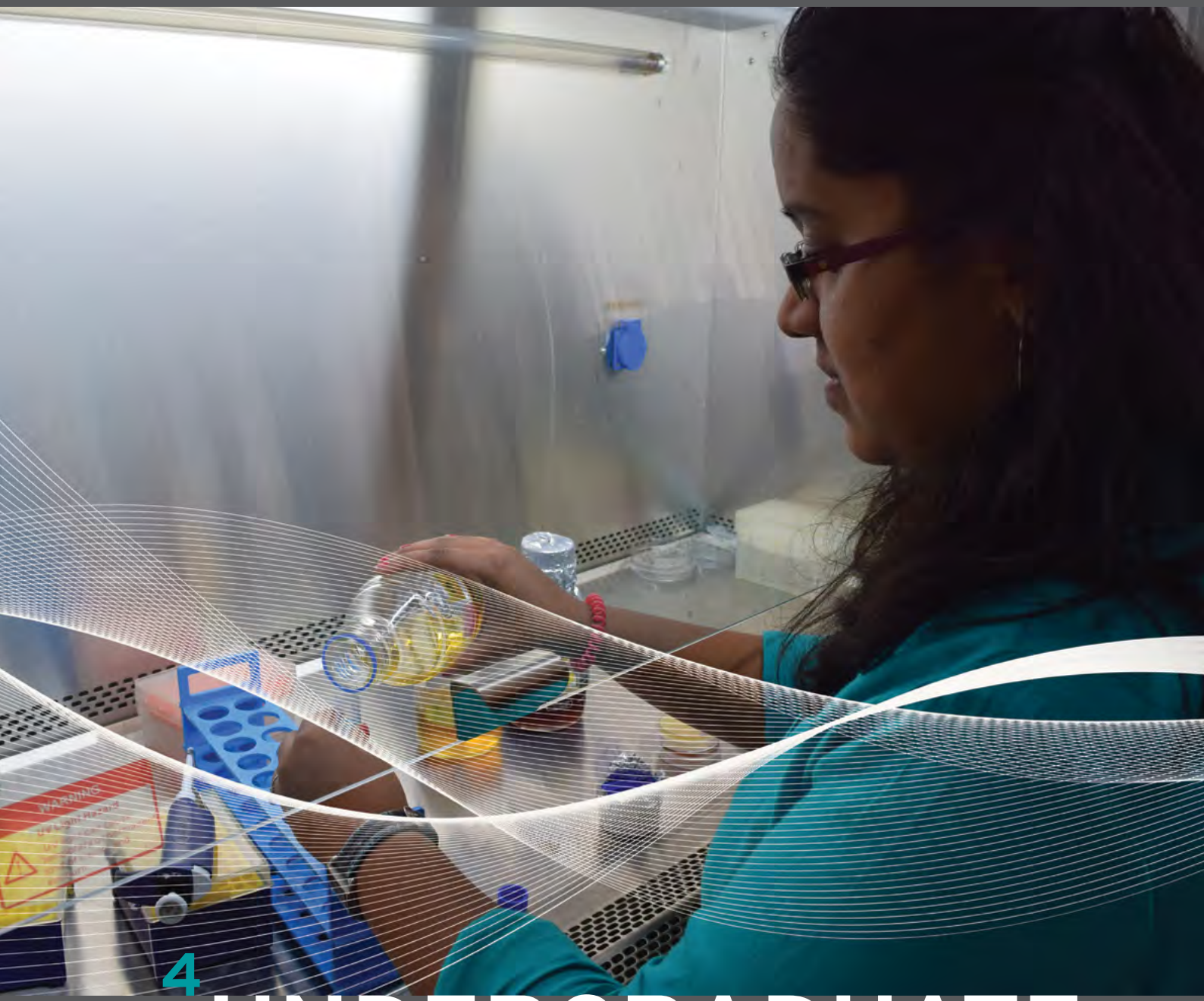
• Overall: 72 recruiters visited till April 2018 and recruited 213 candidates
  o PhD: 20
  o MTech/M.Mgmt Programs: 185
  o Undergraduate Program: 8
Campus Placement for batch 2017-18 ongoing as on preparation of this report.

F. INTERNSHIP PLACEMENT FOR BATCH 2018-19
(i) Initiatives for actively introducing summer internship opportunities
We have taken special initiatives to introduce summer internships for students during the months of May to July of 2018. Many engineering departments have expressed interest to send students during this period.

(ii)Internship Placement for Batch 2018-19
The internship hiring for batch 2018-19 commenced from 1st March 2018. The duration of Internship is 3 months starting from May till July. Many students expressed their interest to participate in the internship selection but eventually majority of them withdrew themselves from the internship placement activities.

Highlights of Internship Placement
• 19 recruiters visited on campus
• 41 students offered internship
• Highest Stipend offered– 1 lakh per month
• Pre-Placement Offers expected by the end of internship

G. SPECIAL EFFORTS FOR UNDERGRADUATE AND PHD STUDENTS
Unlike other institutions in the country, we have figured that special efforts will be needed to address the expectations of our undergraduate (due to the low number of interested graduates) and PhD students. As desired by many, CVs of PhD students are being circulated with potential recruiters. A small number of students from these categories have also secured their job offers through campus placement interviews.
It may be noted that, on October 3, 2016, we organized the first ever research career fair at IISc where, around 100 graduating doctoral students presented their work to representatives from different industries. Although we planned for another event in the month of April 2017, the event was called off as the participation was comparatively less. We compiled a booklet which was shared with the Companies. Students from our research programs such as PhD or M.Sc (Engg) and Master program have submitted their details to be included in this booklet.
PhD students from Biological Sciences Division were addressed to share information about placement opportunities in industry. About 56 PhD students (last year only 1 student registered) expressed their interest for seeking placement support from OCCaP. An attempt to organize some interactive sessions with the industry experts to explore jobs is in process.



4 UNDERGRADUATE PROGRAMME

BSC (RESEARCH) AND MSC PROGRAMMES

DEAN: ANJALI KARANDE | PROFESSOR, BIOCHEMISTRY

ASSOCIATE DEAN: BALAJI R JAGIRDAR | PROFESSOR, INORGANIC AND PHYSICAL CHEMISTRY

ASSOCIATE DEAN: PS ANIL KUMAR | ASSOCIATE PROFESSOR, PHYSICS

The undergraduate program in science which began in 2011 has seen three batches of students who graduated with a Four-year Bachelor of Science (Research) degree and two batches of students who graduated with a Master of Science degree. In June 2018, a fourth batch and a third batch of students will be up for graduation with a Four-year Bachelor's degree and a Master's degree, respectively. In the first three batches, roughly 50% of the students in each batch opted to continue for a fifth year to pursue a Master of Science program. This trend seems to be the norm. The UG students have been continuing to secure fellowships such as S. N. Bose, Khorana, DAAD fellowships, which allows them to carry out summer projects in universities in the U.S.A. or Germany. Some students have taken up summer projects in the industries and several others, in academic institutions within India. Since the program started in 2011, its popularity has gone up tremendously that it has now become one of the most sought after undergraduate programs for several scientifically oriented, bright, young and energetic minds of the country. This had a strong bearing on admissions for the academic year 2018-'19; the cut offs in various qualifying examinations for admission to the UG program for the academic year 2018-'19 had to be raised compared to the year 2017-'18.

CAREER PATHS OF OUTGOING STUDENTS: In each batch, roughly 50% of the students have been opting to continue for the Master's program. Of the remaining 50%, a large fraction of students take the Bachelor's degree and go elsewhere in pursuit of Ph.D. and other programs.

Table 1. The status of remaining students as on date from the first 4 batches

Batch	No. of students joined	Bachelor's (completed)	Master's (completed)	Bachelor's (incomplete)[a]	Master's (incomplete)[a]	Master's (continuing)
2014	102	33[b]		16		53
2013	110*	95	49[b]	11	4	
2012	113*	106	1[b,c]	5	2	
2011	83*	82	--	1[d]		

*students of these batches have already graduated in previous convocations and left the institute
astudents who could not complete the requirements within their tenure due to medical reasons, final year project incomplete, or backlogs
[b] students who have completed requirements and awaiting award of degrees
[c] student from a previous batch who had to join the Master's program one year later due to medical reasons
[d] likelihood of completing the requirements by July 2018

Students who will be graduating in the forthcoming convocation have got admission offers for Ph.D. or Master's programs in top universities/institutes around the world including within India. This is a testimony of the great reputation that the UG program of the institute has carved out itself in the world scenario in a short span of 6 years. A very small number of students opted to take up jobs and have secured jobs in multinational companies.

CO-CURRICULAR ACTIVITIES

The UG students are also involved in several co-curricular activities apart from academics. The annual national science, technology, and cultural fest called PRAVEGA, an event organized by the UG students brings out the best in these students; additionally, the UG magazine QUARKS which exemplifies their literary talents, and certain other activities such as SAMANWAY, the industry outreach initiative of the institute in which UG students have an active role in organization, RANGMANCH and RHYTHMICA which bring out the dramatic and the dance talents respectively, are a demonstration of their exemplary talents. A young team of undergraduate students from the institute won a gold medal at the International Genetically Engineered Machine (iGEM) contest held at Boston, USA from 9th – 13th November, 2017. Over 300 teams from all over the world participated in the competition.

5

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:

SHANTI SWARUP BHATNAGAR AWARD
Neelesh B Mehta, ECE
Aloke Paul, MT

SWARNAJAYANTI FELLOWSHIP
Aveek Bid, PHY
Prateek Sharma, PHY

J.N. TATA CHAIR OF INDIAN INSTITUTE OF SCIENCE
D D SARMA, SSCU

ACADEMY FELLOWSHIPS

INDIAN ACADEMY OF SCIENCES
A J Bhattacharyya, SSCU
Nagasuma Chandra, BC
Raghavan Varadarajan, MBU (Council Member)

INDIAN NATIONAL ACADEMY OF ENGINEERING
Ashok M Raichur, MT
PP Mujumdar, CIE

INDIAN NATIONAL SCIENCE ACADEMY
Gadadhar Misra, MA (Vice-President)
KN Balaji, MCB
Patrick D'Silva, BC
PN Rangarajan, BC
PP Mujumdar, CIE
Rohini M Godbole, CHEP
Rudra Pratap, CeNSE
Satyam Suwas, MT
Shalabh Bhatnagar, CSA
Ajay Sood, PHY (President)

NATIONAL ACADEMY OF MEDICAL SCIENCES
Bikramjit Basu, MRC

OTHER FELLOWSHIPS

ABDUL KALAM TECHNOLOGY INNOVATION NATIONAL FELLOWSHIP FROM INAE/DST
GK Ananthasuresh, ME
DBT Ramalingaswami Fellowship
Vishwesha Guttal, CES
Bratati Kahali, CBR
Ganesh Chauhan, CBR

FELLOW OF A.P. AKADEMI OF SCIENCES
VV Srinivas, CIE

FELLOW OF THE AMERICAN INSTITUTE FOR MEDICAL AND BIOLOGICAL ENGINEERING
Bikramjit Basu, MRC

FELLOW OF THE NATIONAL INSTITUTE OF PERSONAL MANAGEMENT
KB Akhilesh, MS

FELLOW OF THE WORLD ACADEMY OF SCIENCES (TWAS) 2018
Sandhya S Visweswariah, MRDG

FELLOW OF AMERICAN GEOPHYSICAL UNION (AGU)
SK Satheesh, CAOS

FELLOW OF INDIA METEOROLOGICAL SOCIETY, NEW DELHI
GS Bhat, CAOS

FELLOW OF WEST BENGAL ACADEMY OF SCIENCE AND TECHNOLOGY
Saptarshi Basu, ME

FELLOWSHIP OF ST. EDMUND'S COLLEGE
Sanjiv Sambandan, IAP

HONORARY RESEARCH FELLOW OF NATIONAL TSINGHUA UNIVERSITY, TAIWAN
VR Supradeepa, CeNSE

INSTITUTE OF MATERIALS, MINERALS AND MINING, UK
Bikramjit Basu, MRC

J C BOSE NATIONAL FELLOWSHIP
PN Vinayachandran, CAOS
Sriram Ramaswamy, PHY
B Bagchi, SSCU
D D Sarma, SSCU
S Natarajan, SSCU
S Natarajan, SSCU
T N Guru Row, SSCU
P Vijay Kumar, ECE
B Bagchi, SSCU
DD Sarma, SSCU
S Natarajan, SSCU
TN Guru Row, SSCU
SK Satheesh, DCCC
Renee M Borges, CES
R Narasimhan, ME
Pradip Dutta, ME
Vikram Jayaram, MT

MARGADARSHI FELLOWSHIP FROM WELLCOME-DBT INDIA ALLIANCE,
Sandhya S Visweswariah, MRDG

MEITY YOUNG FACULTY RESEARCH FELLOWSHIP
Murthy Chandra R, ECE

NATIONAL AWARD IN OCEAN SCI. AND TECH., MOES, NEW DELHI
PN Vinayachandran, CAOS

RAMANUJAN FELLOWSHIP
Rachit Agarwal, BSSE
Kartik Sunagar, CES
Apoorva Khare, MA

SENIOR FELLOWSHIP, WELLCOME-DBT INDIA ALLIANCE
SP Arun, CNS

SENIOR WELLCOME TRUST-IA FELLOWSHIP (WELLCOME TRUST UK, DBT-INDIA [2017]
Amit Singh, MCB

VISITING RESEARCHER FELLOWSHIP (SUMMER, 2017) FROM RUTGERS UNIVERSITY, NJ, USA
Srimanta Middey, PHY

VISVESVARAYA FACULTY FELLOWSHIP, MINISTRY OF ELECTRONICS AND INFORMATION TECHNOLOGY
Digbijoy Nath, CeNSE
VR Supradeepa, CeNSE
Gope Dipanjan, ECE

WELLCOME-DBT INDIA ALLIANCE MARGADARSHI FELLOWSHIP
Sandhya S Visweswariah, BSSE

AWARDS AND HONOURS

ABHA MISRA, IAP
SERB Women Excellence Award
TWAS Young Affiliate
Associate Editor, Royal Society of Chemistry Advances (RSC Advances)

AG RAMAKRISHNAN, EE
Associate Editor, Sadhana
Member of the Board of Studies for the Department of Biomedical Engineering, MIT Manipal
Member of the Board of Studies of International School of Information Management (ISiM), University of Mysore
Member of the Governing Council of Siddaganga Institute of Technology, Tumkur
Member of the Karnataka Knowledge Commission (Karnataka Jnana Aayoga)
Prof. M. Anandakrishnan Award for the best paper, TIC 2017, University of Toronto, Canada
Vice President, Indian Unit for Pattern Recognition and Artificial Intelligence (IUPRAI)

AJAY SOOD, PHY
Doctor of Science, Honoris Causa, Cooch Behar Panchanan Barma University, Cooch Behar-736101, West Bengal (2017)
Doctor of Science, Honoris Causa, Indian Institute of Technology, Kanpur (2017)
Doctor of Science, Honoris Causa, Jadavpur University, Kolkata (2017)

AKSHAY NAIK, CENSE
"Investigation of Electromechanical Properties of Ultra-Thin Film Materials" was one of the 24 ideas selected worldwide by Lam Research under their "Unlock ideas campaign"
Invited talk at Fourteenth International Workshop on Nanomechanical Sensors, 4-7 April 2017, Hawaii USA

ALOKE KUMAR, ME
Saroj Poddar Young Investigator Award

AMARESH CHAKRABARTI, CPDM
Idea Inspire 3.0—A Tool for Analogical Design / Challenges and some potential strategies for relating engineering issues with their causes in text / Application of InDeaTe design toolbox for designing sustainable products - case study of a natural water cooler/ Towards automatic classification of description of analogies into SAPPhIRE constructs
Certificate of Merit for One of the Most Distinguished Papers Jan 2017, ICoRD'17, IIT Guwahati, India for papers entitled:
Elected as the fifth Editor in Chief for the International Journal Artificial Intelligence for Engineering Design Analysis and Manufacturing (AI EDAM), Cambridge University Press, the first EIC from outside the USA in the history of the journal (2017)
Guest Co-Editor for International Journal of Intelligent Manufacturing (IJLM), Elsevier on Inclusive Manufacturing (2017-18)
Invitee, CII Smart Manufacturing Council (only academic invited to the council)
Member, CII Design Council (National Committee on Design), 2017-18

AMBARISH GHOSH, CENSE
Young Career Award in Nano Science and Technology for 2017 from DST
Prof. Ramakrishna Rao Chair Professorship from 2017-2020

AMRITA SHAH, CCS
Tejeshwar Singh-SAGE Memorial Award for Excellence in Writing on the Urban

ANINDA J BHATTACHARYYA, SSCU
A. V. Rama Rao Foundation Prize Lecture

ANINDA SINHA, CHEP
ICTP prize lecture and lecturer in Spring school in superstring theory and related topics in honour of Kenneth Wilson given by the International Centre for Theoretical Physics

ANNAPOORNI RANGARAJAN, BSSE
DBT national women bioscientist award

ANSHU PANDEY, SSCU
Dr S Rajagopalan Award for Chemical Research 2017
NASI Award for Young Scientists 2017

ANURAG KUMAR, ECE
Institutions of Engineers (India) and IEEE Engineering Excellence Award

APOORVA KHARE, MA
Infosys Young Investigator Award

ARINDAM CHAKRABORTY, CAOS
Karmakar, Nirupam, Arindam Chakraborty and Ravi S Nanjundiah, 2017: A Study of the Relationship between the Intraseasonal Variability and Extreme Rainfall Events in the Indian Summer Monsoon Rainfall in a GCM. Obtained Best Student's Poster Award in American Meterological Society's Annual Meeting, Seattle, USA. February 2017

ARPITA PATRA, CSA
Data Security Council of India's 2017 award
INAE Young Engineer Award 2017 and INAE Young Associateship starting 2017
SERB Women Excellence Award 2018.
TWAS (The World Academy of Sciences) Young Afiliateship (2017-2021)

ARUN KUMAR, MRDG
Editorial Board Member, Scientific Reports (npg)

ASHOK M RAICHUR, MT
Awarded MRSI-ICSC Prize for 2018

ASHOK SHUKLA, SSCU
INSA Viswakarma Medal 2018

ATUL H CHOKSHI, MT
National Metallurgist Award 2017

AVADESHA SUROLIA, MBU
Awarded SERB Fellowship by SERB, Govt. of India
Foundation lecture, National Institute of Immunology, New Delhi
V S S Rao Lecture, Madras

B BAGCHI, SSCU
Honorary Professor SN Bose National Centre For Basic Sciences, Kolkata (2016-2019)
Honorary Professor SN Bose National Centre For Basic Sciences, Kolkata (2016-2019)

B GURUMOORTHY, CPDM
Certificate of Merit for One of the Most Distinguished Papers Jan 2017, ICoRD'17, IIT Guwahati, India for paper entitled: Challenges and some potential strategies for relating engineering issues with their causes in text

BHAVANA KANUKURTHI, CSA
Data Security Council of India's 2017 award

BHUSHAN TOLEY, CH
Grand Challenges Exploration Award from the Bill & Melinda Gates Foundation
Innovative Young Biotechnologist Award from DBT India

CHANDA J JOG, PHY
The Homi Jehangir Bhabha Medal (2017), given by Indian National Science Academy (INSA), New Delhi

CHANDNI U, IAP
Infosys Young Investigator Award

CHANDRA SEKHAR SEELAMANTULA, EE
Appointed as an Associate Editor of IEEE Transactions on Image Processing, March 2018)

CHETAN SINGH THAKUR, ESE
INSPIRE Faculty Award by the Department of Science and Technology, India
Qualcomm gift funding award
Young Investigator Award by Pratiksha Trust

D D SARMA, SSCU
Solenis Bharat Ratna Prof C N R Rao Medal and Chemcon Distinguished Speaker Award, IIChE, 2017
Institute Lecture, Indian Institute of Technology, Kanpur, 2017
"University Professor" of "Computational Material Physics", University of Vienna, May 2017
Adjunct Professor, Indian Institute of Engineering Science and Technology, Shibpur 2017-2019
CSIR Foundation Day Lecture at CSIR-CSMCRI, 2017
Foundation Day Lecture, INST Mohali, March 2018
Institute Colloquium, National Institute of Science Education and Research, Bhubaneswar, 2017
Institute Lecture, Indian Institute of Technology Kanpur, 2017
Honorary Professor, S.N. Bose National Centre for Basic Sciences, Kolkata, October 2014-September 2017

D ROY MAHAPATRA, AE
Malavya Award 2017, Indian Ceramic Society

DEEPAK D'SOUZA, CSA
Best Paper Award at Static Analysis Symposium (SAS) 2017

DEEPAK KUMARAN NAIR, CNS
Prof. Priti Shankar Award for Teaching 2018

DIPANKAR BANERJEE, MT
N.N. Dasgupta Memorial lecture of the Electron Microscope Society of India Institute Lecture, IIT Roorkee
E Arunan, IPC
International Advisory Board Member for the new "International Conference on Non Covalent Interaction";
Section Editor, Chemistry, 'Current Science' from 2018

E N PRABHAKARAN, OC
Member of the Editorial Advisory Board of the Journal of Organic Chemistry [2018-2020]
Erasmus Mundus Master in Chemical Innovation and Regulation KA1 – Scholarship 2017

ED JEMMIS, IPC
Elected to the International Advisory Board of IMEBORON, a triennial international conference on Boron chemistry.

G JAGADEESH, AE
Alumini Award for Excellence in Engineering Research in IISc for 2017

G MUGESH, IPC
Bhagyatara Award by Panjab University for the year
National Prize for Research on Interfaces of Chemistry and Biology by JNCASR, Bangalore
Rajib Goyal Prize in Chemical Science by Kurukshetra University
Elected as President of the Asian Chemical Editorial Society (ACES)
Elected as Vice-President of the Chemical Research Society of India (CRSI)

G R DESIRAJU, SSCU
Chair of the 24th Congress and General Assembly of the International Union of Crystallography at Hyderabad, 21st-28th August 2017
Doctor of Sciences honoris causa by The Rayalaseema University, Kurnool

GANESH NAGARAJU, BC
Sir. C.V. Raman young scientist award from Government of Karnataka

GL SIVAKUMAR BABU, CIE
Chairman, Technical Committee on Forensic Geotechnical Engineering 2017-2021
Governor, Region 10, American Society of Civil Engineers, 2017-2020
John Booker Medal of International Association for Computer Methods and Advances in Geomechanics (IACMAG), USA, For excellent contributions in the application of "probabilistic methods in geotechnical engineering practice, geomechanics, ground improvement and forensic geotechnical engineering" for the year 2017
President, Indian Geotechnical Society, 2017-18
Wesley W. Horner Award 2017 for the paper on "Risk and Reliability Analysis of Multi Barrier System for Near Surface Disposal Facilities". Journal of Hazardous, Toxic and Radioactive waste, ASCE

GOVINDAN RANGARAJAN, MA
Honoured with the Distinguished Alumnus Award, Birla Institute of Technology & Science, Pilani

GR DESIRAJU, SSCU
Chair of the 24th Congress and General Assembly of the International Union of Crystallography at Hyderabad, 21st-28th August 2017

GR JAYANTH, IAP
A paper published in 2016 was chosen among Highlights of 2016 in the Journal Measurement Science and Technology (P. Piyush, and G. R. Jayanth, Measurement Science and Technology, Vol. 20, pp. 025203 (2016))
Keynote talk, International Conference on Manipulation, Automation and Robotics at Small Scales, July 17-21, Montreal, Canada

GS BHAT, CAOS
Distinguished Alumni Award, Department of Aerospace Engineering, IISc

GURUNATH GURRALA, EE
POSOCO Power System Award - PPSA 2018, Ministry of Power, Govt. of India, Research excellence in the field of power systems, February 2018

HARDIK J PANDYA, ESE
EARLY CAREER RESEARCH AWARD, Science and Engineering Research Board

K CHATTOPADHYAY, MT
INAE JAI KRISHNA MEMORIAL AWARD 2017

KARTIK SUNAGAR, CES
Gyandeep Award for excellence in scientific research on snakes by the Organisation for Wildlife Studies (OWLS) and the Department of Forest for the Maharashtra State, 2018.
Department of Science and Technology INSPIRE Faculty Award 2017

KASHYAP NAVIN, ECE
Distinguished Lecturer, IEEE Information Theory Society

KAUSHIK CHATTERJEE, MT
2017 Publication Prize of the Materials Technology Journal

KAVIRAYANI R PRASAD, OC
Associate Editor, Organic Letters published by American Chemical Society
Prof. G S Saharia Memorial Lecture, University of Delhi

KPJ REDDY, AE
Life time Achievement Award, Bangalore Management Association (BMA)
Technology Excellence Award for the year 2017 from the Indian Technology Congress Association

KUMARAVEL SOMASUNDARAM, MCB
Professor Bhim Shanker Trivedi Memorial Medal from INSA (2017)

M H BALASUBRAHMANYA, MS
Invited and included as a member of the Editorial Advisory Board of International Journal of Entrepreneurial Behaviour and Research, an Emerald Journal, USA, a peer reviewed Journal of Emerald Group Publishing Inc., USA

MAYANK SHRIVASTAVA, ESE
Indian National Academy of Engineering (INAE) Young Engineer Award, 2017
Outstanding Paper Award, VLSI Design Conference, Jan. 2017

MH BALA SUBRAHMANYA, MS
Delivered Founders' Day Lecture at Centre for Multi-Disciplinary Research (CMDR), Dharwad (an Indian Council of Social Science Research (ICSSR) sponsored institution) at Regional Science Centre, Karnataka University, Dharwadon 1st February 2017

MINI JOSE DEEPAK, CNS
Early Career Research Award, SERB (Science and Engineering Research Board)

MONTO MANI, CST
Award for Best Faculty of the Year for Specific Innovations – manifest in prototypes, patents, etc. at the TechNext India 2018 Annual Industry and Academia Conference and Awards (2018): Technology for Educational Transformation organized by the Computer Society of India (Mumbai Chapter) and IIT Bombay (Feb' 2018).
Contributor and Reviewer for National Building Code 2016: Group 3, Part 11 on Sustainability Considerations in Buildings released Aug' 2017
Shell Talk (TED talk equivalent) (with Mr. HI Somashekar on behalf of late Prof. SS Lokras) on 'Energy-Sanitation-Energy' as part of Shell's Women and Energy Initiative, 7th March 2017
Mentor in the area of Sanitation for researchers at Venture Centre (National Chemical Laboratory, Pune). Venture Centre is India's largest Science Business Incubator
Domain Expert in Building Integrated Photovoltaics by a. The Kuwait Foundation for the Advancement of Sciencesb. The National Research Foundation, Singaporec. The Swiss National Science Foundation

N BALAKRISHNAN, AE
Cray APJ Abdul Kalam HPC Award (2017)

N JAYARAMAN, OC
Chairman, International Committee of the 2018 Roy Whistler Award of the International Carbohydrate Organization
Associate Editor, J Chem. Sci., Indian Academy of Sciences
Editor, Glycoconjugate Journal, Springer Nature Publications
Editorial Board Member, Carbohydrate Research, Elsevier Journal

N SRINIVASAN, MBU
Inducted into the Scientific Advisory Committee of IBAB, Bangalore

NAMRATA GUNDIAH, ME
Editorial Board Member, Biomechanics and Modelling in Mechanobiology (2015-current).

NAVAKANTA BHAT, CENSE
Best start-up of the year award from Federation of Indian Chambers of Commerce and Industry (FICCI) Healthcare Excellence award
Confederation of Indian Industry (CII) Industrial Innovation Award 2017, for the most promising start-up and CII Grand Jury Award for Innovation
Chair, IEEE Electron Devices Society Technical Committee on Nanotechnology

NEELESH B MEHTA, ECE
Appointed as a Member of the IEEE ComSoc Awards Committee for three years from 2018 to 2021
Appointed as Co-Chair of the Membership Development Committee of the Asia Pacific Board of IEEE ComSoc.

NIRUPAM ROY, PHY
Infosys Young Investigator Award

P ANBAZHAGAN, CIE
Indian Geotechnical Society Reviewer of the Year 2016 Award for the Outstanding contribution to the Indian

Geotechnical Journal
Invited Expert Member for Discussion meeting on "Requirements on ground motion propagation and site amplification studies for NPP site located in alluvial region" 18 January, 2017 - Siting and Structural Engineering Division of Atomic Energy Regulatory Board (AERB), Government of India
Judge in 44th KVS Jawaharlal Nehru Science Exhibition on 24-04-2017 to 26-04-2017, at KV IISc Bangalore
Judge in Clean Tech Competition, Centre for Science Teaching and Learning, Rockville Centre New York, Global STEM (Science, Technology, Engineering, and Math)
Advisory Board, CMR Institute of Technology
Nominated Indian Geotechnical Society Member in the International Technical Committee TC-102 for Ground Property Characterization from In-Situ Tests for period of 2018-2021, under International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE)

PARIMAL PARAG, ECE
SERB Early Career Research Award

PHANEENDRA YALAVARTHY, CDS
Member, Task Force on Bioengineering, Department of Biotechnology (DBT), India
Senior Member, IEEE

PK DAS, IPC
J.C. Ghosh Medal of Indian Chemical Scoiety

PRABEER BARPANDA, MRC
Elected Life Member of National Academy of Sciences India (NASI, Allahabad)
Feinberg Foundation Visiting Fellowship at Weizmann Institute of Science, Israel

PRABHU R NOTT, CH
Associate Editor, Journal of Fluid Mechanics

PRADIP DUTTA, ME
Distinguished Alumnus Award, IIT Madras
Elected as Member, Scientific Council, International Centre for Heat and Mass Transfer
Selected as President, Indian Society for Heat and Mass Transfer (ISHMT)
Member, Scientific Council, International Centre for Heat and Mass Transfer (ICHMT)

PRADIPTA BISWAS, CPDM
DST SERB Early Career Fellowship Award
2-year funded project on Reducing pilots' cognitive load by facilitating human machine interaction in military aviation environment by Aeronautical Research and Development Board, MoD, India as Principal Investigator
Invited to join UK Global Challenge Research Fund International Peer Review College

PRAVEEN KUMAR, MT
INAE Young Engineer Award (Associate) for year 2017

PRIYA GAMBHIRE, BSSE
INSPIRE Faculty Award
SERB early career research award

PROSENJIT GHOSH, CEAS
Advisor IAEA for Stable isotope application in Climate Research

R SUKUMAR, CES
Lead Author, Intergovernmental Panel on Climate Change (IPCC) Second Lead Author meeting for 'Climate Change and Land: an IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security and greenhouse gas fluxes in terrestrial ecosystems'

R VENKATESH BABU, CDS
Chair, IEEE SP Chapter, Bangalore

RACHIT AGARWAL, BSSE
SERB early career research award

RADHAKANT PADHI, AE
Distinguished Alumni Award, Veer Surendra Sai University of Technology, Burla, Odisha
Excellence in Aerospace Education by Aeronautical Society of India
Vice-Chair of the IFAC Technical Committee 7.3 (Aerospace), 2017-2020

RAGHAVENDRA GADAGKAR, CCS
Foreign Honorary Member, American Academy of Arts & Sciences, Cambridge, Massachusetts, USA, 2017
Year of Science Chair Professorship, Department of Science and Technology, New Delhi, 2017-2022

RAHUL PANDIT, PHY
Elected as the Chair of the C3 Commission (Statistical Physics) of the International Union of Pure and Applied Physics (IUPAP) 2018-2021
Elected as Vice-President of the International Union of Pure and Applied Physics (IUPAP) Nov 2017 – Oct 2020
Goyal Prize for Physical Sciences
Elected a Vice President of the International Union of Pure and Applied Physics (IUPAP)
Elected the Chair of the C3 Commission for Statistical Physics of the International Union for Pure and Applied Physics (IUPAP)

RAJAN GURUKKAL, CCS
Braj Dev Prasad Memorial Prize instituted by the Indian History Congress

RAJIV SOUNDARARAJAN, ECE
IEEE Signal Processing Letters Best Paper Award

RAMESH CHANDRA MALLIK, PHY
Brain Pool invited Scientist under the South Korean Brain Pool Invitation Program of KOFST

RAVINDRANATH H ALADAKATTI, CAF
Best Paper Presentation Award at International Conference on "International Conference on Advances in Applied Science and Environmental Engineering (ASEE-2017)", Malaysia

ROHINI M GODBOLE, CHEP
Invited to be a member of the High Energy Physics Advisory Panel CHEPAD of the USA
Asked to make a presentation of five minutes to President of India on Mega projects
Invited as 'Van der Waals Chair of Physics by the Amsterdam Institute of Physics
Invited to be the member of the Governing Council of Indian Statistical Institute, Kolkata, 2016-2019
Member of the DAE-DST Coordination Committee for High Energy Physics, 2017-2019
Member of the International Advisory Committee of the Circular Electron Positron Collider being planned in China
Selected as outstanding American Physical Society (APS) referee for 2018

S BHATTACHARYA, OC
Director, Indian Institute of Cultivation of Science, Kolkata (on deputation)

SANDEEP M ESWARAPPA, BC
Selected as a Section Editor (Medical Sciences) for the journal Current Science

SANDHYA S VISWESWARIAH, MRDG
Royal Society UK, International Collaboration Award for Research Professors

SANJIT CHATTERJEE, CSA
Data Security Council of India's 2017 award

SANJIV SAMBANDAN, IAP
DBT Innovator of the Year 2017

SANTANU MUKHERJEE, OC
Member of the Editorial Advisory Board of the Journal or Organic Chemistry (2018-2020)

Sashikumaar Ganesan, CDS
Joint Secretary, ISIAM

SATHEES C RAGHAVAN, BC
U.T. Tithin Raj award 2017 for Application Oriented Innovations in cancer research

SATYAM SUWAS, MT
Friedrich Wilhelm Bessel Research Award, Humboldt Foundation, Germany
ASM-IIM visiting lectureship award from American Society of Metals-Indian Institute of Metals

SHALABH BHATNAGAR, CSA
ACCS-CDAC Foundation Award, 2017

SK SATHEESH, CAOS
Research Award 2017, Astronautical Society of India (ASI)
Chief Editor, CURRENT SCIENCE
Devendra Lal Memorial Medal- Prestigious AGU medal

SN OMKAR, AE
Inaugurated Sahyadri Science Talent Hunt, 2017 organized by the Sahyadri College of Engineering and Management
Winner of Karnataka Grand Challenge 2 for the project DRONA: Drones for neo agriculture
Chief guest and Keynote speaker at IEEE Symposium on Drone Computing conducted by IEEE Computer Society

SOMA BISWAS, EE
IEEE Late Shri Pralhad P Chhabria Award for the category, Best Women Engineering award, March 2018

SRIDHARAN DEVARAJAN, CNS
Pratiksha Trust Young Investigator Award

SRIRAM GANAPATHY, EE
DST Early Career Award
Prathiksha Trust Young Investigator Award

SRIRAM RAMASWAMY, PHY
Mayent Rothschild – Institut Curie Award 2018 2) DSc honoris cause, Coochbehar Panchanan Barma University, West Bengal 2017
DSc honoris causa, Coochbehar Panchanan Barma University
Homi Bhabha Chair (Tata Education and Development Trust) Oct 2017-Sep 2020

SUBHOJOY GUPTA, MA
Infosys Young Investigator Award

SUDHIR K VEMPATI, CHEP
Selected to serve on DST SERB committee on SERC schools in Theoretical High Energy Physics. Selected as an Associate Editor, Current Science

SUMILAN BANERJEE, PHY
Infosys Young Investigator Award

SWANANDA MARATHE, CNS
DST INSPIRE faculty award
Swetaprovo Chaudhuri, AE
Indian National Science Academy Medal for Young Scientist. April 2017

T G SITHARAM, CIV
Member of Governing Council of NHCE, New Horizon College of Engineering
President, International Association of Coastal Reservoir (IACRR), Australia

TANMOY DAS, PHY
Infosys young investigator award

THILAGAR P, IPC
CRSI Bronze medal

TUSHAR KANTI CHAKRABORTY, OC
CRSI Silver Medal 2016

U JAYACHANDRA SHENOY, EE
POSOCO Power System Award - PPSA 2018, Ministry of Power, Govt. of India, Research excellence in the field of power systems, February 2018

UDAY KUMAR REDDY B, CSA
ACM SIGPLAN PLDI 2017 Distinguished Reviewer Award

INSA YOUNG SCIENTIST MEDAL 2017
Certificate from IEEE Transaction on Power Delivery stating "In grateful appreciation of your dedicated service as an exceptional reviewer for the IEEE Trans. on Power delivery" on March 2017

UMESH VARSHNEY, MCB
President, Society of Biological Chemists (India)

USHA VIJAYRAGHAVAN, MCB
Indian Society for Plant Physiology, G V Joshi lecture Award

VAMSI PINGALI, MA
Infosys Young Investigator Award
Selected for the Junior Associateship of ICTP

VIBHOR SINGH, PHY
Infosys Young Scientist Award-2017 by Infosys Foundation Bangalore

VINOD GANAPATHY, CSA
Data Security Council of India's 2017 award

VR SUPRADEEPA, CENSE
Adjunct Faculty, Department of Electrical Engineering, IIT Madras
One of our papers named as among the 15 most cited papers in Optics Letters for the decade (2010 onwards)

VV SRINIVAS, CIE
Certificate of Outstanding Contribution in Reviewing from the Editors of Journal of Hydrology, Elsevier, in Recognition of the contributions made to the quality of the Journal
Eminent Alumnus, Osmania University, Hyderabad

YOGESH SIMMHAN, CDS
Best Paper Award Finalist, IEEE International Conference on High Performance Computing, Data, and Analytics (HiPC), 2017
Member, CBSE Computer Science Curriculum Review Committee

VAMSI PRITHAM PINGALI, MA
Junior Associate of the International Centre of Theoretical Physics (ICTP)

6 STUDENTS

6.1 ADMISSIONS AND ON ROLL

During the year, 1128 students (432 for research, 60 for Integrated PhD, 531 for course programmes and 105 under graduate programme) joined the Institute taking the number "On Roll" to 4038 (2307 students in research, 307 in Int. PhD, 932 in post graduate and 492 in under graduate course programme).

6.2 SC/ST STUDENTS

57 students belonging to SC/ST in research, 65 in the course programme and 18 in the under graduate programme joined the Institute in the current year and, in all 216 research students, 42 Int. PhD and 123 course students, 97 under graduate students were "On Roll" during the year.

ADMISSIONS:

Research: Out of 847 applicants, 654 were called for an interview; 59 were offered admission and 57 joined.
Int. PhD: Since 2013, admission is through JAM (Joint Admission Test for M.Sc), 39 of them were short-listed and called for an interview, 12 were offered admission and 8 joined.
Courses:
ME/MTech/MMgt/MDes: Out 698 applicants, 158 were offered admission and 65 joined.
B S: Out of 1832 applicants, 85 were offered admission and 18 joined.

6.3 SCHOLARSHIPS / FELLOWSHIPS

The students participating in research and course programmes are granted scholarships at the Institute ranging from 12,000/- to 40,000/- 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.

6.4 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 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 2017-18, students availed themselves of the loan to the extent of Rs 18,25,000/-.

6.5 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.

6.6 HOSTELS

The Students Hostel consists of 11 Gents and 4 ladies Hostel Blocks. Students, Research Associates and Short -term workers totaling 3019 (2215 gents and 804 ladies) are provided accommodation in the Hostel blocks.

Four Dining halls (Two vegetarian and Two Composite) provide a variety of food items in clean and hygienic conditions for all the boarders. The Hostel and Dining halls are managed by the Council of Wardens headed by the Chairman and team.

6.7 AWARD OF MEDALS

The Institute awards medals every year in recognition of the best thesis (both at the Doctoral and Master's levels) in various fields and for excellence in course programmes and projects.

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

SL No	Name of the Medal	Awardee	Dept / Centre
FOR THE BEST PhD THESIS			
1	Prof. Chintakindi V Joga Rao Medal	Dr Korak Sarkar	AE
2	Prof. B K Subba Rao Medal	Dr Indrasen Singh	ME
3	Prof. K P Abraham Medal	Dr Sachin Kumar B	MT
4	The Alumni Medal (Research)	Dr Palash Dey	CSA
5	The Seshagiri Kaikini Medal	Dr V Shashank	ECE
6	Prof. K T S Iyengar Medal	Dr S Abhinav	CE
7	Prof. Giri Memorial Medal	Dr Shubhi Srivatsava	BC
8	Mrs. C V Hanumantha Rao Medal	Dr Ila Pant	MRDG
9	The M Sreenivasaya Medal	Dr Arjun Balakrishnan	MCB
10	Prof. B H Iyer Medal	Dr Abhinav K V	MBU
11	Dr. J C Ghosh Medal (Physical Chemistry)	Dr Ahmad Irshad M	IPC
12	Prof.S Soundarajan Medal(Inorganic Chemistry)	Dr Santanu Mondal	IPC
13	The Guha Research Medal	Dr Veeranjaneyulu Lanke	OC
14	The Toulouse Medal	Dr Sudeshna Sen	SSCU
15	Prof. Anil Kumar MemorialMedal (Experimental Physics)	Dr Nafisa Begum	PH
16	Kumari L A Meera Memorial Medal (Theoretical Physics)	Dr Kallol Sen	PH
17	The Indian Economic Association Medal	Dr Tarun Sharma	MG
18	The Sudborough Medal	Dr Barun Kumar Barman	MRC
19	Amulya and Vimala Reddy Medal	Ms Shwetmala	CST
20	Tag Corporation Medal	Dr Arun Rahul	DESE
21	The Institute Medal	Dr Revathy M Parameswaran	CEaS
FOR THE BEST INTEGRATED PhD THESIS (MS level)			
22	Dr A Nagaraja Rao Medal	Mr Debasish Giri	Chemical Scs.
23	Kumari L A Meera Memorial Medal	Ms Sudipta Kundu	Physical Scs.
24	Prof. P L Bhatnagar Medal	Ms Sruthi Sekar	Mathematical Scs.
FOR THE BEST MSc (ENGG) THESIS			
25	NASAS Medal	Mr Rahul Gupta	AE
26	The Hay Medal	Mr Sudarshan Nagesh	EE
27	Subramanian Rajalakshmi Medal	Ms Kruthiventi S S Srinivas	CDS
FOR THE BEST ME / M Tech / M Mgt / M Des			
28	Mrs. Sabita Chaudhuri Memorial Medal	Mr Soumyajit Behera	AE
29	Prof. N R Kuloor Memorial Medal	Mr Aritra Santra	CH
30	Prof. N S Lakshmana Rao Medal	Mr Agnimitra Dasgupta	CE
31	The Computer Society of India (Bangalore Chapter) Medal	Mr Abhishek Bansal	CSA
32	The K K Malik Medal	Mr Ajaya Pratap Jena	MT
33	S V Sastry Memorial Medal	Mr Atanu Dolai	ME
34	The Alumni Medal	Ms Sooshinivethy S S	ECE/DESE

35	Prof. I S N Murthy Medal	Mr Hisham Rahman	EE/ECE
36	The N R Khambhati Memorial Medal	Mr Thatte Mihir Sunil Chhaya	EE
37	The N R Khambhati Memorial Medal	Mr Shouvik Das	EE
38	Prof. S V C Aiya Medal	Mr Ganesh Ramachandra Kini	ECE
39	Motorola Medal	Mr Rajrup Ghosh-	CDS
40	The DESE Design Medal	Ms Sajna Remi Clere	DESE
41	H R Babu Seetharam Medal	Mr Lithin M G	INAP
42	Prof. K N Krishnaswamy Medal	Mr Bitopan Gogoi	CEaS
43	The Institute Medal	Mr Abhishek K A	CeNSE
44	The Institute Medal	Mr Sumant Sarkar	CeNSE
45	Prof. B G Raghavendra Memorial Medal	Mr M Senthil Nathan	MG
	FOR THE BEST BACHELOR OF SCIENCE (RESEARCH)		
46	The Institute Medal	Ms Sridevi V	Biology
47	The Institute Medal	Mr Avishek Das	Chemistry
48	The Institute Medal	Mr Sanal S Prasad	Mathematics
49	The Institute Medal	Mr Subhayan Sahu	Physics

6.8 Awards & Distinctions

FELLOWSHIP

Gayathri Aaditya, CST
BHAVAN's fellowship, USA

Debanjan Das, MRC
Poornima G, BC
Bristol-Myers Squibb (BMS) fellowship

Manvi Sharma, CES
Carl Storm International Diversity Fellowship

Sriram Rajkumar, CNS
CMU-IISc BrainHub Fellowship

L.R Jaidev, MT
CSIR Research Associateship

Prasoon Kumar, MT
Vipul Agarwal, MT
DST National Postdoctoral fellowship

Sushma Krishnan, CES
EMBO short-term fellowship from Max-Plank Institute, Germany

Aditya Baksi, DCCC
Ali Hasan Siddiqui, DCCC
Anand N, DCCC
Gowri R, DCCC
Jalihal Chetankumar Adappa, DCCC
Kala Nair K, DCCC
Nihar Paul, DCCC
Nikumbh Akshaya Chandrakant, DCCC
Pradeep Kushwaha, DCCC
Priyanshi Singhai, DCCC
Sambrita Ghatak, DCCC
Shubhi Agrawal, DCCC

Sneha Santy, DCCC
Snehlata Joshi, DCCC
Grantham fellowship

Debasmita Dwibedi, MRC
H H Uhlig Summer Fellowship (ECS, USA)

Prasanna K, CEaS
Indo-US postdoctoral fellowship (from SERB)

Puneet Singh, BSSE
Post-doctoral fellowship at Harvard University

Debanjan Das, MRC
Dipayan Ghosh, BC
Rajasekar P., MRC
Raman Charpak Fellowship

Debasmita Dwibedi, MRC
Robert L. Snyder Travel Fellowship by International Centre for Diffraction Data (ICDD, USA)

Ravi Singh, CST
Tata Motors Fellowship for 5 years (yearly grant of 6 lakhs, total 30 lakhs)

Suprovat Ghoshal, CSA
TCS Research Scholar Fellowship

Vishal Shaw, ESE
TI fellowship for Mtech

PAPER/POSTAR AWARDS AND ORAL PRESENTATION

A Dash, CeNSE
Best Poster Award, " Tuning Resonant Wavelength of Silicon Micro-ring Resonator with Graphene", A. Dash, J. Vadivukkarasi, S. K. Selvaraja, A.K. Naik

Aditi Jain, BSSE
Bajpai Saha Award (second prize) for Best Student Paper Presentation at the Sixth Asian Biomaterials Congress

Aditi, MCB
Best Oral Presentation Award

Akash Singh, CeNSE
Springer's Best Paper Presentation Award at 17 th International Conference on Thin Films 2017

Akshay Datey (Same data repeated in BSSE), MCB
Best presentation award at the 5th national symposium on shockwaves, DRDO, Chandigarh (Feb 2018)

Alok Ranjan Verma (PhD), EE
Best paper award at IEEE-UPCON-2017

Anamika S Pratiyush, CeNSE
Best Poster Award, IWPSD (conference), IIT Delhi, Dec 2017

Aneesh Dash, CeNSE
Best poster award at the XIX International Workshop on the Physics of Semiconductor Devices (IWPSD), Jointly organized by Solid state Physics Laboratory- Delhi, Defence Research & Development Organization and Indian Institute of Technology, New Delhi.

Anindita Brahma, CES
Best Poster Award – 1st Prize. European Society for Evolutionary Biology XIV Congress, 20-25 August 2017, Groningen, Netherlands.
Title of Poster: Emergence of Cooperation and Division of Labour in the Primitively Eusocial Wasp Ropalidia marginata

Anupam Sanghi, CSA
Best poster award at the Young Researcher's Symposium of the ACM CoDS-COMAD conference held in Goa

Anwesha Mukherjee, IAP
Best Poster Award at International Workhop on Physics of Semiconductor Devices

Arkamitra Vishnu, CES
Poster presentation and a flash talk on "Distinctive use of mutualistic fungi by the resident ants inside caulinary domatia of the ant-plant Humboldtia brunonis (Fabaceae) and 3rd Symposium on Molecular Analysis of Trophic Interactions at Uppsala, Sweden, 2017; talk selected for invited paper in special issue of Molecular Ecology

Arul Varman Kesavan, MT
Best Poster Prize - Energy & Environmental Science, International Conference on Hybrid and Organic Photovoltaics

B Sampath Kumar, ESE
Best Technical Paper

Balaji Srinivasan Babu and Ganesh Kini, ECE
Finalists for the Best Student Paper Award at IEEE ISIT 2017

Baskar Senthilkumar, MRC
Best Poster Award at ICMAT-2017 by Materials Research Society of Singapore (MRS-S)

Gabriel O Orodepo, IPC
Best Poster Award, 24th National Conference on Liquid Crystals, IISER, Mohali

Gaurav Tiwari, CIE
IGS-Roorkee Chapter Young Geotechnical Engineer Award

Geetika Sharma, MCB
Best Poster Awards, Symposium on Biology and molecular pathogenesis of viruses 2016, IISc. Bangalore

Gowdham Prabhakar, CPDM
Won Best Paper Award at IEEE ICICICT 17 conference

Hemanta Kumar Kundu, PHY
Best poster award in in-house symposium 2017

Hina P A Khan, OC
Best Poster Award, Indian Peptide Symposium 2017, Mumbai

Kiran Ghadge, CPDM
Certificate of Merit for One of the Most Distinguished Papers Jan 2017, ICoRD'17, IIT Guwahati, India for paper entitled: Application of InDeaTe design toolbox for designing sustainable products - case study of a natural water cooler

Lachit Saikia, PHY
Best poster award in Department Inhouse Symposium, 2017

Madhavaraj A (Ph D), EE
Prof. M Anandakrishnan Award for the best paper, TIC 2017, University of Toronto, Canada

Madhura Amdekar, CES
Honorable mention in founders memorial poster competition at International meeting on Animal Behaviour, Toronto, Canada, 2017

Madhusudanan N, CPDM
Certificate of Merit for One of the Most Distinguished Papers Jan 2017, ICoRD'17, IIT Guwahati, India for paper entitled: Challenges and some potential strategies for relating engineering issues with their causes in text

Mangesh Bhattarai, PHY
Best poster presentation, IONS Kochi, Sep 11-14, 2017

Milova Paul, ESE
Best Technical Paper

Mit H Naik, PHY
Best oral presentation award, Winter School-2017 on Frontiers in Materials Science

Namrata Singh, IPC
Best Poster award, 17th Modern Trends in Inorganic Chemistry (MTIC), NCL, Pune
Best poster award, two days in-house symposium 'IPC Day, 2017'

Neha Lamba, CH
Poster award at 10th international conference on "Supercritical fluids (SUPERGREEN-2017)", Japan

Nikita Zachariah, CES
Best poster award for the poster titled "Building mud castles: a perspective from brick laying termites" at the Students Conference on Conservation Science (SCCS), IISc, Bangalore, 2017
Student Ethologist Award for Oral presentation on "Building mud castles: a perspective from brick-laying termites" at the National Conference on Behavioural Ecology: Responses to Changing Climate by Ethological Society of India and Gujarat Institute of Deseart Ecology, Bhuj, India, 2017

Nimisha Roy, CIE
Best theme paper award in 6th Indian Young Geotechnical Engineers Conference
Outstanding paper award in 6th Indian Young Geotechnical Engineers Conference

Nirupam Karmakar, CAOS
A Study of the Relationship between the Intraseasonal Variability and Extreme Rainfall Events in the Indian Summer Monsoon Rainfall in a GCM. Obtained Best Student's Poster Award in American Meterological Society's Annual Meeting, Seattle, USA. February 2017

Nivedita Singh, MRDG
Best Poster Award (2017), Indian Society of Human Genetics, Hyderabad

P Prasad, CeNSE
Best Poster Award, "Parametric amplification in MoS2 drum resonators", P. Prasad, N. Arora, A. K. Naik, poster presentation at Graphene 2017, 28 -31 March 2017, Barcelona, Spain

Pallavi Das Gupta, CeNSE
Best Poster Award, 2017 for Annual Students Symposium, Centre for Nano Science and Engineering, IISc, Bangalore

Phoolwanti Rani, MCB
Best poster award in 86th Conference of Society of Biological Chemists "Emerging Discoveries in Health and Agricultural Sciences", India, 2017

Pratibha Yadav, CES
2nd prize for three minute thesis competition (3MT) at International meeting on Animal Behaviour, Toronto, Canada, 2017

Pratik Dave, MCB
Best Poster Awards, Symposium on Biology and molecular pathogenesis of viruses 2016, IISc Bangalore

Preeti Sharma, BSSE
Best Poster Award at Nanobiotek-2017

Raghavendra G.S., CSA
Best Poster Award, SciVis Track, IEEE Conference on Visualization, 2017

Rahul Chakraborty (MSc.Engg), EE
Best Poster Award at EECS 2017 symposium

Ria Mukherjee, IPC
Best poster award, two days in-house symposium 'IPC Day, 2017'
Honourable Mention Poster Award, 9th International Conference on Advanced Vibrational Spectroscopy, Victoria, Canada

Ritambhara Gond, MRC
Best Poster Award at ICMAT-2017 by Materials Research Society of Singapore (MRS-S)

Sachin and Vysakh, ECE
Cadence Design Contest 2017 - Winners

Saheli Chakraborty, IPC
Best Poster Award – KAUST Research Conference, Saudi Arabia

Satyaghosh Maurya, CH
Poster award - Indian biophysical society meeting held at IISER - Mohali 2017

Satyajeet Gupta, CES
Best poster award for the poster titled "Cost of hitchhikers on a mutualism" in the first "DST-SERB School of Chemical Ecology" held at NCBS Bangalore from 3rd to 16th July, 2017

Saurabh Khanna, ECE
Best Presentation Award at the EECS Divisional Symposium

Sayan Das, PHY
Best Paper presentation award in 4th International Conference on Nanoscience and Nanotechnology (ICONN 2017), SRM University

Shammy Raj and Sachin Kumar, MT
Best paper prize from Materials Technology journal

Shilpa Chaturvedi, CDS
Pratiksha Travel grant for IEEE eScience 2017 Conference

Shubhadeep Bhattacharjee, CeNSE
Best Poster Award, 2017 for Annual Students Symposium, Centre for Nano Science and Engineering, IISc, Bangalore

Sonal Keshwani, CPDM
Certificate of Merit for One of the Most Distinguished Papers Jan 2017, ICoRD'17, IIT Guwahati, India for paper entitled: Idea Inspire 3.0—A Tool for Analogical Design
Certificate of Merit for One of the Most Distinguished Papers Jan 2017, ICoRD'17, IIT Guwahati, India for paper entitled: Towards automatic classification of description of analogies into SAPPhIRE constructs

Souvik Mandal, CES
Best Poster Award – 2nd Prize. European Society for Evolutionary Biology XIV Congress, 20-25 August 2017, Groningen, Netherland
Title of Poster: Ontogeny of Spatial Familiarity and foraging ability in a tropical social wasp

Subhankar Saha, SSCU
Awarded an oral presentation on "Third Generation Crystal Engineering. Hand-Twisted Helical Crystals" at the 24th Congress and General Assembly of the International Union of Crystallography (IUCr 2017) in Hyderabad, India

Subhash Joshi T.G., EE
Best presentation award, EECS Research Students Symposium, 2017

Suman Devadula, CPDM
Certificate of Merit for One of the Most Distinguished Papers Jan 2017, ICoRD'17, IIT Guwahati, India for paper entitled: Application of InDeaTe design toolbox for designing sustainable products - case study of a natural water cooler

Vamsi Krishna N P, CeNSE
Best poster award at the XIX International Workshop on the Physics of Semiconductor Devices (IWPSD), Jointly organized by Solid state Physics Laboratory- Delhi, Defence Research & Development Organization and Indian Institute of Technology, New Delhi.

Vignesh Venkateswaran, CES
2nd prize for three minute thesis presentation (SPEECUP), NCBS, Bangalore, 2017

BEST RESEARCH/THESIS, AWARDS AND MEDALS

Abhijit Hazarika, SSCU
Toulouse medal as best thesis award from Solid State and Structural Chemistry Unit, Indian Institute of Science Bangalore, India. 2017

Abhishek, CIE
Prof N S Lakshmana Rao Medal

Aditi Jain, BSSE
Science Scholar Award by Sun Pharma Science Foundation

Arjun Balakrishnan, MCB
Srineevasaya Best Thesis Award

Atish Roy Choudhury, MCB
Kaikini Award

Bidroha Basu, CIE
Prof N S Govinda Rao Medal for Best Ph D Thesis

Debasmita Dwibedi, MRC
Best Graduate Student Award by Materials Research Society of Singapore (MRS-S)
Ludo Frevel Crystallography Award by International Centre for Diffraction Data (ICDD, USA)

Dipayan Ghosh, BC
Dr. A.S Perumal Award, 2017 for best performance in Research training program from Department of Biochemistry, IISc, Bangalore

Jagmohan Sharma, CST
Amulya & Vimala Reddy Awards

Lakshmi Priya, NMR
Jharana Rani Samal best student award for outstanding contributions in NMR spectroscopy as a Ph.D. student

Lalit Sharma, MRC
Young Scientist Award by the European Materials Research Society (EMRS)

M V Vamsee Aditya, MBU
Prof. B H Iyer Medal award, a former PhD student at MBU

Manish Kumar Mishra, SSCU
IUCr Young Scientist Award

Mr. Dibakar Das, MSc (Research) student, EE
POSOCO POWER SYSTEM AWARDS (PPSA)-2018

Nivedita Singh, MRDG
Young Scietist Award (2017), Indian Society of Human Genetics, Hyderabad

Palash Dey, CSA
ACM India Doctoral Dissertation Award for 2017

Prashanth Vangla, CIE
IGS-AIMIL-HCV Young Geotechnical Engineer Award

Prasobh Kumar, IAP
Gandhian Young Technological Innovation (GYTI) Award

Prateek Katare, IAP
BIRAC-GYTI-SRISTI Award Funding of 15 Lakhs

Prosenjit Das, ME
CSIR Young Scientist Award 2017 in "Engineering Sciences"

Rajrup Ghosh, CDS
M.Tech.(CP) Motorola Medal 2017

Ramesh Naidu, IPC
GRC Carl Storm International Diversity Award to attend the Gordon Research Conference

Reneeta Sara Isaac, ECE
Qualcomm Innovation Fellowship Award

Sandeep Kumar Mishra, MRC
CBMR-NMRS Gold Medal for Outstanding Contributions in NMR during the calendar year, 2017

Sangeetha D, BC
Perumal Award 2017

Shilpa Dinkar Rao, ECE
Best PhD Thesis in the ECE Department

Shubhadeep Bhattacharjee, CeNSE
User Excellence Award, 2017 Micro-Nano Characterisation Facility, IISc, Bangalore

Shubhi Srivatsava, BC
Giri Memorial Award 2017

Srinivas S S Kruthiventi, CDS
MSc (Engg.) Thesis Medal 2017

Supriya V Vartak, BC
Awarded the Sun Pharma (Ranbaxy) Science Scholar Award for Young Scientists (2017) in the field of Pharmaceutical Sciences

Supriyo Chakraborty, MT
K.K. MALIK MEDAL for best ME student in Materials Engg

Suvam Mukherjee, CSA
Patrick and Radhia Cousot Award at SAS 2017 (shared with Oded Padon)

Swapnil Gandhi, Abhilash Sharma, CDS
Best Poster Award, Student Research Symposium, IEEE International Conference on High Performance Computing, Data, and Analytics (HiPC), 2017

Veeranjaneyulu Lanke, OC
The Guha Research Medal 2016-17

Venkatraman, MCB
Young Scientist Award

Vignesh Narayan Hariharan, MRDG
Newton-Bhabha Award

TRAVEL AWARDS

Agrita Dubey, CNS
Travel Award, DBT-CTEP

Benjamin Fosu, Yogaraj Benrjee, Ritika Kaushal,
Goldschmidt travel grant

Debaleena Basu, CNS
Travel Award, Gordon Conference, USA
Travel Award, Pratiksha Trust

Deepak Babu Sam, CDS
Pratiksha Travel grant for CVPR'17 conference + ACM India Travel Grant

Dipayan Ghosh, BC
Research visit to France awarded by CEFIPRA

K P Nagarjun, CeNSE
Travel Grant from SPIE for Presenting Work in Photonics West 2018, San Francisco

K Ram Prabhakar, CDS
MSR India Travel grant for ICCV'17 Conference + ACM India Travel grant

Kasturi S Mahadik, MCB
EMBO Travel Grant

Kiran Manoharan, AE
APS International Research Travel Awards Program

Meenakshi Tanwar, CNS
Travel Award, International Congress of Photobiology

Meisam Begheri, MRDG
ICSA Travel Bursary for Best poster

Monoranjan Boro, MCB
DST International Travel Support

Mopuri Reddy, CDS
Pratiksha Travel grant for BMVC'17 conference + BMVC Student grant

Muthukumaran Venkatachalapathy, CNS
Travel Award, International congress for cell biology

Nikita Zachariah, CES
Travel award from SERB, DST for Oral presentation on "Building mud castles: a perspective from brick-laying termites" at 2017 Annual Meeting of the Ecological Society of America, Oregon Convention Centre, Portland, Oregon, USA.

Pramod RT, CNS
Travel Award, Pratiksha Trust

Puneet Singh, CNS
Travel Award from PMC and DST to attend to the Progress in Motor Control COnference XI, Miami

Rajat Desikan, CH
Bill & Melinda Gates Foundation Global Health Travel Award for the "J6 Progress and Pathways Toward an Effective HIV Vaccine" conference, Banff, Alberta, Canada

Ravikiran S, CDS
Google travel grant for CVPR'17 conference

Sai Rama Krishna Meka, MT
Travel Award to the Till & McCulloch Stem Cell Meeting in Canada

Saloni Patel, MCB
EMBO Travel award for attending EMBO/India meeting on Autophagy: Cellular mechanisms and significance in health and disease

Sandhan Prakash, MCB
Newton Bhabha placement for short term collaborative visit at University of Dundee, UK

Siddharth Nanguneri, CNS
Travel Award, International Travel Support (SERB)

Sukriti Kapoor, MCB
EMBO travel grant for EMBO cytoskeleton meeting 2017 (IISER Pune)

Sushma Indrakumar, MT
Travel Award to the Till & McCulloch Stem Cell Meeting in Canada

Varsha Srinivasan, CNS
Travel Fellowship, Broadcomm Foundation
Travel fellowhip to IFAC, Paris

Vipul Agarwal, MT
Travel Award to the Till & McCulloch Stem Cell Meeting in Canada

OTHERS

Aditya Nalam, CAOS
Nalam, Aditya and G. Bala, 2017: Arctic Geoengineering: "Effects of precipitation in the tropical monsoon regions, European Geophysical Union, Vienna (Highlighted poster of the session), April 2017

Alok Ranjan Verma (PhD), EE
Asian Development Bank fellowship for attending 12th IEEE ICIIS 2017 at University of Peridena, Srilanka

Anoop Jayan, Rahul Kusuma, CPDM
Re-Imagine Waste Hackathon 2 – 3rd Prize, Special Prize (25k+25k – Prize Money)

Anoosha Pai and Shamanth Hampalli, ME
First prize in National Mechanism Design Contest held at iNaCoMM 2017 held in Mumbai in Dec. 2017, for "A compliant hinge mechanisms comprising a pair of shells that simulataneously twist and bend."

C Samanta, CeNSE
Awarded financial support to attend, "Advanced School on Foundations and Applications of Nanomechanics" and "School on Foundations and Applications of Nanomechanics", 18-29 September 2017 at ICTP, Trieste, Italy.

Deepak C, MS
The paper titled "Absorptive Capacity, and Degree of Intra-Cluster and Extra-Cluster Linkages: A Study of Bengaluru High-Tech Manufacturing Cluster", presented by Deepak C, at Graduate Student Research Conference in Business and Economics organized by Association of North America Higher Education International (ANAHEI), [held at Sarasota, Florida, USA during 25-26 May 2017] secured the Best Paper Award

Deval Karia, CPDM
Student Delegate - Environment and Sustainability, Harvard Project for Asian and International Relations (HPAIR)
Student Delegate, South American Business Forum (SABF)
Winning Team of IISc. Signage Design Competition

Dipankar Saha, ESE
Finalist Falling Walls Lab India 2017

Divya Ravi, CSA
Received stipend to attend Real World Crypto Workshop, to be held in Zurich between 10-14 Jan'2018

Gaurav Tiwari, CIE
ISSMGE Foundation grant

Logasrinivasan Palani, CPDM
Selected for the GM India Design - Workshop 2017

PPrasad, CeNSE
Awarded financial support to attend, "Advanced School on Foundations and Applications of Nanomechanics" and "School on Foundations and Applications of Nanomechanics", 18-29 September 2017 at ICTP, Trieste, Italy

Pratik Sarkar, CSA
Received funding from Robert Bosch Centre for Cyberphysical Systems for the project titled "Computing on private data in high-latency networks"

Praveen Chandra Tiwari, CHEP
Best Performing Student at "XI SERC School on Experimental High Energy Physics", 7 - 27 Nov 2017, NISER, Odisha

Purvi Agrawal, EE
ISCA Student Grant for Interspeech 2017

R Sarvendranath, ECE
Sheshgiri M. Kaikini and Krishna S. Kaikini Scholarship in Engineering

Rohit Nambiar, CPDM
Winning Team of IISc. Signage Design Competition

Sharmi Nath, BC
Larvol scholarship

Srimanta Barui, MRC
Common wealth split-site (PhD) Scholarship, University of Manchester, UK, 2017-2018

Subhankar Saha, SSCU
Invited to speak on "Crystal Engineering in the Third Generation. Cocrystals to Engineer Properties: Elasticity" in a Gordon Research Conference in 2016 at Stowe, USA
Invited to speak on "Soft-flexible Crystals by Design" in a Crystal Engineering Meeting on Mechanical Properties of Molecular Crystals in 2017 at Coorg, India.

6.9 PLACEMENT

An attractive Placement Brochure was prepared by OCCaP to be circulated with potential recruiters. A large number of potential recruiters were contacted with an intent for Campus Association for recruiting students. Brochures were shared, and many responded positively with good number of work opportunities for our students for Final placements. This has added on to the list of our Eminent Recruiters who visited our campus last year. On Campus and Off Campus interest to hire our students was shared by the companies.

A modern and fully functional Placement Portal has been set up for students and recruiters. The portal enables companies to register and post their hiring requirements. Students can register, apply for jobs, and manage interface with recruiters. The portal facilitates Emails and SMS alerts to selected set of students, and to disseminate information quickly. Overall 72 recruiters visited till April 2018 and recruited 213 candidates (20 Research, 185 Masters and 8 Undergraduate). Nearly all M. Tech. students of CS/ESE/ Mechanical/ Electrical have been placed for jobs in respective core sectors

6.10 EXTERNAL REGISTRATION PROGRAMME

SL No	Sponsors	No on Roll
1	24 - 7 Customer Private Limited	1
2	ABB Corporate Research Center	1
3	Accenture Technology Labs	1
4	Aeronautical Development Agency	3
5	Aeronautical Development Establishment DRDO	1
6	Amrita School of Engineering	1
7	Atomic Mineral Directorate for Exploration and Research	1
8	BABC Mumbai	1
9	Bangalore Integrated Systems Solutions P Ltd.	1
10	BHEL Corporate R and D Division	1
11	Bloom Energy I Pvt Ltd	1
12	Center for Study of Science Technology and Policy	2
13	Central Research lab	1
14	Centre for Development of Advanced Computing C-DAC	2
15	CSIR- National Aerospace Laboratories	1
16	Defence Metallurgical Research Laboratory	3
17	Defence Research and Development Organisation	10
18	Faurecia Emission Control Technologies	1
19	Gas Turbine Research Establishment	4
20	Generl Electric India Technology Centre	4
21	Hemvati Nandan Bahuguna Garhwal University	1
22	Hewlett Packard	1
23	Hindustan Aeronautics Limited	5
24	Hindustan University	1
25	Honeywell Technology Solutions Pvt. Limited	5
26	IBM India Pvt. Ltd.	2
27	Indian Space Research Organisation	27
28	Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam	1
29	Infosys Ltd.	1
30	Institute of Ayurveda and Integrative Medicine Foundation of Revitalization of Local Health Traditions	1

31	Intel Technology India Pvt Ltd	1
32	John F Welch Technology Centre	1
33	Microwave Tube Research and Development Centre	4
34	MSRIT, Blore	1
35	Nagarjuna Fertilizers and Chemicals Ltd	1
36	National Aerospace Laboratories	12
37	Naval Science And Technological Laboratory	1
38	NSTL.DRDO.Ministry of Defence	1
39	Nuclear Fuel Complex	1
40	Programme AD - Research Center Imarat	1
41	RDE Engineers DRDO	2
42	RESEARCH CENTRE IMARAT. RCI. DRDO	1
43	ROBERT BOSCH Engineering and Buisness Solutions Limited	4
44	Samatvam Science and Research Center	1
45	Samsung R and D Institute India Bangalore Pvt Ltd	2
46	Solid State Physics Laboratory	1
47	Tata Motors Limited	1
48	Texas Instruments India Pvt Ltd	3
49	Triveni Turbine Limited	1
50	Vikram Sarabhai Space Centre - Indian Space Research Organisation	1
51	WEBFIL LIMITED - DIGITAL SYSTEMS DIVISION	1
	TOTAL	**128**

6.11 RESEARCH CONFERMENTS PhD, Int. PhD, MS and M Sc(Engg),

6.11.1 PHD

An attractive Placement Brochure was prepared by OCCaP to be circulated with potential recruiters. A large number of potential recruiters were contacted with an intent for Campus Association for recruiting students.

BIOCHEMISTRY

Mr Kaulage Mangesh Hanumant	Structural and functional characterization of quadruplex DNA structures in human acetyl-CoA carboxylase 1 gene promoters and stabilization of G-quadruplex DNA by carbazole-benzimidazole conjugates
Ms Kshirsagar Rucha Anant	The elucidation of the mechanism of meiotic chromosome synapsis in Saccharomyces cerevisiae: Insights into the function of synaptonemal complex, Hop1 and Red1 proteins and the significance of DNA quardruplex structures
Mr Umakant Sahu	Mxr1p is a global regulator of multiple metabolic pathways in the methylotrophic yeast Pichia pastoris
Ms Saima Masood	Elucidation of the role of Nse1, a RING domain containing component of Smc5/6 complex, in maintenance of chromosome stability in Saccharomyces cerevisiae
Mr Shamik Majumdar	Characterization of Thymocyte Subpopulations and Mechanistic Insights during Various Modes of Thymic Atrophy
Ms Geethanjali D	New anticancer secondary metabolites from an endophytic fungus Chaetomium nigricolor isolated from Catharanthus roseus: Structural elucidation and molecular mechanism underlying anticancer effects

Ms Deepthi R	Molecular insights into lymphoid malignancy: Role of transcription factor BCL11B in T-cell leukemia genesis and biochemical characterization of DNA binding domain of RAG1
Ms Monica Pandey	Understanding the Sequence Dependence of NHEJ Mediated Double-strand Break Repair, and Identification of Novel DNA Ligase Inhibitors and their Potential Use as Cancer Therapeutics
Ms Akanksha Dixit	Immunomodulatory Activity of Glycodelin: Implications in Allograft Rejection
Ms Srishti Atul Kashyap	Isolation, structure elucidation and functional characterization of a novel cytotoxic secondary metabolite Phomafuranone, 2-Hydroxy-2, 4-dimethyl 1-5-[-1-propen-1-y1]-3(2H)-furanone, from Phoma tropica an endophytic fungus isolated from Mappia foetida
Mr Anantha Krishna T H	Anti-thrombotic secondary metabolites from endophytic fungi of Datura metel and Cassia fistula
Mr Arvind A	Characterization of mouse Apolipoprotein L9 and investigation of its cellular functions
Ms Sharanya Chatterjee	Understanding the biology of Heat Shock Protein 90 in opportunistic fungal pathogens

CENTRE FOR ECOLOGICAL SCIENCES

Mr Lakshya Katariya	Ecology of fungus-farming by termites: Fungal population genetics and defensive mechanisms of termites against the parasitic fungus Pseudoxylaria
Mr Deodhar Shreekant J	Sexual selection and personality in Psammophilus dorsalis
Ms Sanjeeta Sharma Pokharel	Stress physiology of free-ranging Asian elephants (Elephas maximus): Influence of ecological and anthropogenic stressors
Ms Attiwilli Suman	Investigating the Impact of Habitat Disturbance And The Role Of Functional Traits In A Tropical Butterfly Assemblage
Ms Sruthi Unnikrishnan	For Queen and Country: reproductive and non-Reproductive Division of labour in the primitively eusocial wasp Ropalidia cyathiforms
Mr Joshi Jaideep Pradeep	Spatial and Coevolutionary Dynamics of Cooperation
Ms Anuradha Batabyal	Urbanisation and shifting Phenotypes Behavioral, Physiological and Cognitive Strategies of the Indian Rock Agama Psammophilus dorsalis
Ms Anindita Brahma	Game of thrones: Direct fitness through nest foundation in the primitively eusocial wasp Ropalidia marginata
Mr Souvik Mandal	Finding the Way Back Home: A study of Spatial Orientation, Navigation and Homing Behaviour in the Social Wasp Ropalidia marginata

CENTRE FOR NEURO SCIENCE

Mr Sumitash Jana	Flexible control of Eye-hand Coordination
Mr Naredla Apurva Ratan Murty	Dynamics of Invariant Object Representations in the Monkey Inferotemporal Cortex
Ms Debaleena Basu	Neural Mechanisms Underlying the Planning of Sequential Saccades
Mr V Prasanna Venkhatesh	Computational Mechanisms Underlying the Voluntary Control of Reach Movement Planning and Execution
Mr Anindo Chatterjee	Factors Regulating Cerebellar Granule Neuron Progenitor Proliferation
Ms Aditi Verma	Mechanisms of do paminergic neurodegeneration in parkinson's disease

MOLECULAR BIOPHYSICS UNIT	
Ms Sambarey Awanti Pradip	Molecular networks of host responses in pulmonary tuberculosis: A data integration approach
Ms Aditi Banerjee	Role of lactate and TREK1 channels in Neuroprotection during Cerebral Ischemia – in vitro study in Rat Hippocampus
Mr Ramachandran Rakesh	Structural and mechanistic features of protein assemblies with special reference to spliceosome
Ms Subashini M	Structural and functional studies on Salmonella typhimurium propionate kinase and Photorhabdus luminescens oxalate decarboxylase
Mr Abhinav KV	Further Structural Studies on Jacalin and Genomic Search for Mycobacterial and Archeal Lectins
Ms Kalaivani R	Dynamics of protein kinases: Its relationship to functional sites and states
Mr C Thyageshwar	Structural studies on non-toxic homologues of type II Ribosome Inactivating Proteins (RIPs)
Ms Mansi Purwar	Design and Characterization of HIV- 1 ENV Derived Immunogens
Mr Sheikh Mohammed Arif	Structural and Biochemical Studies on Mycobacterial Uracil- DNA N-glycosylase and MutT1
Mr Kapil Kumar Goutam	Structural and Functional studies on the Mycobacterium tubercolosis Đ factor ĐJ
Ms Kritika Gupta	Molecular determinants of mutant phenotypes in the CcdAB Toxin-Antitoxin System
Ms Nasreen Bagbul Choudhury	G-Protein Coupled Estrogen Receptor (hGper)-Mediated Action of 17Đ-Estradiol on hTREK-1 Potassium Channel
Ms Sanjukta Das	Synergistic influence of gene architecture and promoter structure on transcription in plants: An in silico analysis
Mr Saurabh Yadav	Studies on the molecular mechanism of lysozyme invoked neuropathic pain

MICROBIOLOGY AND CELL BIOLOGY	
Ms Shruti Bhargava	Panoramic view of RNA binding proteins (RBPs) in Glioblastoma: IMP3, an RBP, is essential for glioma stem-like cell maintenance
Mr Jees Sebastian	Response of Mycobacterium tuberculosis to Rifampicin-A Cellular, Molecular, and Ultrastructural Study
Ms Rashmi Ravindran Nair	Unique Response and the Survival Mechanism of Mycobacterial Subpopulations against Oxidative and Nitrite Stress
Mr Nagaraja M	Identification, Structural and Functional Characterisation of the Molecule that Induces Asymmetric Cell Division in Mycobacteria
Mr G Shyam	Role of the ELONGATED GYNOPHORE/ELONGATA2 protein in fruit and root development in Arabidopsis thaliana
Ms Pallavi Anil Kakade	Understanding the Role of ZCF32, A Zinc Cluster Transcription Factor, In Candida Albicans Biology.
Ms Priyanka Agrawal	Physiological Role of Arr, an ADP-ribosyltransferase in Mycobacterium smegmatis
Ms Jagriti Pal	Elucidating Deregulated Novel Pathways in Glioma through Genetic and Epigenetic Approaches
Mr Monoranjan Boro	Regulation of host innate immune responses by Hippo signaling pathway during pattern recognition receptors(PRRs) driven inflammation: Implication for Host-Pathogen interactions
Mr Saurabh Shakya	Understanding the role of Rab22A in recycling endosome biogenesis and melanocyte pigmentation

Ms Titash Sen	Deciphering Functions & Interactions of Fission Yeast Splicing Factor SpSlu7 Relevant to Constitutive & Alternative Splicing
Ms Mahadik Kasturi	Bone Morphogenesis Protein(BMP) signaling at the cross-roads of Host-Pathogen interactions: Implications for pathogenesis
Mr Praveen Prakhar	Wnt/β-Catenin-dependent epigenetic factors shape host immune responses during mycobacterial infection

MOLECULAR REPRODUCTION DEVELOPMENT AND GENETICS

Mr Katti Prasanna	Investigating the novel roles of miR-9a and the regulators of mitochondrial dynamics during the development and functioning of indirect flight muscles in Drosophila Melanogaster
Mr Arka Baksi	Spermatogenomics: correlating testicular gene expression to human male infertility
Ms Madhangi M	Functional Characterization of WD40-repeat Protein, WDRS in Zebrafish to gain insight into its role in Isolated Micropherophakia
Ms Aparamita Pandey	Glucose and Lipid Metabolism During Pregnancy and Lactation in Rats: Role of Undercarboxylated Osteocalcin
Ms Ruchi Jhonsa	Dissecting the Role of Calcium Binding Proteins in Muscles using Drosophila Indirect flight Muscles as the Model System
Ms Nivedita Singh	Genetic analysis of Wilson disease in a south Indian population and molecular characterization of 13 novel ATP7B mutations
Ms Sakshi Gera	Notch3 Receptor: Activation Mechanism and Association with Ovarian Cancer.

INORGANIC AND PHYSICAL CHEMISTRY

Mr Raja K	The Effect of Substituents and Solvents on the Deiodination Reactions of Thyroid Hormones by Iodothyronine Deiodinase Mimics
Ms Srilakshmi P Bhaskar	A Study on Digestive Ripening Mediated Size and Structure Control in Nanoparticles Prepared by Solvated Metal Atom Dispersion Method
Ms Sananda Chanda	Itaconate-based Periodically Grafted Polyesters
Mr Aditya Garai	Studies on Iron and Cobalt Complexes showing Photo-induced Anticancer Activity
Mr Khokan Roy	Ultrafast Raman Loss Spectroscopic Investigations of Excited State Structural Dynamics of Bis (phenylethynyl) benzene and trans- Stilbene
Ms Debdyuti Mukherjee	Electrocatalytic Studies Using Layered Transition Metal Thiophosphates, Metal Chalcogenides and Polymers
Ms Aderonke Ajibola Adeyemo	Self-Assembly and Cytotoxic Activity of Homometallic And Heterometallic Coordination Architectures
Ms Deep Mala	Chemistry of Ru(II) complexes bearing N-heterocyclic carbene, hydride, and dihydrogen ligands: Synthesis, mechanistic insights, and applications

MATERIALS RESEARCH CENTRE

Mr Satyendar Sunkara	Nanostructured Metal Oxides and their Composites as Anode Materials for Li-ion Batteries
Mr Srikanth K	A dynamical approach to plastic deformation of nano-scale materials: Nano-and micro-indentation
Ms Deya Das	Optimization of Li storage in graphitic materials through tuning of electronic structures
Mr A Sree Rama Murthy	Physicochemical Characterization and Gas Sensing Studies of Cr1-xFexNbO4 and Application of Principal Component Analysis

Mr Mustaque Ali Khan	Efficient Photodetectors Based on Reduced Graphene Oxide
MrSelvakumar N	Novel 1-D and 2-D Carbon Nanostructures Based Absorbers for Photothermal Applications
Ms Anupama AV	Synthesis and applications of size and shape controlled magnetic oxide particles for magnetorheological fluids
Ms Bharathi P	Investigations into the synthesis, structural and multifunctional aspects of Ba0.85Ca0.15Zr0.1Ti0.9O3and K0.5Na0.5NbO3 Ceramics
Mr Shet Tukaram Shankar	Investigations into the microstructure dependent dielectric, piezoelectric, ferroelectric and non- linear optical properties of Sr2Bi4Ti5O18 ceramics
Ms Shalini Tripathi	Electron Microscopy Investigation of Formation Mechanism, Structure and Stability of Functional Nanostructures & Hybrids

ORGANIC CHEMISTRY

Ms Mitasree Maity	Bile Acid based Supramolecular Gels, Soft Hybrid Materials and their Applications
Mr Tumpa Gorai	Lanthanide based hydrogels in sensing, energy transfer and nanoparticle synthesis
Mr Sunil Kumar Gupta	Nature of Local Interactions at cisPro-Aro Peptide Sequences in Proteins: Evidences for van der Waals type Interactions. Design and Synthesis of Novel Covalent Surrogates for the Peptide Hydrogen Bond
Mr Soumya Jyoti Singha Roy	Catalytic Enantioselective Allylic Alkylative Desymmetrization, Carbon-Carbon and Carbon-Heteroatom Bond Forming Reactions
Mr Yogesh S	Design and Development of Metal-Free Cross Dehydrogenative Coupling Reactions for the Constructions of C-S,C-O and C-C Bonds
Mr Kiran R Bettadapur	Site-selective C-H Functionalization using Directing Group Strategy via C-H Bond Activation
Mr Amit Kumar Bali	Alkynones derived from tartaric acid: efficient building blocks for the synthesis of macrolactone natural products
Ms K Vaithegi	Total synthesis of natural products diospongin a, cryptofolione, cryptopyranmoscatoneb2, sch725674 and towards the total synthesis of palmerolide c

SOLID STATE AND STRUCTURAL CHEMISTRY

Mr Subhradeep Mistry	Copper-azides: syntheses, structures, and magnetic behavior
Ms SukantiBehera	Thermoelectrics and Oxygen Sensing Studies of Selected Perovskite Oxides
Mr Sushrutha S R	Syntheses, Structures and Characterization of New Coordination Polymer Compounds
Ms Indrani Pal	NMR based studies and applications of molecular interactions: From small molecules to bio - nanoconjugates
Mr Sandeep Kumar Mishra	Study of Diverse Chemical Problems by NMR and the Design of Novel Two Dimensional Techniques
Mr Suryoday Prodhan	Theoretical Investigations of Opto- Electronic processes in organic Conjugated Systems within Interacting Models: Exact Diagonalization and DMRG Studies
Ms Vaishali Sharma M	Structural Characterization of Complex Oxides and Sulfates Towards the Design of Photocatalytic and Sodium Ion Conducting Materials
Mr Subhankar Saha	THIRD GENERATION CRYSTAL ENGINEERING. Supramolecular Synthons, IR Spectroscopy and Property Design

Mr Ajay Kumar Jana	Metal-Organic Framework (MOF) Compounds: Synthesis, Structure, Sensing and Catalytic Studies
Ms Subhra Gope	Investigations of Chalcogen-Cathodes and a Carbonitride-Anode for Alkali-Based Rechargeable Batteries
Ms Rekha M	Study of change separation in quantum dots and their assemblies
Ms Sharada G	Structure, dynamics and optical properties of organic –inorganic hybrid perovskites
Ms Tushita Mukhopadhyay	Studies on Correlation between Microstructures and Electronic Properties of Organic Semiconductors

COMPUTER SCIENCE AND AUTOMATION

Ms Shalini Kaleeswaran	Program Repair by Automated Generation of Hints
Mr Satyanath Bhat	Design of Quality Assuring Mechanisms with Learning for Strategic Crowds
Ms Lavanya Sita Tekumalla	Non-Parametric Clustering of Multivariate Count Data
Mr Praphul Chandra	Incentive Design for Crowdfunding and Crowdsourcing Markets
Mr Palash Dey	Resolving the Complexity of Some Fundamental Problems in Computational Social Choice
Mr Shourya Roy	New Techniques for Automatic Short Answer Grading
Mr Ranganath B N	Scalable Sparse Bayesian Nonparametric and Matrix Tri-factorization Models for Text Mining applications
Mr Cherukupally Srikanth	Number Theoretic, Computational and Cryptographic Aspects of Certain Sequences of Arithmetic Progressions
Mr Arun R	Ranking from Pairwise Comparisons: The Role of the Pairwise Preference Matrix
Ms Maria Francis	Gröbner Basis Algorithms for Polynomial Ideal Theory over Noetherian Commutative Rings
Mr Jaynarayan Thakurdas Tudu	Power Issues in SoCs: Power Aware DFT Architecture and Power Estimation
Mr Somashekaracharya G Bhaskaracharya	Automatic Storage Optimization of Arrays in Affine Loop Nests
Mr Ajin George Joseph	Optimization Algorithms for Deterministic, Stochastic and Reinforcement Learning Settings
Ms Divya Padmanabhan	New Methods for Learning from Heterogeneous and Strategic Agents
Mr Anirudh Santhiar	Concurrency Analysis and Mining Techniques for APIs
Mr Suvam Mukherjee	Efficient Static Analyses for Concurrent Programs
Mr Arunselvan Ramaswamy	Stochastic Approximation Algorithms with Set-Valued Dynamics: Theory and Applications
Ms Pallavi Maiya H P	Data Structures and Algorithms to Analyze Concurrency in Android Applications
Mr Unnikrishnan C	A Graph Manipulation Language for Distributed Heterogeneous Systems

ELECTRICAL COMMUNICATION ENGINEERING

Mr Anirban Ghatak	Algebraic Techniques for Error Corrections in Random Networks
Mr Shashank V	Lattice Codes for Secure Communication and Secret Key Generation
Mr Sreenivasulu Tupakula	Photonic Crystal Ring Resonators for Optical Networking and Sensing Applications
Ms Keerthan P	Wideband Radio Frequency All-Pass Networks for Analog Signal Processing
Mr Arkaprovo Das	Fast Solvers for Integral-Equation Based Electromagnetic Simulations
Mr Anindya Gupta	Functional Index Coding, Network Function Computation and Sum-Product Algorithm for Decoding Network Codes

Ms Zaira Zahir	Frequency Synthesis for Cognitive Radio Receivers and Other Wideband Applications
Mr P T Akhil	Network Utility Maximization: Interior Point and Finite- step Methods
Mr Immanuel Raja	Fully Integrated CMOS Transmitter and Power Amplifier for Software-Defined Radios and Cognitive Radios
Mr Manuj Mukherjee	Secret Key Generation in The Multiterminal Source Model: Communication and Other Aspects
Mr Raviteja Upadrashta	Design and Development of A Passive Infra-Red-Based Sensor Platform For Outdoor Deployment
Ms Nikita Ambasana	Analysis, Diagnosis and Design for System-Level Signal and Power Integrity in Chip-Package-Systems
Mr D Thirumulanathan	Optimal Mechanisms for Selling Two Heterogeneous Items
Mr V Udaya Sankar	Resource Allocation in Femotocells via Game Theory
Mr Satya Kumar Vankayala	On Design and Analysis of Energy Efficient Wireless Networks with QoS
Mr Mallikarjun B Channappagoudar	An EÐcient Network Management System using Agent for MANETs
Mr Jobin Francis	Wideband Rate Adaptation and Scheduling in OFDM Cellular Systems: Modeling, Analysis, and Base Station-Side Estimation

ELECTRICAL ENGINEERING

Mr Sethupathy S	Stable Galerkin Finite Element Formulation for the Simulation of Electromagnetic Flowmete
Mr Anirudh Guha	Dead-Time Induced Oscillations in Voltage- Source Inverter-fed Induction Motor Drives
Mr Joseph Vimal Vas	Electromagnetic Properties of Carbon based Polymer Nanocomposites for Shielding, Chaffing and Camouflage Applications
Mr Sunil Kumar P R	Design and Analysis of Real-Time Message Scheduling under FlexRay Protocol
Mr K Venkata Vijay Girish	Speech and noise analysis using sparse representation and acoustics-phonetics knowledge
Mr Satish Mulleti	Sub-Nyquist Sampling and Super- Resolution Imaging
Mr Aniruddha Adiga	Sparsity Motivated Auditory Wavelet Representation and Blind Deconvolution
Mr Avanish Tripathi	Low Switching Frequency Pulse Width Modulation for Induction Motor Drives
Mr Bhosale Vijay Hiralal	Developmental Studies on Ultra Wide Band Type High Power Electromagnetic Radiating System for Use as an Intentional Electromagnetic Interference Source
Mr Basty Ajay Shenoy	Phase Retrieval and Hilbert Integral Equations — Beyond Minimum-Phase

ELECTRONIC SYSTEMS ENGINEERING

Mr T Ramachandra Budihal	Unified Cognitive Radio Architectural Analysis, Design and Implementation
Mr T Mohan Reddy	Capacity and life estimation of flooded lead acid batteries using eddy current sensors
Mr Mathews Boby	Multilevel Dodecagonal and Octadecagonal Voltage Space Vector Structures with a Single DC Supply Using Basic Inverter Cells
Mr Bharathkumar Hegde	Design, Development and Characterization of Variable Reluctance Ferrofluid Pump
Mr Dipankar Saha	Atomistic study of carrier transmission in hetero-phase MoS2 structures
Mr Tapas Kumar Patra	Content Dissemination in Mobile Ad Hoc Networks

Mr Viju Nair R	Investigations on Stacked Multilevel Inverter Topologies Using Flying Capacitor and H-Bridge Cells for Induction Motor Drives

COMPUTATIONAL AND DATA SCIENCES

Mr Appala Naidu Kotana	Numerical Studies of Axially Symmetric Ion Trap Mass Analysers
Mr Tarun Uppal	Feasible Path Prescription for Engineering Systems in a High-Index Constrained Dynamics Framework
Mr Birupaksha Pal	Projection based Variational Multiscale Methods for incompressible Navier-Stokes equations to model turbulent flows in time-dependent domains
Ms Yamuna N S	Studies on Kernel Based Edge Detection and Hyper Parameter Selection in Image Restoration and Diffuse Optical Image Reconstruction

CENTRE FOR NANO SCIENCE & ENGINEERING

Mr Ashish Kumar Pradhan	Energy Efficient Flexible Baseband Processing for Mobile and Cognitive Radios
Mr Emil Mathew Joseph	Multielectron Bubbles: A Curved Two-dimensional Electron System in Confinement
Ms Janeni N	Biodegradable Polymers for Drug Delivery and Tissue Engineering
Mr Anuj Bisht	Response of shock loading on microstructural and texture evolution in close packed metallic materials
Ms Greshma Nair	Theoretical and Experimental Study of Three-Dimensional Chiro-Optical Materials
Ms Santhi Natarajan	Accelerated and Accurate Alignment of Short Reads in High Throughput Next Generation Sequencing (NGS) Platforms
Mr Pooyath Lekshmy Venugopalan	Feasibility studies on magnetic nanopropellers for biological applications
Mr Venu Anand	Cold Atmospheric Plasma system- Simulation, Fabrication, Diagnosis and Thinfilm deposition
Mr Prasanna Kumar S Mural	Porous Antibacterial Membranes Derived from Polyethylene (PE)/ Polyethylene oxide (PEO) Blends and Engineered Nanoparticles
Mr Vinay Kumar	Electrochemical biosensors based on novel receptors for diabetes management
Ms Maya Sharma	Microporous membranes derived using crystallization induced phase separation in PVDF/ PMMA (Polyvinylidene fluoride/ polymethyl methacrylate) blends in presence of multiwalled carbon nanotubes
Ms Suman Pahal	Molecular Transport in Polyelectrolyte Multilayers
Mr V Kranthi Kumar	Large Area Mos2: Growth and Device Characteristics
Ms Debadrita Paria	Integration of Graphene with Plasmonic Nanostructures for Photodetection in the UV, Visible and IR
Mr Kasireddy Jayaprakashreddy	Towards Design and Development of Indienous Rate-Grade MEMS Gyroscopes
Mr N Krishna Rao Eswar	Development of Photoactive and Photoelectroactive Nanomaterials for Water Remediation

MANAGEMENT STUDIES

Ms Sindhuja CV	A Study of High Responsibility Teams – Context, Structure and Process
Mr Krishna H S	High-Tech Startup Lifecycle in India: An Exploratory Study of the Determinants of Emergence, Survival and Growth

Ms Rashmi Singh	Investigation of Existing Release Policies and Development of a Few Efficient Release Policies for Wafer Fabrication System- A Simulation Approach
Mr Lohith CP	The Impact of Strategic Marketing on the Innovation Performanceof Organizations: A Study with respect to Indian Micro Small and Medium Manufacturing Organizations
Ms N Kavita	Dynamics of Research Scholar-Supervisor Relationship: A Study of Conflict Resolution among Indian Research Scholars
Ms Pratheeba Vimalnath	A Comparison Between Singleton and Portfolio Patent Valuation In Auction Mode Of Patent Transaction
Ms M Vimala Rani	Impact of Real Time Events on the Relative Efficiency of the proposed Dynamic Scheduling Algorithms for Diffusion Furnace(s) in the Semiconductor Manufacturing
Ms Padmavathi Koride	Deliberations on Borrower Behaviour In the Context Of Micro- Finance
Mr Mitra Kumar Patel	The Effects of Social Capital and Open Innovation on R&D Outcomes and Job Satisfaction: A Study of The Indian Defence Sector
Mr Santhosh C	Internationalization of SMEs: Analysis of Antecedents, Strategies, and International Performance in the Indian Context
Ms Nibedita Dash	Benchmarking and Modelling the Sustainability of Urban Mobility System: A case study of Bangalore city, INDIA
Ms Mamatha S V	Dimensions of Social Capital, Learning Culture and Individual Performance: A Case of An It Organization
Mr Srigowatham Arunagiri	Assessment of University Technology Transfer Efficiency in the Context of Medical Device Technologies
Mr S Velmurugan	Sustained Competitive Advantage Strategic Hrm Initiatives, Antecedents and Consequences in Indian Context

SUPERCOMPUTER EDUCATION AND RESEARCH CENTRE

Mr Jayvant P Anantpur	Enhancing GPGPU Performance through Warp Scheduling, Divergence Taming and Runtime Parallelizing Transformations

AEROSPACE ENGINEERING

Mr Brijesh Kumar)	Flutter susceptibility assessment of airplanes in subÐcritical regimeusing ameliorated flutter margin and neural network based methods
Ms Pooja Agrawal	Optical Flow Based Guidance for UAV Safe Navigation through Urban Environments
Mr Abhishek Katta	Experimental studies on shock-shock interactions in hypersonic shock tunnels
Mr Anoop Jain	Synchronized and Balanced Collective Formations in Multi-Agent Systems
Mr Abdul Saleem P K	Guidance Laws for Engagement Time Control
Mr K K N Anbuselvan	Magneto- aerodynamic interaction studies in hypersonic shock tunnel
Mr Vijay Panchore	Analysis of Rotating Beam Problems Using Meshless Methods and Finite Element Methods
Mr Suneesh S S	Experimental Studies on the Effect of an Upstream Periodic Wake on a Turbulent Separation Bubble
Mr P Phani Kumar	Effect of a mesh on boundary layer transitions induced by free-stream turbulence and an isolated roughness element
Mr Akhil G	Time-Optimal Guidance Law for Impact Angle Constrained Interception of Moving Targets
Mr Jinraj V Pushpangathan	Design and Development of 75 mm Fixed-Wing Nano Air Vehicle

Mr Saurabh Upadhyay	Continuous-Curvature Path Planning Using Four Parameter Logistic Curves
Mr P Shivashankar	Analytical Modelling and Non-Linear Characterisation Of Piezoelectric Materials for Actuation And Vibration Control Of Beams
Mr Rajendra Kumar Munian	Time Domain Spectral Finite Element Simulation of Ultrasonic Wave Propagation in Composite with Defects

CENTRE FOR ATMOSPHERIC AND OCEANIC SCIENCES

Mr Nirupam Karmakar	Space-Time Evolution of the Intraseasonal Variability in the Indian Summer Monsoon and its Association with Extreme Rainfall Events: Observations and GCM Simulations
Ms Kruthika Eswaran	The Retrieval of Aerosols above Clouds and their Radiative Impact in Tropical Oceans
Mr Govardhan Gaurav Rajabhau	Simulations of Aerosol Species over the Indian Region: Evaluation and Improvements

CENTRE FOR EARTH SCIENCES

Ms M P Revathy	Geodynamics of The India-Eurasia Plate Boundary from Earthquake Source Models: Examples From The Makran, Central Himalaya, Burma, And Andaman-Sumatra Segments
Ms Ritika Kaushal	Stable isotopic composition of rice grain organic matter as an archive of monsoonal climate

CHEMICAL ENGINEERING

Mr Naga Samrat Maruvada V V	Studies in water treatment: defluoridation using adsorption, denitrification using a microbial fuel cell, and contaminant removal using solar distillation
Mr Ayush Agarwal	Pore Forming Toxins; Unravelling Oligomerization Pathways and Related Kinetics
Ms Chalil Simna Manoharan	Engineering the N- glycosylation Pathway in Pichia pastoris for the Expression of Glycoprotein Hormones
Mr Ankit Tyagi	Direct numerical simulations and fluctuating force simulations of turbulent particle- gas suspensions
Mr Jaju Someshwar Jagadish	Multi-scale modelling of lamellar mesophases
Mr S Srinivasa Sandeep	Testing the hypothesis of quorum sensing in Vibrio fisheri: Luminescence, motility and biofilm
Mr Vipul Gupta	Stochastic models suggest guidelines for protocols with novel HIV-1 interventions
Mr Pradeep Nagaraja	Modeling Human Immunodeficiency Virus Transmission And Infection
Mr C Ram Narayan	Non-Catalytic Synthesis of Biolubricant Esters and their Solubilities in Supercritical fluids
Mr Praveen Kumar Bommineni	Molecular Simulation Studies of Cometing Pathways in Crystal Nucleation
Mr Satya Paul Singh Amarthaluri	Synthesis of Thermally Stable Catalysts for Methane Reforming and CO Abatement

CIVIL ENGINEERING

Mr D Harinadha Reddy	Time Dependent Deformations and High Temperature Effects on Different Types of Concrete: Experimental and Numerical studies

Mr R Balagopal	Experimental and Analytical Studies on Damage Detection and Failure Analysis of Transmission Towers and Tower like Structures
Mr T G Parameswaran	Factors Controlling the Dispersivity of Soils and the Role of Zeta Potential
Mr Manohar D R	Characterization of Sand-Rubber Mixture and Numerical Analysis for Vibration Isolation
Mr SoumyadiptaSarkar	Methods on probabilistic structural vibration using stochastic finite element framework
Mr Eswar R	Modelling of Evapotranspiration from satellite data Using semi-empirical models: Applications to the Indian Subcontinent
Ms Lekshmi Suku	Response of Geosynthetic Reinforced Granular Bases under Repeated Loading
Mr Ganesh Dattatrayrao Kale	Detection of Trends in Rainfall of Homogeneous Regions and Hydro-Climatic Variables of Tapi Basin with their Attribution
Ms Shwetha HR	Estimation of Daily Actual Evapotranspiration using Microwave and Optical Vegetation Indices for Clear and Cloudy Sky Conditions
Ms Logeshwari J	Characterization of Deferent Slags for Bulk Geotechnical Applications
Ms Chandra Rupa Rajulapati	Quantification of Uncertainties in Urban Precipitation Extremes
Mr Vivek P	The Behaviour of Granular Materials Under Shock and Blast Loading – A Shock Tube Investigation
Mr Tarun Naskar	Testing of ground subsurface using spectral and multichannel analysis of surface waves
Mr S P Deepu	Non-local continuum models for damage in solids and delamination of composites

CENTRE FOR PRODUCT DESIGN AND MANUFACTURING

Mr Gunti Ranga Srinivas	Applications of Advanced CAE Methodologies to Orthopaedic Implant and Vehicle Occupant Cum Pedestrian Safety Countermeasure Design
Mr Divyanshu Joshi	Analysis of Vehicle Dynamics and Control of Occupant Biodynamics Using A Novel Multi-Occupant Vehicle Model
Mr Khadilkar Pramod Ratnakar	Formulation of a Framework for Needs Analysis and Stakeholders Behavioural Simulation for Design for the BOP
Ms B Santhi	Supporting Real-time, Automated Evaluation of Difficulty in Manual Assembly

CENTRE FOR SUSTAINABLE TECHNOLOGIES

Mr Santhosh L G	Reliability based approach for evaluation of Landfill Designs and Site Selection Using GIS
Mr N C Balaji	Studies into thermal transmittance of conventional and alternative building materials and associated building thermal performance

MATERIALS ENGINEERING

Ms Maya Kini K	Interfacial processes in densification of cubic zirconia
Mr Mithipati Siva Bhaskar	Precipitate Growth and Coarsening in Ternary Alloys
Mr Himalay Basumatary	Structure, Microstructure and Magnetic Properties of Fe-Ga and R-Fe based Magnetostrictive Thin Films
Mr Piyush Vijay Jagtap	Whisker Growth from Electrodeposited Sn Coatings
Mr Allwin Ebinesar J S S	Bioremediation of zinc using Pseudomonas species- Mechanistic studies and biosensing applications
Mr Adarsh K Hegde	Dry sliding wear of Saffil short fibre- reinforced AZ91D Mg-alloy composite

Ms V Ezhilselvi	Development of corrosion protective coating systems for AZ31B magnesium alloy
Mr Pawar Shital Patangrao	EMI Shielding Materials Derived from PC/SAN Blends Containing Engineered Nanoparticles
Ms Suryawanshi Jyoti Balaji	Mechanical and Corrosion Properties of Selective Laser Melted Alloys
Mr Sumanth G	Effect of humidity and temperature on wear of TiN and TiAlN coatings
Ms Megha Sahu	Nanostructured toughening agents for tetrafunctional epoxy composites
Ms Agrawal Priyanka Kantibhai	Dynamic Strain Aging and Creep in near-a Ti Alloy, IMI834
Mr Varun Arvind Baheti	Diffusion – Controlled Growth of Phases in Metal-Tin Systems Related to Microelectronics Packaging
Mr Arka Lahiri	Theoretical and numerical study of microstructure formation in multi-component alloys
Mr Dipak Kumar Khatua	Insights into the influence of electric field on the structural evolution and its correlation with the properties in the lead-based BiScO3-PbTiO3 and the lead-free Na0.5 Bi 0.5 TiO3 based Piezoceramics
Mr Y Raghupathy	Nano Surface Modification for Anti-corrosive and Anti-Biofouling Applications

MECHANICAL ENGINEERING

Mr Midhun Sreekumar Menon	Motion Planning of Flexible One-dimensional Objects and Hyper redundant Robots
Mr Dilip D	Maintaining Underwater Cassie State for Sustained Drag Reduction in Channel Flow
Mr Rammohan Sriramdas	Vibrational Energy Harvesting: Design, Performance and Scaling Analysis
Mr Raviteja Chanumolu	A Novel Hybrid Vehicle Architecture: Modeling, Simulation and Experiments
Mr Sandip Sarkar	Studies on Multiphase, Multi-scale Transport Phenomena in Presence of Superimposed Magnetic field
Mr C S Gurudath	Experimental and Numerical Studies on Phase Shifting in an Inertance Pulse Tube Cryocooler
Mr Venkatesh Kadbur Prabhakar Rao	Experimental studies on extremely small scale Vibrations of Micro-Scale Mechanical and Biological Structures
Mr Boggavarapu V V S U Prasad	Experimental Studies on Biodiesel Spray Characteristics: Effects of Evaporation & Nozzle Cavitation
Mr Amlan Kar	Micro-mechanisms Associated with Friction Stir Welding Aluminum with Titanium
Mr Ajay Dangi	Piezoelectric Micromachined Ultrasound Transducers: From Design to Applications
Mr A R Anand	Investigations on Miniature Loop Heat Pipe with Flat Evaporator
Mr Vinayak Malik	Studies on the Effect of Process Aspects on Material Mixing and Defect Formation in Friction Stir Welding
Mr Deepak Govind Madival	Droplet growth in moist turbulent natural convection in a tube
Mr Hariharan Krishnamurthy	Intent-Driven Correspondence and Registration Of Shapes
Mr Ashith Shyam R Babu	Design and Development Of A Three-Degree-Of-Freedom Parallel Manipulator To Track The Sun For Concentrated Solar Power Towers
Garimella Venkarta Krishna KumarAug 2009	Characterization of Flow Induced Noise Received by an Array Placed at Stagnation Point of an Underwater Axisymmetric Body
Mr Rama Krishna K	Motion Space Analysis of Smooth Objects in Point Contacts
Mr Prahallada J	Blade Flutter in a Linear Cascade: Unsteady Loads and Flow Features in Subsonic and Transonic Flows

Mr Lalit Kumar Bansal	Evaporation and Buckling Dynamics of Sessile Droplets Resting on Hydrophobic substrates
Ms Binita Pathak	Externally Induced Instabilities in Contactless Functional Droplets

CENTRE FOR HIGH ENERGY PHYSICS

Mr Avinash Raju	Aspects of Higher Spin Theories, Conformal Field Theories and Holography

INSTRUMENTATION AND APPLIED PHYSICS

Ms M S Kiruba	Fabrication and Optimization of Yttria stabilized Zirconia thin films towards the development of electrochemical gas sensor
Ms Mamatha Venugopal	A Stochastic Search Approach to Inverse Problems
Ms Chethana K	Design, Development and Validation of Fiber Bragg Grating Sensor Based Devices for Detecting Certain Healthcare Parameters
Mr L L Rajeswara Rao	Design Fabrication and Characterization of Metal Oxide Semiconductor Based MEMS Gas Sensors for Carbon Monoxide Detection
Ms Sri Muthu Mrinalini R	A Probing System with Replaceable Tips for Three Dimensional Nano-Metrology
Mr Sonalikar Hrishikesh Shashikant	Numerical Investigation of Segmented Electrode Designs for the Cylindrical Ion Trap and the Orbitrap Mass Analyzers
Ms Shikha	Development of Fiber Bragg Grating Sensor based Devices for Force, Flow and Temperature Measurement for Emerging Applications in Biomedical Domain
Ms Leema Rose Viannie	Design, fabrication and development of polymer microcantilever for flow rate measurement and thermal actuation
Mr Sumesh M A	Studies on Performance Enhancement of Infrared and Terahertz Detectors for Space Applications
Mr Veerendra kalyan J	Point-of-Care High- throughput Optofluidic Microscope for Quantitative Imaging Cytometry
Mr KP Mohanan	Ultrasound-Assisted Optical Imaging of Mechanical Property Distribution in Tissue-Like Object: Theoretical and Experimental Investigations
Mr Banoth Earu	Absorption Flow-Cytometry for Point-of-Care Diagnostics
Mr S Sathish Kumar	Sputter deposited ZrC and NbC films - Studies on Microstructure, Texture and Hardness

MATHEMATICS

Mr S Nanda Kishore Reddy	Eigenvalues of products of Random matrices
Mr Aiyappan S	Unfolding Operators in Various Oscillatory Domains: Homogenization of Optimal Control Problems
Mr Somnath Hazra	Homogeneous Operators
Ms Prachi Mehrotra	Computational Studies on Structures and Functions of Single and Multi-Domain Proteins
Ms Shweta Srivastava	Stabilization schemes for convection dominated scalar problems with different time discretizations in time – dependent domains
Mr Naveen Kumar Garg	Novel Upwind and Central Schemes For Various Hyperbolic Systems
Ms Ankit Ruhi	Kinetic Theory Based Numerical Schemes for Incompressible Flows

PHYSICS

Ms Manjari Gupta	Studies of Ultracold Bosons in Optical Lattices using Strong – Coupling Expansions
Mr Debayan Dey	Crystal Structures of Native and AdoMet Bound rRNA Methyltransferase from Sinorhizobium meliloti: Structural Insights into rRNA Recognition. Evolutionary, Structural and Functional Studies on Nucleoid-Associated Proteins HU and IHF
Mr Arvind Kumar	Facile and Process Compatible Growth of High-K Gate Dielectric Materials (TiO2, ZrO2 and HfO2) on Si and the Investigation of these Oxides and their Interfaces by Deep Level Transient Spectroscopy
Mr Pradeep AV	Development of a spin-polarized low energy electron diffraction system and investigations on spin-orbit and exchange interactions on Ir(100) and ultrathin Fe(100) grown on Ir(100)
Ms Jem Teresa John	Optical Diffraction Tomography for the refractive index profiling of objects with large space-bandwidth product
Mr Abhale Atul Prakash	Laser Beam Induced Conductance Modulations as a Potential Microprobe in the Investigation of Defects and Inhomogeneities in Bulk Si and Pbs, HgCdTe Quantum Dot Heterostructures
Mr Himanshu Joshi	Understanding DNA– Based Nanostructures using Molecular Simulation
Mr Ansuman Biswas	Structural Studies on Thymidylate Kinase: Evolution, Specificity and Catalysis
Mr Debabrata Pramanik	Polymer Assisted Dispersion of Carbon Nanotubes (Cnts) And Structure, Electronic Properties of CNT – Polymer Composite
Mr Harish Ravi	Experiments on the 852 Nm D2 Line Of 133CS With A Diode Laser System and Their Use In Measurement Of The Permanent Electric Dipole Moment Of The Electron
Mr Yogeshwar Prasad	Studies of "clean" and "disordered" bilayer optical lattice systems circumventing the 'fermionic cooling-problem
Mr Manohar Lal	Investigations and stabilization of vortex states in cobalt and permalloy nanorings in contact with nanowires
Mr Ravi Kiran Saripalli	Structural, optical and electrical studies on multi-functional organic single crystals
Mr Motiur Rahman Khan	Nonlinear charge transport and photo-physical studies in conjugated polymers (P3MeT, P3HT) and their hybrid composites with silver sulfide quantum dots
Mr Soumavo Ghosh	Dynamical imprint of dark matter Halo and interstellar gas on spiral structure in disk galaxies
Mr Paritosh Karnatak	Emergent phenomena from contacts and disorder in high mobility graphene
Mr Tirthankar Chakraborty	Magnetic, electrical and structural properties of doped manganite, ferrite and nickelate perovskites
Mr Soling Yur Zimik Kachui	Dynamics of spiral and scroll waves in a mathematical model for human-ventricular tissue: the effects of fibroblasts, early-after depolarization, and heterogeneities
Ms Roy Arpita	A Study of Superbubbles in the ISM: Break-Out, Escape of LYC Photons and Molecule Formation
Mr Kartick Chandra Sarkar	Fermi Bubbles and galactic outflows in circumgalactic medium
Mr Gopal Hazra	Understanding the behavior of the Sun's large scale magnetic field and its relation with the meridional flow
Mr Subbarao Kanchi	Dendrimer Interactions with Cell Membrane and Pore Forming Toxin

6.11.2 INT. PHD

BIOCHEMISTRY

Ms Supriya VIkas Vartak	Radiation-induced DNA Damage and Repair: Mechanistic Insights into Radioprotection and Sensitization by Endogenous and Exogenous Factors
Mr Deepesh Nagarajan	Computational and experimental approaches to protein design

CENTRE FOR ECOLOGICAL SCIENCES

Ms Pratibha Yadav	Host location in non- pollinating fig wasps of Ficus racemosa: age, oviposition history and the ovipositor

MOLECULAR BIOPHYSICS UNIT

Mr Likhesh Sharma	Modulation of Protein Stability and Function by Cysteine Mutations and Signal Peptides
Mr Subho Ghosh	Biochemical, biophysical and evolutionary perspectives of zinc finger proteins in Mycobacterium smegmatis
Ms Geeta Deka	Structural and Functional studies on Pyridoxal kinase and Pyridoxal 5'-phosphate dependent enzymes
Ms Anindita Das	Theta-band spectral selectivity and gamma-range coincidence detection in spike initiation dynamics of hippocampal pyramidal neurons
Ms Swati Balakrishnan	Solution structure studies on the effects of aromatic interactions and cross-strand disulfide bonds on protein folding

MICROBIOLOGY AND CELL BIOLOGY

Ms Shreya Ahana Ayyub	The Role of Initiation Factor 3: Insights from E.coli, mitochondria and mycoplasma
Mr Ashwin G	Alternate fates of tRNAs in initiation and elongation
Ms Debalina Chaudhuri	Division of the Salmonella containing vacuole and other virulence strategies employed by Salmonella
Ms Mayuri Gogoi	Salmonella pathogensis in dendritic cells: stealthy approach against adaptive immune response

MOLECULAR REPRODUCTION, DEVELOPMENT AND GENETICS

Ms Ananthalakshmy	Deciphering the Mechanisms of AMPK Activation Upon Anchorage-Deprivation
Ms Anisha Ajay Zaveri	Nucleic acid-binding adenylyl cyclases in mycobacteria: Studies on evolutionary & biochemical aspects

INORGANIC AND PHYSICAL CHEMISTRY

Mr Samir Kumar Sarkar	Triarylborane-BODIPY Conjugates: White Light Emission, Multi-color Cell Imaging and Small Molecule Based Solar Cells
Mr Brij Kishore	Electrochemical Investigations Related to the Next Generation Sodium and Potassium Batteries
Mr Ramaraj A	Activation of H-X (X = H, Si,B,C) Sigma Bonds in Small Molecules by Transition Metal Pincer complexes

Ms Saheli Chakraborty	Exploring New Designs of Amphiphilic Graft Copolymers and Forays into 2D Polymers

MATERIALS RESEARCH CENTRE

Ms Priyadarshini Ghosh	Controlled nanoscale growth of 2D materials and their heterostructures

ORGANIC CHEMISTRY

Mr Nilanjan Dey	Engaging Small Organic Molecules and Self-Assemblies for 'Label –Free' Recognition of Biologically Relevant Analytes
Mr Sayantan Chatterjee	Hybrid Nanostructured Materials from Bile acid Derived Supramolecular Gels

SOLID STATE AND STRUCTURAL CHEMISTRY UNIT

MrBanabir Pal	Electronic and Magnetic Structures of Some Selected Strongly Correlated Systems

CENTRE FOR HIGH ENERGY PHYSICS

Mr Apratim Kaviraj	Conformal Bootstrap: Old and New
Ms Oindrila Deb	Studies of Topological Phases of Matter: Presence of Boundary Modes and their role in Electrical Transport
Ms Jayita Lahiri	Direct and indirect search for new physics at colliders

MATHEMATICS

Mr Vikramjeet Singh Chandel	The Pick-Nevanlinna interpolation problem: complex-analytic methods in special domains

PHYSICS

Mr Mohammed Ali Aamir	Impact of disorder and topology in two dimensional systems at low carrier densities
Mr Vineeth Mohanan P	Spin Hall effect mediated current induced magnetization reversal in perpendicularly magnetized Pt/Co/Pt based systems
Mr Haobijam Johnson Singh	Engineering Plasmonic Interactions in Three Dimensional Nanostructured Systems
Ms Sayonee Ray	Topology and quantum phases of low dimensional fermionic systems
Mr Kallol Roy	Optoelectronic properties of graphene based van der Waals hybrids
Mr Sandip Mondal	Fully Solution Processed Flash Memory

6.11.3 MASTER OF SCIENCE, MSC (ENGINEERING)

CENTRE FOR EARTH SCIENCES	
Mr N Ghanesh	MHD waves driven by small-scale motion and implications for the Earth's core

CENTRE FOR NEUROSCIENCE	
Mr Venkatapathy K	The role of Cytoskeletal Morphology in the Nanoorganization of Synapse

MOLECULAR BIOPHYSICS UNIT	
Mr Divyaratan Popli	Effect of ultrasound on neuronal network communication
Mr Sanmoy Basak	NMR Structural Studies on the Harmonin-N-like Domin 2 of Human RTEL1
Ms Disha Mohan Bangalore	Crystallization and preliminary structural studies on Mycobacterium tuberculosis RuvX

MICROBIOLOGY AND CELL BIOLOGY	
Ms Veena Subramanian	Role of SirT6 In Myofibroblast Cell Death

MATERIALS RESEARCH CENTRE	
Mr Rahul Kumar Upadhyay	Development of Polyethylene Grafted Graphene Oxide Reinforced High Density Polyethylene Bionanocomposites

COMPUTER SCIENCE AND AUTOMATION	
Mr Siddartha Y R	Learning Tournament Solutions from Preference-based Multi-Armed Bandits
Mr Danda Sai Koti Reddy	Stochastic Newton methods with enhanced Hessian estimation
Mr Vinay V Vasista	Automatic optimization of Geometric Multigrid Methods Using A DSL Approach
Mr Prakhar Ojha	Utilizing Worker Groups and Task Dependencies in Crowdsourcing
Mr Sridhar G	Efficient Whole Program Path Tracing
Mr Aritra Chattaerjee	A Study of Thompson Sampling Approach for the Sleeping Multi-Armed Bandit Problem
Mr Ajith S	Fast Actively Secure OT Extension for Short Secrets
Mr Datta Krupa R	Generalization of Hitting, Covering and Packing Problems on Intervals
Mr Nitesh Chandra Upadhyay	Large Scale Graph Processing in A Distributed Environment
Ms Sneha Mondal	A Referral Reward Embedded Bi-Phase Information Diffusion Technique for Social Networks
Mr Abhijat Sharma	An Improved Lower Bound for Depth Four Arithmetic Circuits
Ms Rashmi Balasubramanyam	Supervised Classification of Missense Mutations as Pathogenic or Tolerated using Ensemble Learning Methods
Mr Anurita Mathur	On the gap between outcomes of voting rules
Mr Indranil Bhattacharyya	Feature Selection under multicollinearity and Causal Inference on Time Series
Mr Sumant Hegde	An improved lower bound for multi-r-ic depth four circuits as a function of the number of input variables
Ms Parita Shamiibhai Patil	Compilation of Graph Algorithms for Hybrid, Cross-Platform and D1stributed Architectures
Mr Mayank Tiwari	Fully Resilient Non-Interactive ID-Based Hierarchical Key Agreement
Mr Shyam Sankaran	A Fine-Grained Dynamic Information Flow Analysis for Android Apps
Mr Nikhil Gupta	Towards a characterization of the symmetries of the Nisan-Wigderson polynomial family

Mr Adarsh D Patil	Heterogeneity Aware Shared DRAM Cache for Integrated Heterogeneous Architectures
Mr Girijanandan Nucha	Computing Contour Trees for 2D Piecewise Polynomial Functions
Mr Akash Anil Valsangkar	An Exploratory Framework for Cyclone Identification and Tracking

ELECTRICAL COMMUNICATION ENGINEERING

Mr Vinayak R	On Codes for Private Information Retrieval and Ceph Implementation of a High-Rate Regenerating Code

ELECTRICAL ENGINEERING

Mr Subhash Chandran K S	Analysis of Local Field Potential and Gamma Rhythm Using Matching Pursuit Algorithms
Ms Yamini Devi S D	Fractal Encoding for Inpainting and Secure Image Sharing
Mr Anurag A Devadiga	Lightning Shielding Failure analysis of Ultra high Voltage Power Transmission Lines
Mr Dibakar Das	Control Strategies for Seamless Transition between Grid Connected and Islanded modes in Microgrids
Mr Adhip	Active power flow tracing for preventive control in deregulated power systems
Mr Rajat Sanyal	On a Divide-and-conquer Approach for Sensor Network Localization
Mr Rahul Chakraborty	Studies on Silicone Rubber Insulators used for High Voltage Transmission
Ms Narmada Naik	Real time Face Recognition on GPU using OPENCL

COMPUTATIONAL AND DATA SCIENCES

Mr Suraj Srinivas	Learning Compact Architectures for Deep Neural networks
Mr Anshu Shukla	Benchmarking and Scheduling Strategies for Distributed Stream Processing
Mr Puneet Jain	Error Estimation for solutions of linear systems in Bi-Conjugate Gradient Algorithm

AEROSPACE ENGINEERING

Mr Rahul Gupta	Influence of chemical coating on droplet impact dynamics
Mr Swastik Samantaray	Robust Adaptive Control of a Laser Beam System for Static and Moving Targets
Mr Manu Kamin	A numerical study of changes to flow organization and their prognostic measures
Mr Jai Kiran E	Modeling of Contact in Orthotropic Materials using Variational Asymptotic Method
Mr Varghese Albin Bab Marykutty	Mixing Enhancement Studies on Supersonic Elliptic Sharp Tipped Shallow (ESTS) Lobed Nozzles
Mr P Shivakanth Chary	Linear stability models for reacting mixing Layers
Ms Viverjita U	Edge-Effect of Semi-Infinite Rectangular Posts on Impacting Drops
Mr Sukhendu Sekhar Manna	A Study on The Effect of Inhomogeneous Phase of Shape Memory Alloy Wire
Mr Kiran S	A Ghost Fluid Method for Modeling Liquid Jet Atomization
Mr Sachin Shriwastav	Negotiator Initiated Connectivity Restoration in Partitioned Wireless Sensor Networks

CENTRE FOR ATMOSPHERIC AND OCEANIC SCIENCES

Mr Vijay Kumar	Installation and Operation of Air-Sea Flux Measuring System On Board Indian Research Ships

CHEMICAL ENGINEERING	
Mr Vemparala Bharadwaj	Unravelling the Evolutionary Advantages of Crosstalk Between Two-Component Signalling Systems of M. Tuberculosis
Mr Kaushal Verma	Molecular simulation study of Electric double Layer Capacitor with aqueous electrolytes
Mr Vishnu Venugopal	Modelling How Refractoriness to Interferon Compromises Interferon-Free Treatment of Hepatitis C Virus Infection

CIVIL ENGINEERING	
Ms Manju M A	Numerical investigation of Masonry Infilled RC Frames Subjected to Seismic Loading
Ms Nimisha Roy	Shape Characterization of Granular Particles Using Image Based Techniques
Ms V Svetha	Numerical Modelling of Reinforced Concrete Structural elements and Assemblages Exposed to Thermo- mechanical Loading
Mr Mandeep Raj Pandey	Contaminant Transport Through Soil and Effect of Bentonite and super-Absorbent Polymer on Transport Parameters

CENTRE FOR PRODUCT DESIGN AND MANUFACTURING	
Mr Rahul Kanyal	The effect of mismatch of total knee replacement components with knee joint: A finite element analysis
Ms Prabha Samudre	Manufacture and Evaluation of Cast Aluminum Foam Heat Exchangers
Mr Vineeth Muralidharan	Development of Multipoint Haptic Device for Spatial Palpation
Mr Anshul Mittal	Mechanical Characterization of Adhesively Bonded Jute Composite Joints Under Monotonic and Cyclic Loading Conditions

MECHANICAL ENGINEERING	
Mr Varun S	Numerical simulation of a high-speed jet injected in a uniform supersonic crossflow using adaptively redistributed grids
Mr Bishnu Sanghai	Techno-Economic Evaluation of Rooftop Photovoltaic Systems in the Indian Context
Mr Nidhil Mohamed A R	Influence of hydrodynamic slip on the wake dynamics and convective transport in flow past a circular cylinder
Mr Shoham Sen	Simulation and Study of Noise Generated due to Turbulent boundary Layer in Towed Hydrophone Array
Mr Shounak Bhattacharya	Design, analysis, Simulation and Experimentation of a Flexible Spine Quadruped
Mr S Koushik	Estimation of Stress Concentration and Stress Intensity Factors by A Semi-Analytical Method

INSTRUMENTATION & APPLIED PHYSICS	
Mr Aritra Chatterjee	Design of a Vortex Tube Based Refrigeration System
Mr Mani Ratnam Rai	Fringe Projection Technique for Deformation Measurements under Impact Loading

MATHEMATICS	
Mr Bharath Kumar Ethamukula	Asymptotic lower bound for quasi transitive codes over cubic finite fields
Mr Sayatan Maitra	The Space of metric Measure Spaces

PHYSICS	
Mr Ojasvi Khare	Edge States and Effects of Disorder in Finite Graphene Sheets
Mr Mohd Ibrahim	Experimental and Molecular Dynamics Simulation Study of Viscosity of Polymer Nanocomposites

7 EVENTS

7.1 INSTITUTE LECTURES

The Institute has organized the following Centenary, Memorial, Endowment, Institute lectures during the year:

IISc CENTENARY LECTURE

- IISc Centenary Lecture on "Cycles of Invention and Discovery: Rethinking the Endless Frontier" by Prof. Venkatesh Narayanamurti, Benjamin Peirce Research Professor of Technology and Public Policy, Cambridge, on 21st March, 2018.
- IISc-DST Centenary Lecture on "Meeting the Clean Energy Demand with Nanotechnology" by Prof. Prashant V Kamat, Department of Chemistry & Biochemistry and Radiation Laboratory, University of Notre Dome, Notre Dome, on 12th December, 2017.

PROF CNR RAO ENDOWMENT LECTURE

- Prof. C N R Rao Endowment Lecture on "Precise Chemical, Physical and Electronic Nanoscale Contacts" by Prof. Paul S Weiss. UC President Chair, Distinguished Professor of Chemistry and Biochemistry, UCLA, USA on 7th December, 2017.

INSTITUTE SPECIAL LECTURE

- Prof. A. Srikrishna Memorial Lecture on "Molecular Complexity and Diversity from Aromatics: Concept, Strategy and Reality" by Dr Vishwakarma Singh, FNA, Professor of JC Bose National Fellow, Department of Chemistry, IIT, Mumbai, on 5th February, 2018.

GOLDEN JUBILEE LECTURE

- IISc Golden Jubilee Lecture on "Financial Crises-why they occur and what to do about them?" by Prof. Eric Maskin, Harvard University, on 26th February, 2018.

SIR VITHAL N CHANDAVARKAR MEMORIAL LECTURE

- Sir Vithal N. Chandavarkar Memorial Lecture by Ambassador Nirupama Rao, The Watson Institute, Brown University On "Asian Geopolitics Today" on 6thJune, 2018.

IISc-SID ENDOWMENT LECTURE

- IISc-SID Business Leader Lecture on "More and Cleaner Energy: Challenges to Science and Engineering" by Prof. Dirk Smit, Chairman, Shell Science Council, Netherlands, on 4th September, 2017.

SPECIAL LECTURE

- M J Thirumalachar & M J Narasimhan Memorial Lecture on "The cyro EM revolution in structural biology" by Dr. Richard Henderson, MRC Laboratory of Molecular Biology Cambridge, UK on 23rd January, 2018.
- M J Thirumalachar & M J Narasimhan Memorial Lecture on "Gene Therapy: It works" by Prof. Inder Verma, Irwin & Joan Jacobs Chair, In Exemplary Life Science, American Cancer Society, Professor of Molecular Biology, USA, on 9th January, 2018.

INSTITUTE COLLOQUIUM

- Institute Colloquium by Prof. Jayant M Modak, Deputy Director, Professor Department of Chemical Engineering, on 17th April, 2017, about "Modelling for Industrial Biotechnology".
- Institute Colloquium by Prof. Tushar Kanti Chakraborty, Dept. of Organic Chemistry, on 12th October, 2017 on "Synthesis of Natural Products today and the Challenges of Tomorrow".
- Institute Colloquium by Prof. G K Ananthasuresh, Dept of Mechanical Engg., on "Bistability" on 30thOctober, 2017.
- Institute Colloquium by Prof. V Venkataraman, Dept of Physics, on "New ways to Probe Electronics in Semiconductors" on 29th November, 2017.
- Institute colloquium by Prof. B Gurumoorthy, CPDM and Dept of Mechanical Engineering, on "Product information models in PLM" on 25th January, 2018.
- Institute Colloquium by Prof. Vinod Sharma, Dept of Electrical Communication Engineering, on "Modelling and analysis of communication systems with energy harvesting" on 23rd March, 2018.

7.2 CONFERENCE/ SYMPOSIA/ SEMINARS/ 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:

BIOLOGICAL SCIENCES

- Indo-French Conference on "Recent Advances in Genome Integrity and Plasticity", December 4-5, 2017 (BC)
- International School on Radiation Research (ISRR-2017), February 2-4, 2017 (BC)
- Lecture workshop on "Recent Advances in Life Sciences", February 22-23, 2017 (BC)
- Lecture workshop on "Recent trends in Biological Sciences", March 9-10, 2017 (BC)
- National conference on "Perspectives in Malaria Research and Growth of Biotechnology in India" March, 23-24, 2018 (BC).
- Indo-US conference on Transcription Chromatin Structure, DNA repair and Genomic Instability", March, 6-10, 2018 (BC).
- Machine learning techniques and their applications in ecology, 23-25 October 2017 (CES)
- Young Scientists Meeting on effect of climate change on biodiversity, 27-28 Oct 2017 (CES)
- Workshop on the NATCOM3: Report Chapter on Forests and Biodiversity, 27 Nov 2017 (CES)
- Nature Science Internship Programme, venue: CCE Lecture Hall, IISc, 18-19 Nov 2017 (CES)
- Workshop on Role of Students in Coastal Ecosystem Management - Government Highscool (Urdu), Kumta, Uttara Kannada district, 18-Sep-2017 (CES)
- Workshop on Role of Students in Coastal Ecosystem Management - Janata Vidyalaya, Kumta, Uttara Kannada, 12-Sep-2017 (CES)
- Workshop on Role of Students in Coastal Ecosystem Management - Shri Ramanath High School, Kumta, 11-Sep-2017 (CES)
- Nature Science Internship Programme, Venue: Adamya Chetana, 22, 23 July 2017 (CES)
- Workshop on Microbiology at Shri Dharmastala Manjunatheshwar college, Honnavar, 21-July-2017 (CES)
- World Environment Day-2017 - Connecting People to Nature (Coastal Environment), 06-Jun-2017 (CES)
- Workshop on Mega-Regional Development and Environmental Change in China and India, 7-14 May 2017 (CES)
- Workshop on rejuvenation and conservation of lakes in Bengaluru: Sujala - Water for Bengaluru an initiative from Arekere Lake, 1 April 2017 (CES)
- World Wetlands Day, Aghanashini High School, Kumta, U.K. District, 2 Feb 2017 (CES)
- DST-SERB School in Chemical Ecology, NCBS, Bangalore, 3-16 July 2017 (CES)
- Student Conference on Conservation Science – Bengaluru, 21-24 September 2017 (CES)
- Second Annual Meeting on Infectious Disaeses, 23rd November 2017 (CIDR)
- Second Annual Workshop on Biorisk preparedness in laboratory setting, 22 Dec 2017 (CIDR)
- Gordon Research Conference, Jul-2017 (CIDR)
- Wellcome Trust-UK meeting, Jul-2017 (CIDR)
- GIAN workshop on Tuberculosis Drug Development, Dec-2017 (CIDR)
- Hands on Workshop on Neurolucida, May15-17, 2017 (CNS)
- Neuromorphic Cognitive Computing, Oct 4, 2017 (CNS)
- Advanced workshop on single molecule based localization microscopy, Oct 31-Nov 2, 2017 (CNS)
- Elettra Beamlines Awareness Program, August 13-14, 2017 (MBU)
- International Union of Crystallography computational Crystallography School, August 15- 20, 2017 (MBU)
- Brain Computation and Learning, January 9–13, 2017 (MBU)
- Computational Approaches to Memory and Plasticity, July 19 - August 3, 2017 (MBU)
- Executive Committee Meeting of the International Union of Biochemistry and Molecular Biology, 7-11, September 2017 (MBU)
- Guha Research Conference, 2 -6, December 2017 (MBU)
- JCBN, Carbohydrate, Enzyme & Biochemical Nomenclature Committee meetings 2017, 7-12, May 2017 (MBU)
- EC Meeting and attendance to 50th Miami Winter Symposium 2017, 20-26, Jan 2017 (MBU)
- Autophagy: cellular mechanisms and significance in health and disease, 11-13 Dec 2017 (MCB)
- Academy Symposium, Christ University, 22nd-23rd May,2017 (MCB)
- Science Academies: Refresher course for college teachers. "Advances in molecular biology", December 8-22, 2017 (MCB)
- 42nd Annual Meeting of the Indian Society of Human Genetics & International Symposium on Trends in Human Genetic Research & Management (ISHG2017), 2-4 March, 2017 (MRDG)
- Recent advances in Genetics and Genomics, 13-14 Nov, 2017 (MRDG)
- Collective dynamics of-, on- and around filaments in living cells: motors, maps, tips and tracks, 28 Oct, 2017 to 2 Nov, 2017 (MRDG)

- First Indo-Australian Symposium on "Epithelial-Mesenchymal Transition"- New advances in cancer development, 6 Oct, 2017 (MRDG)
- Chetana Winter Programme for Empowering Girls in Technology, Dec 16 – 22, 2017 (MRDG)

CHEMICAL SCIENCES

- Indo-US Bilateral Workshop on Organometallic Chemistry: From Fundamentals to Applications, Dec 7-10, 2017 (IPC)
- Recent Advances in Chemistry, 4-5 July (IPC)
- Indo-Japan Joint Symposium, 42767 (IPC)
- KAUST Research Conference, 42771 (IPC)
- IISc-Georgetown University Joint Symposium, August 25-26, 2017 (IPC)
- 66th SPSJ Symposium on Macromolecules, September 22-24, 2017 (IPC)
- IUPAC-FAPS 2017, October 10-14, 2017 (IPC)
- Spectroscopy and Dynamics of Molecules and Clusters, 16th-19th February 2017 (IPC)
- 90 Year of Raman Effect: Current Status and Future Directions, 27th Feb to 2nd March 2018 (IPC)
- 7th Asia Pacific Nuclear Magnetic Resonance Symposium, 16-19 February 2017 (NMR)
- Peptides - Natural and Designed - An NMR Point of View, 11th July 2017 (NMR)
- Prof. D.K. Banerjee Memorial Award Lecture, 5th Feb 2018 (OC)
- Pfizer Endowment Lecture, 5th Feb 2018 (OC)
- Prof A. Srikrishna Memorial Lecture, 5th Feb 2018 (OC)
- Recent Advances in Computational Chemistry, 4th Dec 2017 (SSCU)
- Elettra Awareness Programme Meeting, 13, August 2017 (SSCU)
- A Discussion meeting on Recent Advances in Molecular simulations, 8-11th Feb 2018 (SSCU)
- Parallel computing using MPI, 28th Feb 2018 (SSCU)
- Workshop on Accelerator based photon sources as a versatile tool to probe matter: Present scope and outlook from, 27-29th March 2018 (SSCU)

ELECTRICAL SCIENCES

- 18th International Conference on Cryptology in India (INDOCRYPT) 2017, 10-13th Dec (CSA)
- 2nd Workshop on Analysis and Inference from UGC, 9-10th October (CSA)
- 9th Forum for Information Retrieval Evaluation, 9-10th December (CSA)
- The role of Assistive Technologies in Autism Spectrum Disorder, 30th May 2017 (CSA)
- Conference, Deepak D'Souza (15th Intl Symposium on Automated Techniques for Verification and Analysis, Pune, India)
- 1st Winter School on Program Analysis, Dec 11-16 2017 (CSA)
- Neuromorphic Cognitive Computing, 4th Oct 2017 (CSA)
- Cyber-Physical Systems, July 19-21, 2017 (CSA)
- First Workshop on Brain, Computation, and Learning, January 9-13, 2017 (CSA)
- QIP Course on Game Theory and Mechanism Design, April 10-14, 2017 (CSA)
- Workshop on AI for Social Good, April 17-18, 2017 (CSA)
- EECS Symposium, April 7-8, 2017 (CSA)
- Workshop on AI for Social Good, October 17-18, 2017 (CSA)
- Thirteenth International Conference on Web and Internet Economics, Dec 17-20, 2017 (CSA)
- IEEE and ACM SIGSOFT International Conference on Software Engineering, Demo Track, May 20-28, 2017 (CSA)
- IISc – IACR school of cryptology, 4 – 8th January 2018 (CSA)
- Second Workshop on Brain Computation and learning (BCL2), 8 – 12th January 2018 (CSA)
- Research to Impact, Nov 2017 (ECE)
- Technical Program Committee Member for 2017 IEEE Information Theory Workshop (ITW 2017), Nov 2017 (ECE)
- Cisco-IISc Miniworkshop at Cisco India Pvt. Ltd., Oct-2017 (ECE)
- International Symposium on Cyber-Physical Systems, Jul 2017 (ECE)
- Indo-French Workshop on MIcrowave Nanotechnology, Jul. 2017 (ECE)
- Technical Paper Committee, IEEE International Symposium on Information Theory, Jul. 2017 (ECE)
- Topics in Control, Operation and Protection of Power Systems, April 10 - 14, 2017 (EE)
- Asia-Pacific Power and Energy Engineering Conference 2017, Nov 8-10, 2017 (EE)
- Teaching workshop on DC Machines and DC Drives, 1 - 5th January, 2018 (EE)
- CCE AICTE QIP Short Term Course (EE)
- QIP in Electronics Systems Packaging, January 16-20, 2017 (ESE)
- Technology Development and Reliability of Future Nanoelectronic Devices, 22nd May, 2017 (ESE)
- 2nd India ESD Workshop, 18th March,2017 (ESE)

INTERDISCIPLINARY RESEARCH

- BSSE Annual Research Symposium 2018, 24- 28 Jan 2018 (BSSE)
- A short course on Bioengineering, 22-23rd Jan 2018 (BSSE)
- Advances in Atomic Force Microscopy Imaging Techniques and Capabilities, 20-21 July 2017 (BSSE)
- Colloquium on Integarted Science Education, 18th Aug 2017(CCS)
- Computational Science Symposium, 16-18 Mar 2017 (CDS)
- Data Science Symposium (DSS) 2017, 24-25 February 2017 (CDS)
- Think Nano 2017, Sept.14-17, 2017 (CeNSE)
- "Advanced Micro / Nano Fabrication and Characterization Techniques" for DMRL scientists, 10-24 May (CeNSE)
- Pressure Sensor Fabrication" for NPOL and RIC scientists, 22-28 May (CeNSE)
- Overview of PMUT" for NPOL and RIC scientists, 20-25 Nov (CeNSE)
- IEEE workshop on Women in Science and Engineering 2017, 12 & 13 January 2017 (CeNSE)
- Flair Introductary Workshop on Nano Fabrication technologies, 17 to 20 Jan 2017 (CeNSE)
- 2nd Evaluation & Presentation Workshop of Vishvesvaraya PhD Fellows, 20 and 21 February 2017 (CeNSE)
- RAITH Workshop on Nanolithography and Nanofabrication, 16 and 17th May 2017 (CeNSE)
- NSNST Workshop, 2nd to 4th July 2017 (CeNSE)
- Eighth ISSS International Conference on Smart Materials, Structures & Systems, 5th to 7th July 2017 (CeNSE)
- One Day Technical Workshop of Young Faculty Research Fellows of the Visvesvaraya PhD Scheme, 28th Jul 2017 (CeNSE)
- Introductory Training Course in Nanofabrication Technologies (For neighbouring countries) 17 August - 01 September 2017 (CeNSE)
- Familiarization Workshop, conducted at IIT, Roorkee, 27-28 Ap, 2017 (CeNSE)
- Hands-on Training workshops at CeNSE in 2017: 7-15 February, 16-26 May, 13-23 June, 18-28 July, 12-22 September, 14-24 November, 28-30 November.
- Workshop on Ecosystem for High Technology Start-Ups, 21st April 2017 (MS)
- Ecosystem for Tech Start-Ups in India and Japan, 2-4 May 2017 (MS)
- Panel of Discussion on GST towards a Unified Indian market, 15th September 2017 (MS)
- The 17th Consortium of Students in Management Research, 20-21 Nov 2017 (MS)
- DAAD - Workshop, 27-29 Nov 2017 (MS)
- India-UK Workshop on Data Sciences, 26-27 Feb 2017 (RBCCPS)
- Symposium on Smarter Cities, 10-11 March 2017 (RBCCPS)
- CPS Day - Presentations of supported Master students and faculty, 21 June 2017 (RBCCPS)
- Cyber-Physical Systems Symposium (CyPhySS), 19-21 July 2017 (RBCCPS)
- ICPS Review Meeting, 03 Oct 2017 (RBCCPS)
- Research to Impact, 13-14 November 2017 (RBCCPS)

MECHANICAL SCIENCES

- National Workshop on 'Combustion Research in Aerospace Applications', 21-09-2017 (AE)
- System Identification and Parameter Estimation, 17-12-2017 (AE)
- Advances and Success Stories of Robust and Adaptive Control, 8-9 Sept. 2017 (AE)
- National Round-table Discussion on Geoengineering and India: Science and Policy, 23rd June 2017 (CAOS)
- INCOMPASS meeting, 29-31 March 2017 (CAOS)
- Short course on "Challenges and Advances in Planetary Science" (CAPS 2017), 18-22 September 2017 (CEaS)
- JFM Symposia: From Fundamentals to Applied Fluid Mechanics, 13-14 December 2017 (CEaS)
- Applications of IoT in Contemporary Civil Engineering, November 28-29, 2017 (CIE)
- Design flood estimation and reservoir operations, 16 – 18 August, 2017 (CIE)
- Surge analysis and design of surge protection systems, 19-21 January 2017 (CIE)
- Surge analysis and design of surge protection systems, 20-22 July 2017 (CIE)
- Sustainable Mobility Solutions for Bangalore – Bridging Research and Practice, 28-May-2017 (CIE)
- Monsoon Schoool on Urban Floods, 3-8 July 2017 (CIE)
- JAIST-IISc Workshop 2017, 07-Mar-2017 (CPDM)
- ICoRD17, India, 9-11 Jan 2017 (CPDM)
- ICED'17, Canada, 21-25 August 2017 (CPDM)
- Ist Inclusive Manufacturing Forum, NIAS, India, 5-7 April 2017 (CPDM)
- Ripples 2017, 3-5 March 2017 (CPDM)
- CPDM Research Seminar Series, 2017 (CPDM)
- Biotech Ignition Grant 11 (BIG 11) Mentoring Seminar for Entrepreneurs and Innovators, 17-Jul-2017 (CPDM)
- Reimaging Waste Hackthon, 11-14 August 2017 (CPDM)
- National Science day Celebaration, 28-Feb-2017 (CPDM)
- CPDM Alumni Reunion, 16-Dec-2017 (CPDM)
- DesIC Workshop, 2017 (CPDM)

- Design for School Workshop, 2017 (CPDM)
- Time2Leap Summit, 09-Dec-2017 (CPDM)
- CAD to Product for Chetana Program at CPDM, 21-Dec-2017 (CPDM)
- GCRF India Plastics in Society Workshop, CPDM, 28-29 March 2018
- Ripples 2018, CPDM, 09-11 March 2018
- EMeDS (Emergency Medical Delivery Systems: Integrating Unmanned Aerial Vehicles, CPDM, 5-7 March 2018
- 11th Workshop on "Low carbon materials and building systems", 13 - 18 Feb. 2017 (CST)
- 12th Workshop on "Low carbon materials and building systems", 24 - 29 July 2017 (CST)
- Training Program on Fuel-efficient wood burning devices, 22 – 26 March 2017 (CST)
- Fuel-efficient ASTRA Agro-processing Dryer, Construction & Usage, 24-27 Mar 2017 (CST)
- Hands on training workshop on stabilized soil blocks for buildings, 3rd June 2017 (CST)
- ASTRA Fuel Efficient Large Stove construction training programme, 19 - 23 Sep 2017 (CST)
- ASTRA Fuel Efficient Large Stove construction training, 24 - 26 Oct 2017 (CST)
- Training Programme on stabililzed soil blocks and new sanitation units, 27 - 28 Oct 2017 (CST)
- 13th Workshop on "Low carbon materials and building systems, 19 - 24 Feb 2018 (CST)
- "National Conference on Himalayan Cryosphere-2017 ", 23-24 January 2017 (DCCC)
- One day Workshop on Future earth and its vision, 02-Feb-2017 (DCCC)
- Workshop on "Aethalometer intercomparison experiment", 3-4 April 2017 (DCCC)
- 'Training on Glacier, Climate Change and Remote Sensing", 19-30 June 2017 (DCCC)
- South Asia Reginol Workshop on "Future Earth", 20-21 July 2017 (DCCC)
- Workshop on "Water Challenges and Solutions in India, with focus on Urban Water", 31 July – 1 August 2017 (DCCC)
- Workshop on the "Performance and potential of wind energy systems in India", 22-23 August 2017 (DCCC)
- Eleventh Jeremy Grantham Lecture on Climate Change "Too Late for the Paris Targets ", 14 September 2017 (DCCC)
- "Climate Change Quiz 2017", 14 September 2017 (DCCC)
- "IISc -Dutch Joint workshop on Climate Science", 18th September 2017 (DCCC)
- "12th Jeremy Grantham Lecture on Climate Change" - Undersatanding of Weather and Climate from Global-to-Regional Scales, 7th November 2017 (DCCC)
- International Ocean Discovery Program (IODP) Expedition, 6-8 November 2017 (DCCC)
- Project Appraisal Monitoring Committee (PAMC) of MoES, 23rd November 2017 (DCCC)
- 13th Jeremy Grantham Lecture on Climate Change "Thriving on our Changing Planet: New Spaceborne observations of the Water Cycle", 22nd February 2018(DCCC).
- Seminar on "Anthropocene Changes in large river systems and their impact on coastal processes", 20th February 2018(DCCC).
- Meeting on Consultation of "Second order Draft of IPCC Special Report on Impact of Global Warming of 1.5o C", 12th February 2018(DCCC).
- 30th Annual Students Symposium, 19-20 Jan 2017 (MT)
- International conference on texture, micro-texture and mechanical behaviour, 13th -15th Feb, 2017 (MT)
- Mechanics, Physics and Mechanisms of Ductile Failure, June 18-23, 2017 (ME)
- Plastic deformation and failure mechanisms in notched nano-scale metallic glass specimens., Jan 4-7, 2017 (ME)
- Tensile deformation behaviour of notched nano-scale metallic glass specimens., 26th Feb to -2nd March, 2017 (ME)
- Ductility Enhancement Strategies in Bulk Metallic Glasses: Insights from Continuum Simulations., June 18-23, 2017 (ME)
- Finite element simulations of void growth and coalescence in Mg single crystals., Sep.2-4, 2017 (ME)
- Internal Combustion Engines, 27th Nov, 2017 to 1st Dec 2017 (ME)
- Chairing of a Planary Session, Dec 15-17, 2017 (ME)
- Experimental Studies on Non-Evaporating and Evaporating Sprays of n-Dodecane and n-Hexadecane, July 25-28, 2017 (ME)
- Integrative Modelling of Soft Tissue Mechanobiology, April, 2017 (ME)
- 5th World International Conference, October 11-12, 2017. (ME)
- National Level Two Day Seminar on Biofuel-Opportunities and Challenges, Mar 16-17, 2017 (ME)
- Vibration Analysis Concepts - Hand Calculations and FE Analysis, 16th – 17th Feb (ME)
- Second International conference on sustainable energy, 31-12 2017 to 03-01-2018 (ME)
- GIAN course on Atomization and Sprays for Gas Turbine Applications, 12-17th Nov, 2017 (ME)
- Fluids Day Symposium, 12th December 2017 (ME)
- JFM Symposium, 13th December 2017 (ME)

PHYSICAL AND MATHEMATICAL SCIENCES

- CHEP In-House Symposium, 4 February 2017 (CHEP)
- Brain-storming Workshop on Quantum Computation, Information, Communications and Cryptography, 22-23 July 2017 (CHEP)

- School and Workshop on Geometry and Physics of Modulli Spaces, 20 - 31 Mar 2017 (MA)
- 2017 Annual Conference of Indian Women and Mathematics, 13 - 15 Jul 2017 (MA)
- Workshop in Harmonic Analysis, 11 - 16 Dec 2017 (MA)
- Discussion Meeting in Harmonic Analysis, 18 - 21 Dec 2017 (MA)
- ICTS Discussion Meeting on Surface Groups and Geometric structures, 27 - 30 Nov 2017 (MA)
- International Linear Algebra Society 2017 Meeting: Invited Mini-symposium on Linear Algebra and Positivity with Applications to Data Science (Iowa State University, Ames, USA), 24 - 28 Jul 2017 (MA)
- Lectures on Probability and Stochastic Processes XII, 15 - 19 Dec 2017 (MA)
- ICTS Workshop and Conference on Large Deviations Theory in Statistical Physics, 14 Aug - 13 Oct 2017 (MA)
- Indian Women and Mathematics: Regional Workshop, 6 - 7 Feb 2017 (MA)
- THE FINAL INDO-EUROPEAN CONFERENCE ON MODULI, Dec 11 - 15, 2017 (MA)
- School and Workshop on Geometry and Physics of Moduli Spaces, Mar 20 - 31, 2017 (MA)
- Analysis and Probability, Mar 6 - 7, 2017 (MA)
- Hilbert Modules in Analytic Function spaces, May 22 - 26, 2017 (MA)
- The third Indo-Russian meeting in probability and statistics, 8-12 January 2018 (MA)
- 7th Indo–Israeli meeting on frontiers in condensed matter physics, 17-10 Oct 2017 (PHY)
- 1st NTU-IISc bilateral symposium, 17-04-2017 (PHY)
- 10th India-Singapore Joint Physics Symposium, 24-26 Feb 2017 (PHY)
- Geometrical and Statistical Fluid Dynamics (at the Simons Centre for Geometry and Physics, Stony Brook University, USA, 11-17 October 2017 (PHY)
- Correlations and Disorder in Classical and Quantum Physics, 29th May - 2nd Jun 2017 (PHY)
- Discussion Meeting on Soft matter and fluids, 17-19 Feb 2017 (PHY)
- Inhouse Symposium, Department of Physics, IISc, 17-18 Nov 2017 (PHY)
- Stochastic Thermodynamics, Active Matter and Driven Systems, 07-11 Aug 2017 (PHY)
- Conference on plasma simulations, 18 – 19th Jan 2018 (PHY)

8

OTHER INSTITUTE UNITS

8.1 CCMD

Estate Management is done by the Centre for Campus management (CCMD), which look after maintenance of all the buildings, infrastructural needs, electrical requirements, and construction of new buildings, maintenance of water supply, sanitation and maintenance of roads. The overall improvements in the campus maintenance also come under the purview of Centre for campus management.

CCMD takes care of Main building, residential quarters, Departments, Guest House, Hostels, Mess, Gymkhana, Health Centre, Faculty club. Tata Memorial club and all central Amenities – such as Restaurants, etc.

Electrical breakdown, Generators, Transformers, High Tension Wires, Low Tension Wires, Water supply and sanitation are addressed within 24 hours.

CCMD also look after the Sewage Treatment Plant (STP), which recycles sewage water. This Recycled water is used for gardens and flush tanks.

24 hours Maintenance and Service Centre is available to attend minor complaints.
During the year 2017-18, the works completed, work in progress and new initiatives are as follows: -

Works completed from April 1, 2017 to March 31, 2018

Sl.No.	Description of Works	Cost(Rs.in lakhs)	Area in Sq.Mtrs.
1.	Construction of New Block for Electronics and Communication Engineering Department	643.93	3206.00
2.	Director's Office Renovation & Interior works.	65.00	
3.	Modification of 'C' Mess including adding new patio and Annexe	275.57	--
4.	Establishment of 0.5 MLD domestic STP	294.00	--
5.	Conversion of class rooms, renovation of students Laboratory and other renovation works to Management Studies building at IISc	106.08	1357.22
6.	Formation of hockey ground & improvements to foot ball ground in Gymkhana	50.58	16030.80
7.	Providing new sanitary line from NNE Quarters/New 8 storeyed quarters under construction upto the proposed STP behind swimming Pool	51.75	--
8.	Additional constructions for Divecha Centre for Climatge Change at CAOS premises	368.77	1840.00
9.	Renovation of Biochemistry Building at IISc	49.29	745
10.	Re-surfacing the existing damaged bituminous Roads at IISc	100.07	13627.37
11.	Construction of Lab Space at III Floor for Centre for Biosystems Science and Engineering (BSSE) at IISc	37.05	275
12.	Construction of Toilet for drivers and Renovation of East wing Toilet Block at J N Tata Auditorium at IISc	29.00	45
13.	Renovation of Finance and Accounts Building to Accommodate DIGITS Office at IISc	63.97	750
14.	Construction of CIDR (Annexe) Building	65.00	232
15.	Supply, erection, testing and commissioning of one transformer bay with 66/11 KV 12.5 MVA transformer by extending the existing 66 KV switch yard adding two Nos. of 11 KV VCB panels to existing 11 KV switchgear and SCADA system including all civil works.	297.90	

8.2 Official Language

UNIT: CHAIRPERSON: PROF ANJULA GURTOO

HINDI WORKSHOP: The Institute has been organising Hindi workshops on various aspects related to the use of Hindi in Central Government's offices, for the benefit of staff members of the institute. A workshop was organised on July 12th, 2017 in the Official Language Unit of the Institute. Dr. Mahesh, Hindi Officer, CAIR, DRDO, Bangalore, discussed the role of computesr in the implementation of the Official Language. On December 12th, 2017, Mr. M.P. Damodaran, Deputy Director (Official Language), Coffee Board, Bangalore conducted a workshop on the subject of Official Language Policy. Thirty employees from various departments/units of the Institute participated in this workshop.

HINDI DAY: "Hindi Day" celebration was held in the Institute on September 14th, 2017 at MRC Auditorium. The function was presided by Prof.Rahul Pandit, Divisional Chairman of Institute (Physical and Mathematical Engineering). Sri Gyan Chand Marmagya, poet-cum-lyricist was the chief guest. Mr. Marmagya is an entrepreneur and his contribution to literature is respectable. Prof. Rudra Pratap (Nano Science Department) was invited as special guest. And Prof. Anjula Gurtoo, Chairperson of the Official Language Unit gave the welcome address.

In order to encourage the use of Hindi language by the staff in official work, Official language Unit and Hindi Samiti jointly organised several competitions such as Calligraphy, Antakshari, Extempore Speech, and Dumbcharades. Faculty members, employees and students of the Institute participated in large numbers in these competitions. Winners of these competitions were honored by the Chief Guest on the Hindi Day. Students of 'Rangmanch' presented Munshi Premchand's short drama "Poos ki Raat".

TOLIC COMPETITIONS: The Institute conducted Official Language Written Quiz competition on 13th September, 2017 for Town Official Language Implementation Committee (TOLIC), among 15 different competitions. In this competition, 19 staff from various Central Government Offices of Bangalore participated. Prizes were distributed to the winners on the Joint Hindi Day celebrations held on 27th November 2017.

DARSHINI MAGAZINE: Hindi quarterly magazine "Darhini" is regularly published. For the year 2017, January - March 2017, April - June 2017 editions were published.

TRANSLATION:

- Translation of the annual report of the institute in Hindi
- Translation of Annual Accounts in Hindi
- Hindi translation of other administrative manuals, forms and routine correspondence.

8.3 SC/ST Cell

LIAISON OFFICER IN CHARGE: DR. PANNER SELVAM

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 that the Institute adheres to to Government of India directives/orders regarding reservations, concessions, relaxation etc., for Scheduled Castes and Scheduled Tribes. The Cell furnishes statistical information regarding the representation of SCs & STs in the service of the Institute to the Ministry of Human Resource Development, the University Grants Commission and the National Commission for Scheduled Castes and Scheduled Tribes as and when called for.

The Cell also looks after the implementation of welfare measures such as the reimbursement of tuition and other fees, etc. for SC/ST staff wards.

8.4 PUBLIC INFORMATION OFFICE

Right to Information Act, 2005: The Institute adopted the Right to Information Act, 2005 in the year 2006. The Institute has disseminated certain information through its website, which is accessible to the public. During the year, the public have made around 160 requests seeking information and prompt action has been taken and the applicants have been informed accordingly.

9 CAMPUS FACILITIES

9.1 HEALTH CENTRE

- A fully equipped Clinical Laboratory, Digital X-ray, Ultrasonography, ECG, fully equipped Physiotherapy Unit services are available.
- Specialist consultants in General Medicine, Gynecology, ENT, Ophthalmology, Dermatology, Dentistry and Psychiatry are available on appointment basis
- It has a Pharmacy, which stores most of the required medicines.
- It has an Operation Theater where minor surgical procedure can be carried out efficiently.
- For cases requiring hospitalization for major illness, patients are referred to external hospitals for admission and treatment. All the permanent Employees and their Family Members and Retired Employees and their Spouses and Family Pensioners are covered by Group Mediclaim Insurance Policy under the Contributory Health Service Scheme (CHSS).
- The Health Centre provides OPD consultation for students residing on campus.
- The Health Centre has experienced doctors residing on campus and Area Medical Officers catering the institute population residing outside the campus in the city.
- The Health Centre also provides Ayurvedic Health Care by a recognized Ayurvedic Practitioners
- Emergency care is given round the clock at the Health Centre.
- The Health Centre has a fully equipped Ambulance to transfer critically ill patients round the clock.
- The Health Centre at 1st Floor of Faculty Club provides counseling by a recognized psychologist.

9.2 RECREATIONAL FACILITIES

9.2.1 GYMKHANA

The spacious and well-designed Gymkhana is the nodal centre for sports and cultural activities of the students and faculty. It offers facilities for many outdoor and indoor games and has a well-equipped gymnasium 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 Basketball, Tennis, Swimming, Kung Fu, Archery, Athletics, Aerobics and Dance. The Football/ Hockey and Tennis grounds are fitted with floodlights. 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.

9.2.2 FACULTY CLUB

The Faculty Club is a place for recreational, social and cultural activities.
Some of the salient activities of the club are: Indoor Games (Billiards/Snooker, Carrom, Table Tennis and Chess); Outdoor Games (Tennis); Fine Arts; Library & Reading Room (subscribes to dailies, weeklies and popular magazines); T V Lounge; Ladies Section; Snack Parlour and Pastry Shop and a Mini Gym. Classical music concerts are organized regularly on the campus.

During the year dining and gym facilities were improved. Science learning activity for school kids is arranged through science club.

9.2.3 TATA MEMORIAL CLUB

This Club provides the space and facilities for various games and cultural activities for the supporting staff of the Institute.

In addition to organising 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. Tuition 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 organized Badminton / Carrom / Table Tennis tournaments for students, faculty and staff. The club also organised the Karnataka Rajayotsava with the Kannada Sangha.

9.3 AUDITORIA

9.3.1 NATIONAL SCIENCE SEMINAR COMPLEX

The magnificent National Science Seminar Complex situated in the IISc Campus is the first of its kind in India. The complex is open for seminars, symposia and conferences organized by recognized scientific societies, educational institutions and professional bodies. The total built up area measures around 5750 sq. metres.
This fully air condition complex houses the JN Tata Auditorium with a seating capacity of 750 and 3 mini auditoria to seat 120, 90 and 60 people respectively. Interactive concourses at the basement and ground level with excellent light and sound facilities are part of the seminar complex. The business centre at the complex has facilities for photo copying, FAX, STD/ISD phone booths and secretarial assistance.

9.3.2 PROF. SATISH DHAWAN AUDITORIUM

Located on the first floor of the Centre for Scientific and Industrial Consultancy, this medium sized auditorium has a seating capacity of 265. It has fixed seats and a dais suitable for conferences and chamber music. It is fully air-conditioned and is adequately equipped with sound, lighting and projection equipment.

9.3.3 RUSTUM CHOKSI HALL

Located close to the entrance of the Institute, with a seating capacity of 120, the interior of the hall and its surroundings provide the right environment for intellectual inquiry and cultural activities.

9.3.4. FACULTY AND RECEPTION HALL

The Faculty Hall with a seating capacity of 275 is located in the east wing, on the first floor of the tower building. The Reception Hall is in the west wing. These are used for formal events.

9.4 AMENITIES

The following amenities located in different parts of the campus make day-to-day life smoother and more comfortable. In fact, these facilities have made IISc a totally self-contained Campus.

- Travel Agencies (Domestic & International Travel)
- Photo copying and DTP Centers
- Stationery/Book Shop
- Laundries/Dry cleaners
- Tailoring Shops
- Restaurants
- Juice Shop
- Provision and General Stores
- Vegetable Shop
- Bakery & Pastry Shop
- Hair Dressing Salons
- Baby Care Centre
- Ladies Boutique
- Cycle Shop
- Cable Facility
- Milk Parlour
- STD/ISD, Courier & Mobile Services

COMMUNICATIONS: 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 department 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: Canara Bank and State Bank of India have fully computerized branches with many facilities including foreign exchange transactions and ATM machines.

10 FINANCE

The Ministry of Human Resource Development provides Revenue and Capital Grants to the Institute for meeting revenue expenditure & for creating 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 release grants for research in emerging areas & for expansion of Infrastructure under Centre for Advanced Study/ FIST Programmes, respectively.

The total receipts covering all major areas for the year 2017-18 was Rs. 1,13,090.96 lakhs and the payments for various activities of the Institute was Rs. 98,240.45 lakhs.

THE DETAILS OF RECEIPTS AND PAYMENTS FOR THE YEAR 2017-18 ARE AS FOLLOWS:

Sl. No.	Particulars	Receipts	Payments
1	Revenue - MHRD Grants	46,100.06	43,652.71
2	Capital - MHRD Grants	5,905.88	7,331.59
3	Developmental Projects	4,851.13	5,757.50
4	Sponsored Research Schemes	43,301.31	30,423.51
5	Scientific & Industrial Consultancy	1,816.43	1,721.58
6	ODAA Projects	3,958.95	2,446.96
7	Continuing Education Programme	528.36	556.08
8	Sponsored Scholarships (CSIR/UGC/AICTE etc)	1,168.65	890.33
9	Academic/Other Income	1,587.80	1,587.80
10	Interest earnings/Project Overheads	3,872.39	3,872.39
	Total	**1,13,090.96**	**98,240.45**

Salaries & Allowances	23,669.80
Research Associateship	6,146.10
Working Expenses	15,424.61
Total	**45,240.51**

11

ENDOWED CHAIRS

11.1 Endowed Chairs for Faculty

A number of Endowed Chairs have been instituted in recent years to recognize the outstanding contribution of Institute faculty members.

YEAR	NAME	DEPARTMENT
ABB		
2012-15	Prof. P S Sastry	EE
2015-18	Prof. K Gopakumar	ESE
AMRUT MODY		
2015-18	Prof. Binny J Cherayil	IPC
ASTRA		
2012-15	Prof. Sandhya S Visweswariah	MRDG
2015-18	Prof. C Jayabaskaran	BC
HAL CHAIR		
2017-18	Prof. K.P.J. Reddy	AE
J N TATA CHAIR		
2017-20	Prof. D.D. Sarma	SSCU
JRD TATA CHAIR		
2017-20	Prof. Kumaran	Ch. Eng.
HOMI BHABHA CHAIR		
2017-20	Prof. Sriram Ramaswamy	PHY
KSIIDC		
2012-15	Prof. P. P. Mujundar	Civil
2015-18	Prof. T.G. Sitharam	Civil
MSIL		
2012-15	Prof. Chanda J Jog	PHY
2015-18	Prof. B Ananthanarayan	CHEP
2015-18	Prof. Vasant Natarajan	PHY

PROF. SATISH DHAWAN		
2012-15	Prof. KPJ Reddy	AE
2015-18	Prof. Ranjan Ganguli	AE
TATACHEM		
2012-15	Prof. P Vijay Kumar	ECE
2015-18	Prof. N Surya Prakash	NMRC
RAMAKRISHNA RAO		
2014-17	Prof. Srinivasan Raghavan	CeNSE
PRAT & WHITNEY		
2016-18	Prof. Gopalan Jagadeesh	AE

11.2 Endowed Visiting Chairs

A number of Endowed Visiting Chairs have been instituted to facilitate the visits of celebrated researchers from all over the world.

YEAR	NAME	DEPARTMENT
BRAHM PRAKASH		
2015	Prof. Tamas Ungar	Eotvos University, Budapest, Hungary
2015-16	Prof. Kannan M Krishnan	University of Washington, Seattle, USA
2016	Prof. Jiang-Zhong Jiang	Zhejiang University, Hangzhou, PR China,
2016	Prof. Tamas Ungar	Eotyos University, Budapest, Hungary
2016	Prof. David P Field	Washington State University, Pullman, USA
2016	Prof. Surya R. Kalidindi	George W. Woodruff School of Mechanical Engineering, Atlanta, USA,
2017	Prof. Jerzy Antoni Szpunar	Univ. of Saskatchewan, Saskatoon, Canada
2017	Prof. David P. Field	Washington State Univ., Pullman, USA
2017-18	Prof. Sridhar Seetharaman	Colorado School of Mines Golden, USA
2018	Prof. Hamish L. Fraser	Dept. of Materials Science & Engg, The Ohio State University, Columbus
PROF. SATISH DHAWAN		
2015	Prof. Tribrikram Kundu	University of Arizona, Tucson, AZ
2016	Prof. P. Guruswamy	Ames Research Center, California, USA
2016-17	Prof. D.S. Naidu	University of Minnesota, USA
2017	Prof. Garry L. Brown	Princeton University, Princeton, NJ
2017	Prof. Rama K Yedavalli	The Ohio State University, Columbus, USA
SUNDARARAJAN		
2015	Prof. Uma Das Gupta	Kolkata
PRATT & WHITNEY		
2015-16	Prof. Ravi N Banavar	IIT Bombay

DST-IISc CENTENARY CHAIR		
2015	Prof. Ramesh Narayan	Harvard University, USA
2015	Prof. Jainendra K Jain	Pennsylvania State University, USA
2015	Prof. William A Goddard	Caltech, California, USA
2017	Prof. Allan Peter Young	Univ. of California, USA
2017	Prof. Richard N. Zare	Stanford University, Stanford, CA
BHARAT ELECTRONICS CHAIR PROFESSORSHIP		
2016	Dr. Goutam Chattopadhyay	Jet Propulsion Lab, USA
SMT. RUKMINI – SHRI GOPALAKRISHNACHAR DISTINGUISHED CHAIR PROFESSORSHIP		
2015	Prof. Michael L Norman	University of California, San Diego, USA
2016	Prof. Rakesh Agrawal	Microsoft Research, Redmond, USA
K VAIDYANATHAN DISTINGUISHED VISITING CHAIR		
2015-2020	Prof. Shihab Shamma	University of Maryland, USA
SMT SUDHA MURTHY DISTINGUISHED VISITING CHAIR		
2016-2019	Prof. Vasant Honavar	Pennsylvania State University, USA
INFOSYS VISITING CHAIR		
2016-2020	Prof. Jainendra K Jain	Pennsylvania State University, USA
	Prof. Susanne C Brenner	Louisiana State University, USA
	Prof. Aneesh V Manohar	University of California, USA
2018	Prof. Xerxes Tata	Dept. of Physics & Astronomy, Univ. of Hawaii at Manoa, USA

DESIGN
www.thefool.in

PRINTING
Tholasi Prints India

ARCHIVES AND PUBLICATIONS CELL
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IISc Press

www.iiscpress.iisc.in