Annual Report

IISc 2024-25
Bagchi-Parthasarathy Hospital &
Tata IISc Medical School

INDIAN INSTITUTE OF SCIENCE

IISc
Leadership 2024-25

VISITOR
THE PRESIDENT OF INDIA

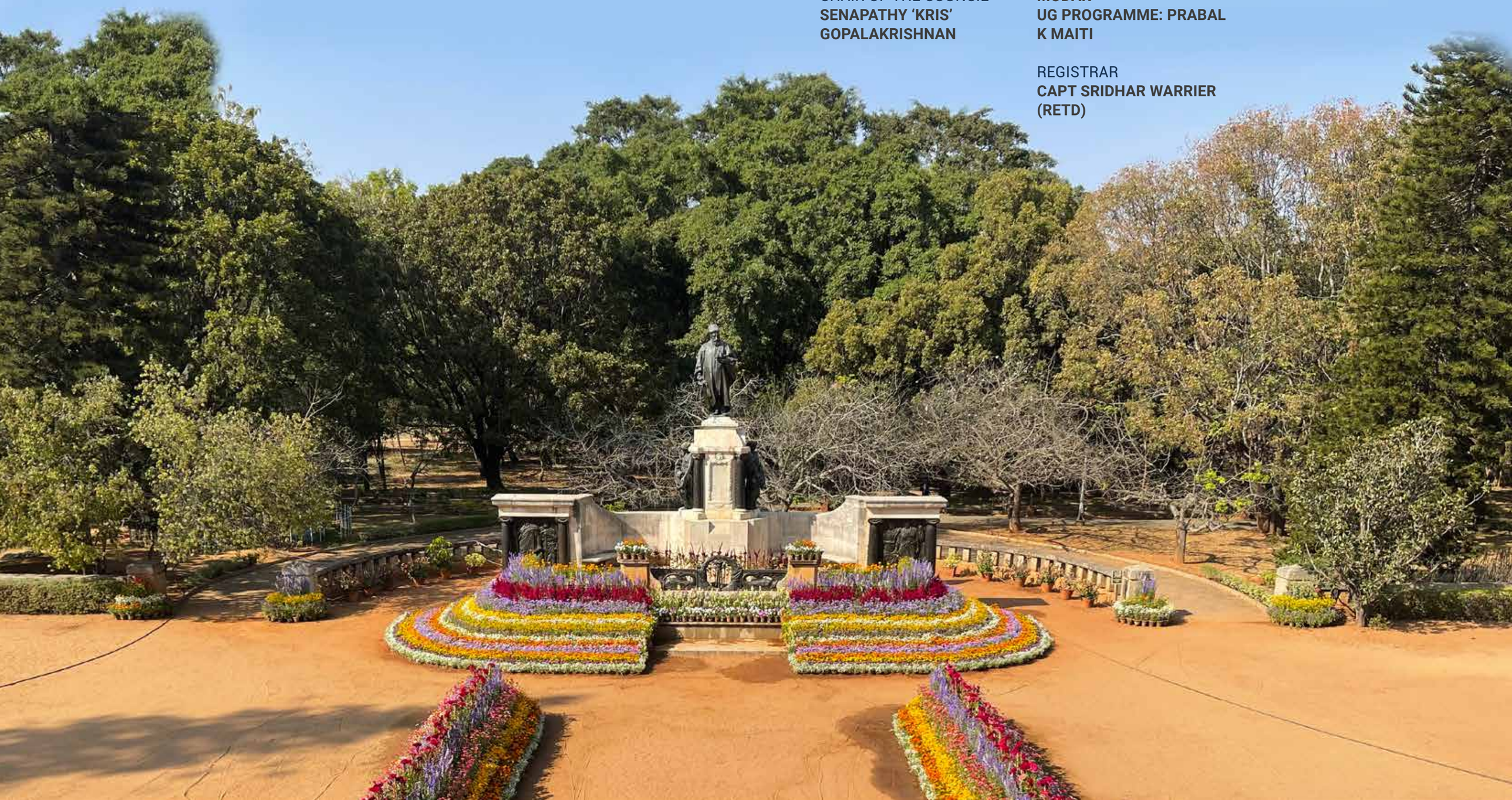
PRESIDENT OF THE COURT
N CHANDRASEKARAN

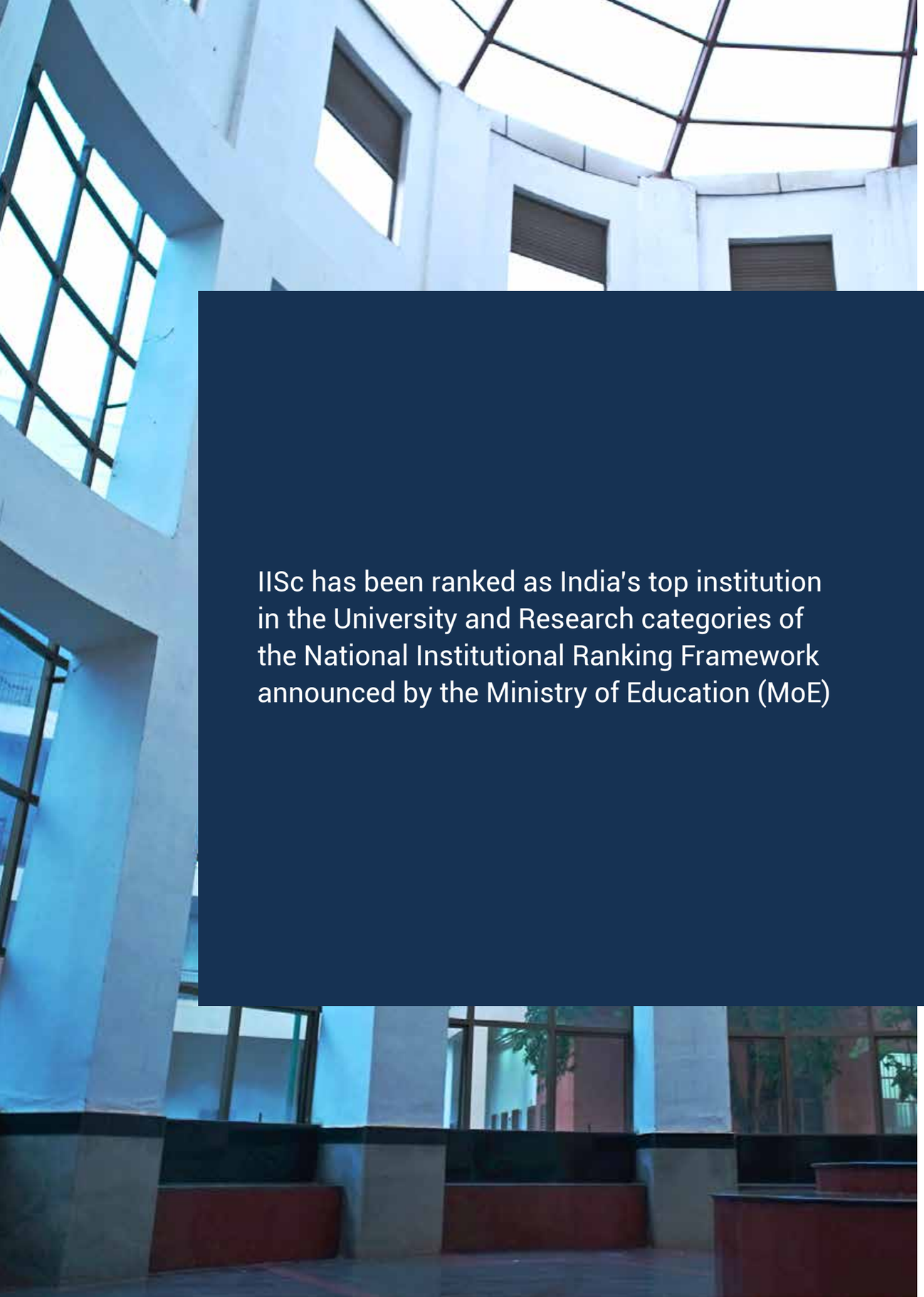
CHAIR OF THE COUNCIL
SENAPATHY 'KRIS' GOPALAKRISHNAN

DIRECTOR
G RANGARAJAN

DEANS
SCIENCE: S ASOKAN
ENGINEERING: JAYANT MODAK
UG PROGRAMME: PRABAL K MAITI

REGISTRAR
CAPT SRIDHAR WARRIER (RETD)





IISc has been ranked as India's top institution in the University and Research categories of the National Institutional Ranking Framework announced by the Ministry of Education (MoE)

Table of *Contents*

Forward

IISc at a Glance

01 **The Institute**
- Court
- Council
- Finance Committee
- Senate
- Faculties

02 **Staff (administration)**

03 **Divisions**
- Biological Sciences
- Chemical Sciences
- Electrical, Electronics, and Computer Sciences
- Interdisciplinary Sciences
- Mechanical Sciences
- Physical & Mathematical Sciences
- Centres under the Director

04 **Undergraduate Programme**

05 **Awards/Distinctions**

06 **Students**
- Admissions & On Roll
- SC/ST Students
- Scholarships/Fellowships
- Assistance Programme
- Students Council
- Hostels
- Institute Medals
- External Programmes
- Awards and Distinctions
- Placements

07 **Events**

08 **Other Institute Units**

09 **Campus Facilities**

10 **Endowed Chairs**

Foreword

I am honoured to present the 2024-25 Annual Report of the Indian Institute of Science (IISc).

In May 2024, the Institute turned 115. IISc has continued to remain a leading institution for original research and higher education while staying true to its mandate to "provide for advanced instruction and to conduct original investigations in all branches of knowledge as are likely to promote the material and industrial welfare of India."

In a significant development this past year, the Tata Group has made a magnanimous commitment of Rs 500 crore to support the establishment of the Tata IISc Medical School on campus. The Tata IISc Medical School will be a centre of excellence that seeks to catalyse a unique model of clinical research and medical education in India, by bringing basic science and engineering to bear on clinical science and practice. It will focus on a variety of specialities including oncology, cardiology, neurology, nephrology, diabetes and metabolic disorders, infectious diseases, integrative medicine, and public health.

Given the Tatas and IISc's historic connection and our century-old legacy of excellence, the school is expected to set a new benchmark for medical education and research in the country.

We received numerous accolades this year. IISc has yet again retained its position as the top university and research institution in the National Institutional Ranking Framework (NIRF) rankings. IISc also ranked the highest among Indian institutions in the Nature Index 2024 rankings in the academic, biological sciences, chemistry, and overall categories.

Four of our faculty members received the new Rashtriya Vigyan Puraskar awards, with G Padmanaban winning the Vigyan Ratna, Umesh Varshney winning the Vigyan Shri, and Aravind Penmatsa and Mahesh Kakde both receiving the Vigyan Yuva awards. Our students have also excelled, with two undergraduate teams placing 7th and 11th among 49 teams in the international PLANCKS competition. Two undergraduate teams also won gold and silver medals in the International Genetically Engineered Machines competition.

We were privileged to host the four astronaut-designates selected for the Gaganyaan mission as MTech students at IISc. Two of them, Group Captain Shubhanshu Shukla and Group Captain Prasanth Balakrishnan Nair, have been selected for the historic Axiom-4 Mission to the International Space Station.

We also conferred the IISc Excellence in Teaching awards on six faculty members – Debasis Das, Pavan Nukala, S Karthikeyan, Atanu Kumar Mohanty, Ramray Bhat, and Gautam Bharali – for their efforts to promote a deeper and more engaging learning experience.

IISc has continued to push the boundaries of knowledge with rigorous research across departments. Among the key highlights this past year include a breakthrough neuromorphic platform for AI applications, insights into the glass transformation that lies at the heart of memory storage, a hydrogel that can adsorb microplastics from water, the development of a synthetic antibody for snakebite toxin, a hitchhiking antigen that can stimulate antibodies against cancer cells, a new series representation for 'pi', tuneable coloured films for displays and sensors, and a device that can turn infrared light to visible light. Such advancements have the potential to drive great change in their respective fields.

The Institute has also started several initiatives such as the Longevity India initiative aimed at holistic research on healthy ageing, and a Centre of Excellence in high temperature materials research. The Department of Civil Engineering will host an International Centre of Excellence for Dams focused on dam rehabilitation and improvement projects with support from the Ministry of Jal Shakti.

IISc also organised an Industry-Institute Conclave which saw a mixture of industry leaders, entrepreneurs, researchers, government officials, and students participating. An outreach programme for 40 students from Navodaya Vidyalaya schools, called the Agastya Science Enrichment Programme, was also successfully conducted in the summer of 2024.

On the infrastructure front, hostel complexes for men and women students have been completed. Construction of the Axis Bank Centre for Maths and Computing and the UG Complex is expected to be completed in 2025. Renovation of the Gymkhana grounds is nearing completion.

IISc has continued to build strong partnerships with leaders in technology, industry, and education. The Institute has partnered with University College London to facilitate collaboration with the forthcoming medical school for research, education, innovation, and commercialisation. A Chair Professorship was established with support from the Bureau of Indian Standards (BIS). The Institute is also collaborating with Carl Zeiss to establish a cutting-edge AI lab for eye care and fellowships for MTech students. We have partnered with Toyota Kirloskar Motor to establish a Mobility Engineering Laboratory, with Walmart for a new Centre for Tech Excellence at CSA, with Intel to investigate thermal management in microelectronic systems, and with Fujitsu Limited on research related to data science.

IISc researchers have also partnered with IOCL and the Government of Karnataka to screen for sickle-cell anaemia among tribal districts in the state. Blockchain for Impact and the National Payments Corporation of India are also supporting important research initiatives at the Institute.

While support and funding from the government has been critical for IISc's operations, support from non-government sources has also proven beneficial for the Institute's advancement in the last few years. Endowments and grants from generous donors and alumni have not only enabled the Institute to modernise its infrastructure and provide enhanced support for its students, but also helped our faculty members pursue groundbreaking research.

In the years to come, we will continue to persist in our pursuit of excellence in research and teaching and contribute to nation-building activities, as we have always done.

On behalf of IISc, I thank the Ministry of Education, and Chair and members of the Council for their valuable support and guidance in all our endeavours.

G Rangarajan
Director, IISc

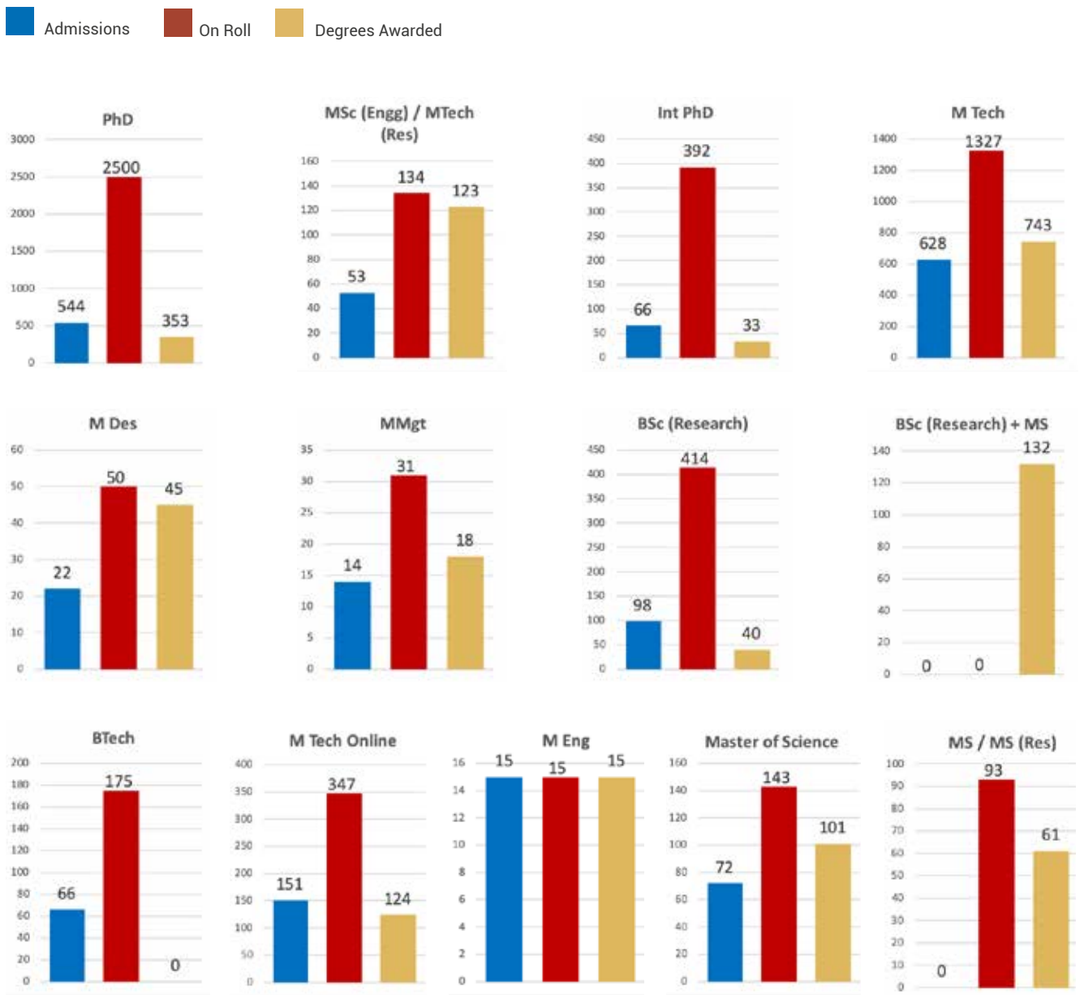
2024-25
IISc at a Glance

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
	DBG	Developmental Biology and Genetics
	MCB	Microbiology and Cell Biology
	MBU	Molecular Biophysics Unit
Division of Chemical Sciences	IPC	Inorganic and Physical Chemistry
	MRC	Materials Research Centre
	OC	Organic Chemistry
	SSCU	Solid State and Structural Chemistry Unit
Division of Electrical, Electronics, and Computer Sciences	CSA	Computer Science and Automation
	ECE	Electrical Communication Engineering
	EE	Electrical Engineering
	ESE	Electronic Systems Engineering
Division of Interdisciplinary Sciences	BE	Bioengineering
	CSP	Centre for Society and Policy
	CDS	Computational and Data Sciences
	CeNSE	Centre for Nano Science and Engineering
	CiSTUP	Centre for infrastructure, Sustainable Transportation and Urban Planning
	ICER	Interdisciplinary Centre for Energy Research
	ICWaR	Interdisciplinary Centre for Water Research
	MS	Management Studies
	RBCCPS	Robert Bosch Centre for Cyber-Physical Systems
	SERC	Supercomputer Education and Research Centre
Division of Mechanical Sciences	AE	Aerospace Engineering
	CAOS	Centre for Atmospheric and Oceanic Sciences
	CEaS	Centre for Earth Sciences
	CE	Chemical Engineering
	CiE	Civil Engineering
	DM	Design and Manufacturing
	CST	Centre for Sustainable Technologies
	DCCC	Divecha Centre for Climate Change
	MT	Materials Engineering
	ME	Mechanical Engineering
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 & Autonomous Centres	LIB	JRD Tata Memorial Library
	OoC	Office of Communications
	OIR	Office of International Relations
	CCE	Centre for Continuing Education
	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
	ORG	Office of Research Grants
	OCCaP	Office of Career Counselling and Placement
	FSID	Foundation for Science, Innovation and Development
	CBR	Centre for Brain Research
	KSCST	Karnataka State Council for Science and Technology
	ARTPARK	AI and Robotics Technology Park

Students:

Admissions, On Roll & Degrees Awarded 2024-25



Continuing Education	
QIP Degree programme	NIL
QIP Short Term courses	NIL
CCE Proficience	18
Semester long courses	551 successfully completed
Industry sponsored short term/full term courses:	2038
45 Self Support courses	participated

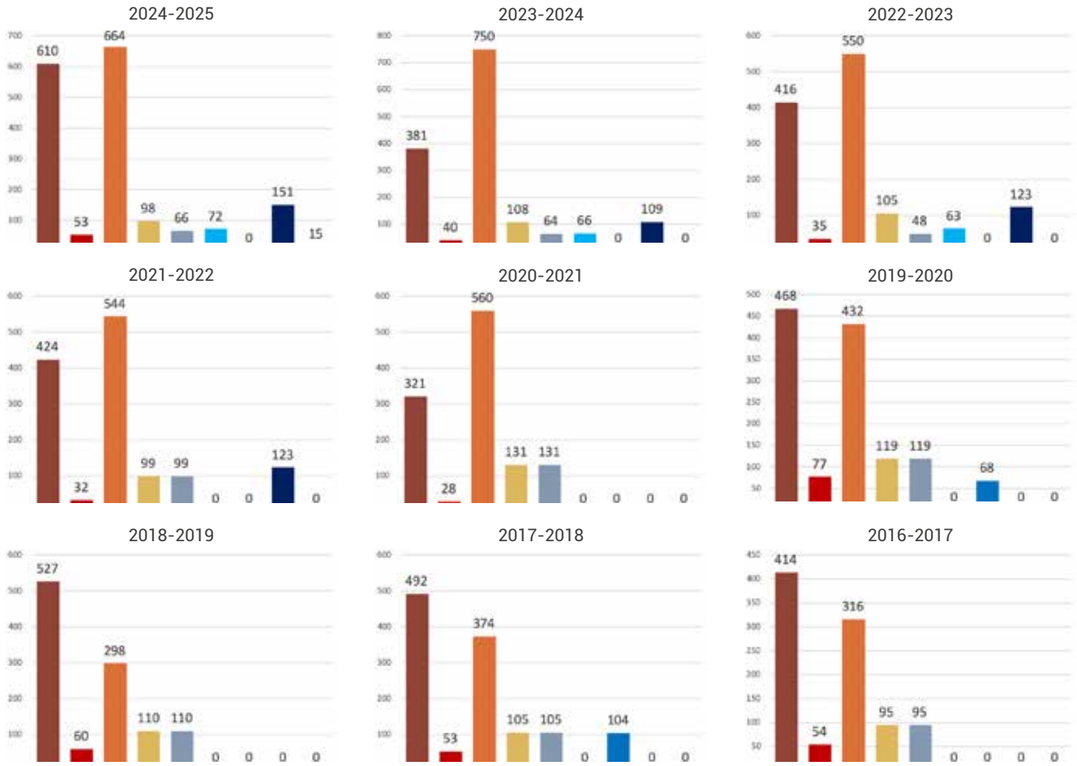
Hostels	
Men	18
Women	5
Messes	5

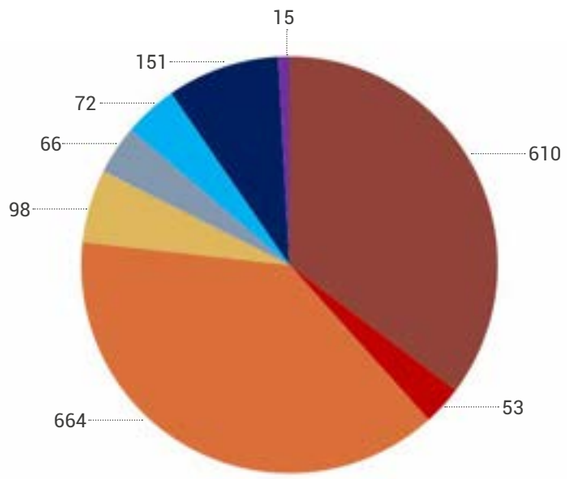
Scholarships/Fellowships 5148	
IISc	3668
Others	1480

Students:

Admissions, Conferments, On Roll

Admissions from 2016-17 to 2024-25



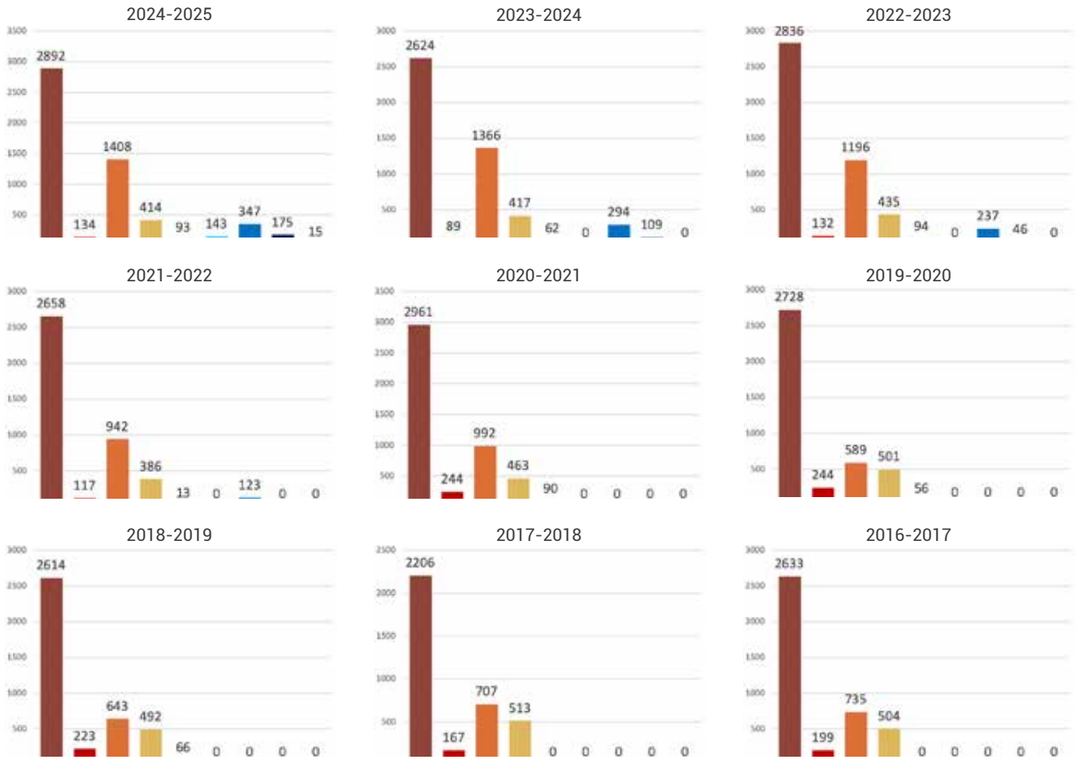


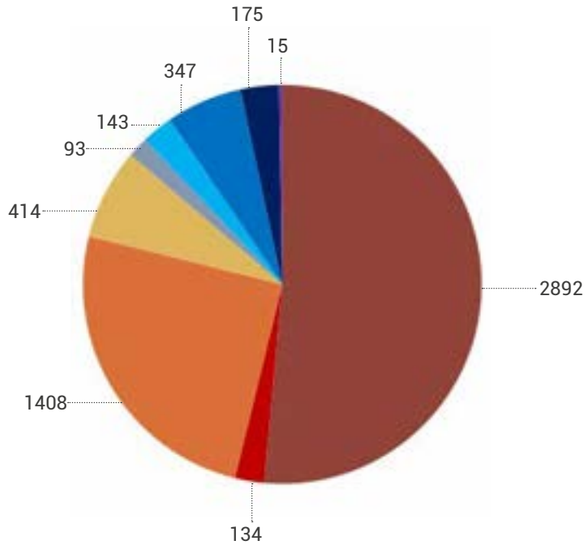
2024-2025
Total - 1729

- PhD / Int PhD
- M Tech (Res)
- Master Programme
- B Sc (research)
- B Tech
- Master of Science
- M S
- M tech online
- M Eng

Students:
Admissions, Conferments, On Roll

On Roll from 2016-17 to 2024-25



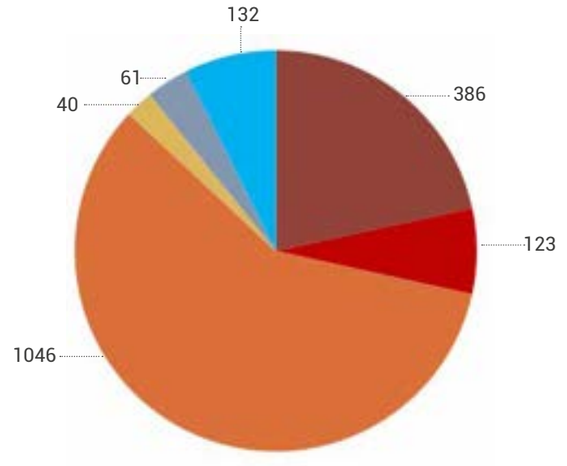


2024-2025
Total - 5621

- PhD / Int PhD
- M Tech (Res)
- Master Programme
- B Sc (research)
- M S
- Master of Science
- M tech online
- B Tech
- M Eng

Students:
Admissions, Conferments, On Roll

Conferments from 2016-17 to 2024-25



2024-2025
Total - 1788

- PhD / Int PhD
- MSc (Engg) / M Tech (Res)
- Master Programme
- B Sc (Research)
- MS/ MS (Res)
- BS+MS

Programmes

Research

PhD Int PhD Bsc Research MSc

Science	PhD	Int. PhD	M Tech (Res)	BSc (Research)	MSc
Biochemistry	■	■			
Ecological Sciences	■	■			
Microbiology and Cell Biology	■	■			
Molecular Biophysics	■	■			
Developmental Biology and Genetics	■	■			
Neurosciences	■	■			
Inorganic and Physical Chemistry	■	■			
Materials Research	■	■			
Organic Chemistry	■	■			
Solid State and Structural Chemistry	■	■			
Mathematics	■	■			
Physics	■	■			
Astronomy and Astrophysics	■	■			
High Energy Physics	■	■			
Interdisciplinary Programme - IMI	■				
Undergraduate Programme				■	
Life Sciences					■
Chemical Sciences					■

Programmes

Course/ Research

PhD Mtech (Res) MTech MDes MMgt

Engineering	PhD	M Tech (Res)	M Tech (Res)	M Des	M Mgt
Civil Engineering	■	■	■		
Earth Sciences	■	■	■		
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 and Applied Physics	■	■	■		
Computational and Data Science	■	■	■		
Nanoscience and Engineering	■		■		
Energy Research	■				
Management Studies	■				■
BioSystems Science and Engineering	■				
Water Research	■				
Sustainable Technologies	■	■			
Cyber Physical Systems	■				
Climate Change	■				

Programmes

Courses offered 2024-25

Division	Level 100	Level 200	Level 300	Level 400	Level 500	Grand Total
Undergraduate Programme	28	43	28	10	7	116
Division of Biological Sciences	3	58	11			72
Division of Chemical Sciences		24	16	1		41
Division of EECS		127	18			145
Division of Interdisciplinary Sciences		98	22			120
Division of Mechanical Sciences		214	8			222
Division of Physical and Math. Sciences		62	55			117
Online Courses		29				29
Support and Services under the Director		2				2
Grand Total	**31**	**657**	**158**	**11**	**7**	**864**

Faculty

Staff (864)	SC/ST	OBC	GN	EWS
Academic, Scientific & Technical (541)				
Academic	43	22	419	0
Scientific	26	1	26	0
Technical	3	0	1	0
Support (323)				
Officers	7	9	24	0
Administrative	60	31	61	10
Technical	26	18	37	10
Maintenance	10	2	18	0
Others	0	0	0	0

Publications	
Biological Sciences	355
Chemical Sciences	419
Electrical, Electronics, and Computer Sciences	627
Mechanical Sciences	1141
Physical & Mathematical Sciences	574
Interdisciplinary Research	665
Autonomous Society/centre	71
Centres under Director	4
UG Studies	17
Total	**3873**

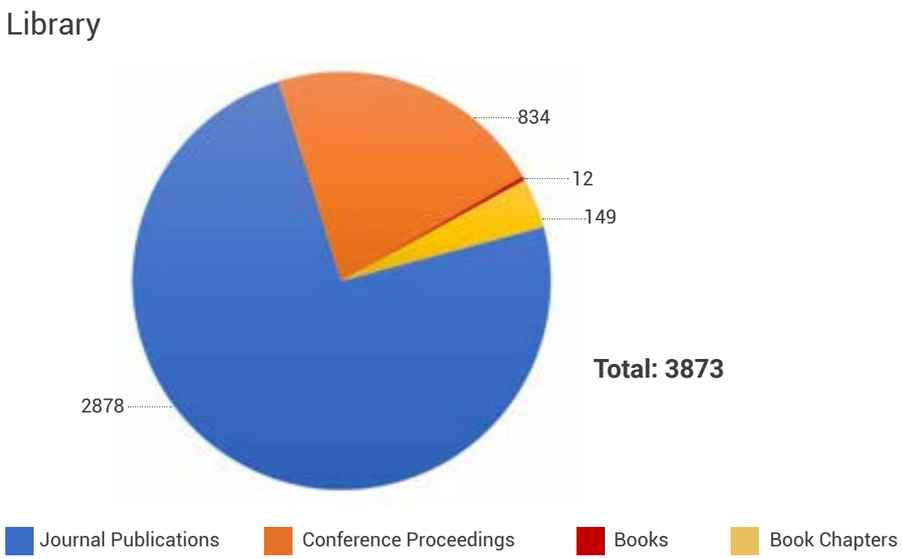
Academic Divisions: 7 Departments: 43	
Biological Sciences	8
Chemical Sciences	4
Electrical, Electronics, and Computer Sciences	4
Mechanical Sciences	10
Medical Sciences	2
Physical & Mathematical Sciences	5
Interdisciplinary Sciences	10

Faculty

Interactions	
On Campus	
Institute Lectures	12
Institute Colloquium	6
International Conferences	34
National Conference/Workshop	25
Visitors - Visits from different Minstries	9
Experts from different fields	8
School/College	188
Staff	
Visits	814
Conferences	
Lectures delivered	
Assistance in Other Institutions	

Awards and Distinctions	
J C Bose Fellowhsip	
TWAS	1
Indian Academy of Sciences	7
Indian National Academy of Engineering	5
National Academy of Sciences	6
Indian National Science Academy	
Shanti Swarup Bhatnagar (SSB) Prize	
Swarna Jayanti	
IEEE	1

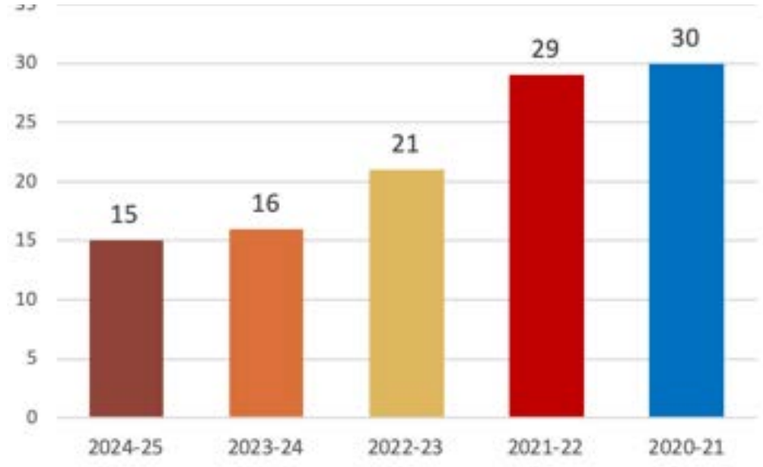
Publications



Degrees Awarded 2024-2025	
Int. Ph.D	33
MS (Res)	61
Ph.D	353
M.Tech	743
M.Tech (Res)	123
M.Mgt	18
M.Des	45
Four Yr. BSc (Res)	40
BSc (Res) + MS	132
M.Sc	101
M.Engg	15
M.Tech (Online)	124
Total	**1788**

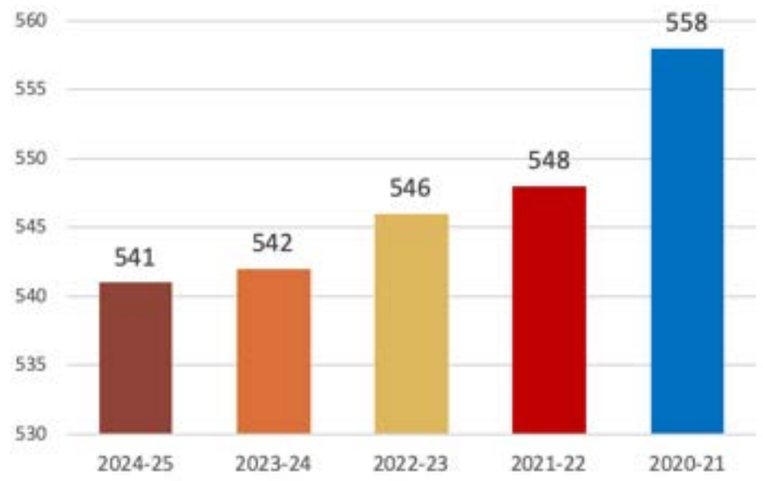
Faculty
Induction, Academic and Technical Staff

New Faculty Inducted during 2020-2025

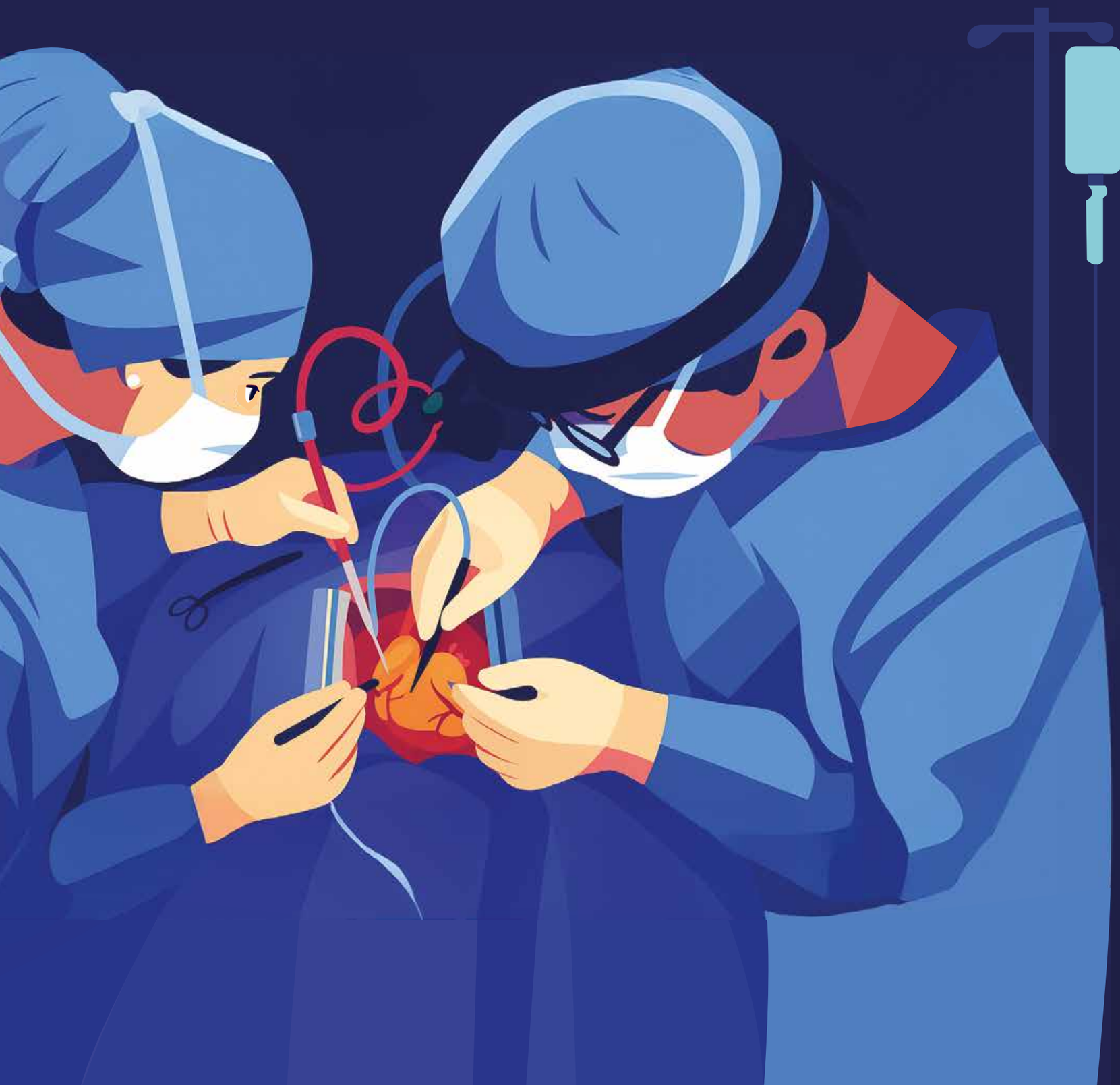


Induction during the year

Academic, Scientific and Technical Staff On Roll from 2020-2025



Year



1.
The *Institute*

The Indian Institute of Science (IISc) 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 and Chairman, Tata Sons Limited, Mumbai

AS Kiran Kumar
Former Secretary, Department of Space, ISRO, Government of India

S Subbiah
HoD, Department of Surgical Oncology, Government Royapettah Hospital and Kilpauk Medical College, Chennai

Anil Sahasrabudhe
Chairman, National Educational Technology Forum

Shireesh B Kedare
Director, Indian Institute of Technology (IIT), Bombay

S Somanath
Former Secretary, Department of Space, ISRO, Government of India

Manjushree N
Commissioner, Department of Collegiate Education and Technical Education, Government of Karnataka

KN Vyas
DAE Homi Bhabha Chair Professor and Former Chairman, Atomic Energy Commission (AEC) & Secretary, Department of Atomic Energy (DAE)

SN Agarwal
Chairman, All India Organisation of Industrial Employees, Bhoruka Power Corporation Limited, Bangalore

R Mukundan
President, Employers Federation of India, Mumbai and Managing Director & CEO, Tata Chemicals Limited

TG Sitharam
Chairman, All India Council for Technical Education

Rajan Sankaranarayanan
Outstanding Scientist/Scientist H, Centre for Cellular & Molecular Biology, Council of Scientific and Industrial Research

Ankur Arun Kulkarni
Vice Chancellor, SAGE University, Indore

Rajita Kulkarni
President, Sri Sri University, Cuttack

GD Sharma
Vice Chancellor, University of Science & Technology, Meghalaya

Alok Kumar Chakrawal
Vice Chancellor, Guru Ghasidas Vishwavidyalaya, Chhattisgarh

Nirupama Rao
Foreign Secretary (Retd) and Ambassador of India (Retd)

V Mohan
President and Director, Dr Mohan's Diabetes Specialties Centre & Madras Diabetes Research Foundation, Chennai

Lt Col G Rajaram (Retd)
President, IISc Alumni Association, Bengaluru

Govindan Rangarajan
Director, IISc (Ex-officio)

All members of the Council
(Ex-officio)

Professors of the Institute
(Ex-officio)

Capt Sridhar Warrier (Retd)
Registrar (Secretary) (Ex-officio)

Every year, the Court meets once in March

MEMBERS OF THE COUNCIL WHO ARE NOT OTHERWISE MEMBERS OF THE COURT:

Senapathy 'Kris' Gopalakrishnan
Co-Founder, Infosys and Chairman, Axilor Ventures Private Limited

G Satheesh Reddy
President, Aeronautical Society of India (AeSI), Former Secretary DD R&D and Chairman DRDO and Former Scientific Advisor to Raksha Mantri

Vineet Joshi
Secretary, Department of Higher Education, Ministry of Education, Government of India

Ritesh Kumar Singh
Principal Secretary, Finance Department, Government of Karnataka

Siddharth Sharma
CEO, Sir Dorabji Tata Trust (SDTT) & Sir Ratan Tata Trust (SRTT)

Ekroop Caur
Secretary to Government, Department of Electronics, Information Technology, Biotechnology, Science and Technology

TV Narendran, CEO & Managing
Director, Tata Steel Limited

Avinash C Pandey
Former VC, Bundelkhand University, Jhansi; Director, Inter-University Accelerator Centre, New Delhi

PC Mohan
Hon'ble Member of Parliament (LS)

LS Tejasvi Surya
Hon'ble Member of Parliament (LS)

Narayana Koragappa
Hon'ble Member of Parliament (RS)

Asokan S, Dean,
Faculty of Science

Jayant M Modak
Dean, Faculty of Engineering

Capt Sridhar Warrier (Retd)
Registrar (Ex-officio, Secretary)

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:

Senapathy 'Kris' Gopalakrishnan
Chairman of the Council
Co-Founder, Infosys and Chairman, Axilor Ventures Private Limited

G Satheesh Reddy
President, Aeronautical Society of India (AeSI), Former Secretary DD R&D and Chairman, DRDO, and Former Scientific Advisor to Raksha Mantri

Vineet Joshi
Secretary, Department of Higher Education, Ministry of Education, Government of India, New Delhi

Ritesh Kumar Singh
Principal Secretary, Finance Department, Government of Karnataka

Ekroop Caur
Secretary to Government, Department of Electronics, Information Technology Biotechnology, Science and Technology

Siddharth Sharma
CEO, Sir Dorabji Tata Trust (SDTT) & Sir Ratan Tata Trust (SRTT)

TV Narendran
CEO & Managing Director, Tata Steel Limited

Avinash C Pandey
Former VC, Bundelkhand University, Jhansi; Director, Inter-University Accelerator Centre, New Delhi

PC Mohan
Hon'ble Member of Parliament (LS)

LS Tejasvi Surya
Hon'ble Member of Parliament (LS)

Narayana Koragappa
Hon'ble Member of Parliament (RS)

Nirupama Rao
Foreign Secretary (Retd) and Ambassador of India (Retd)

V Mohan
Chairman & Chief Diabetologist, Dr Mohan's Diabetes Specialities Centre & Madras Diabetes Research Foundation

GD Sharma
Vice Chancellor, University of Science & Technology, Meghalaya

Alok Kumar Chakrawal
Vice Chancellor, Guru Ghasidas Vishwavidyalaya, Koni, Bilaspur

TG Sitharam
Chairman, All India Council for Technical Education

Rajan Sankaranarayanan
Outstanding Scientist /Scientist H, Centre for Cellular & Molecular Biology, Council of Scientific and Industrial Research, New Delhi

Govindan Rangarajan
Director, IISc (Ex-officio)

Asokan S
Dean, Faculty of Science

Jayant M Modak
Dean, Faculty of Engineering

Capt Sridhar Warrier (Retd)
Registrar (Secretary) (Ex-officio)

Councils Meetings were held **on 22.06.2024, 21.09.2024, 07.12.2024 and 15.03.2025**

1.3
Finance Committee

Senapathy 'Kris' Gopalakrishnan
Chairman of the Council
Co-Founder, Infosys and Chairman, Axilor Ventures Private Limited

Sanjog Kapoor
Joint Secretary & Financial Adviser, Ministry of Education, Government of India

Saumya Gupta
Joint Secretary (TE), Ministry of Education, Government of India

Mohammed Ikramulla Shariff
Joint Secretary (Budget & Resources) Finance Department, Government of Karnataka

Ashish W Deshpande
Secretary & Chief Financial Officer, Sir Ratan Tata Trust, Mumbai

RF Savaksha
Secretary & Chief Financial Officer, Sir Dorabji Tata Trust, Mumbai

Nirupama Rao
Foreign Secretary (Retd) and Ambassador of India (Retd)

Smitha Gopal
Principal Accountant General (A&E), Bangalore, Karnataka

Govindan Rangarajan
Director (Ex-officio)

Capt Sridhar Warrier (Retd)
Registrar (Secretary) (Ex-officio)

Finance Committee Meetings were held on **21.06.2024, 20.09.2024, 06.12.2024 and 13.03.2025**

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.

The Senate recommended the award of various degrees as follows:

PhD	353
Int PhD	33
MTech	743
MTech (Res)	123
MMgt	18
MDes	45
Four year BSc (Res)	40
MS (Res)	61
BS+MS	132
MEngg	15
MTech (Online)	124
MSc	101
Total	**1788**

During the AY 2024-25, the Senate met on **20 August 2024, 28 November 2024, 12 February 2025, 22 May 2025 and 12 June 2025.**

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 Chairperson, all Professors, Associate Professors, Assistant Professors as members and Chief Research Scientists, Principal Research Scientists and Senior Scientific Officers as invitees and the Deputy Registrar as the Secretary.

The joint faculty is headed by the Director, all Professors, Associate Professors, Assistant Professors as members and Chief Research Scientists, Principal Research Scientists and Senior Scientific Officers as invitees with Registrar as the Secretary.

The Joint Faculties were held on **09 August 2024 and 23 January 2025. Science Faculty meeting and Engineering Faculty meeting were held on 10 December 2024.**

2.
Staff

Director
Govindan Rangarajan

Dean (Science)
Asokan S

Dean (Engineering)
Jayant Modak

Dean (Planning and Infrastructure)
SK Satheesh

Dean (Administration and Finance)
PS Anil Kumar

Dean, Division of Biological Sciences
Usha Vijayraghavan

Dean, Division of Chemical Sciences
G Mugesh

Dean, Division of Electrical, Electronics, and Computer Sciences
Rajesh Sundaresan

Dean, Division of Interdisciplinary Sciences
Navakanta Bhat

Dean, Division of Mechanical Sciences
GK Ananthasuresh

Dean, Division of Medical Sciences
Navakanta Bhat

Dean, Division of Physical & Mathematical Sciences
Kaushal Verma

Dean, UG Programme
Prabal K Maiti

Associate Dean, UG Programme (BSc (Research))
Dipshikha Chakravortty

Associate Dean, UG Programme (BTech)
Srikanth Krishnan Iyer

Registrar
Capt Sridhar Warrier (Retd), MBA

Financial Controller
Indumati Srinivasan, PGDPPM

Joint Registrar (Finance)
M Krishna Murthy, PhD

Joint Registrar (F&A)
MC Jayaprakash, MBA

Deputy Registrar
Anoop S, MA
Aparna Kandi, MBA
Ramanathan K, MCom
Veeranna Kammar, MSc

Assistant Registrars
Anilkumar Angadi, MA
Anoop Yadav, MBA
Gopi Konkipudi, MTech
Jayaraj K, MBA
Krishna Kant Kumar, MA
Mahesh Kumar TM, PhD
Michealraj S, MBA
Mithun Nair, MBA
Nithya RG, MBA
Nitin Anand A, MBA
Raghavendra G, MCom
Sathish Kumar S, MSc
Senthil Kumar M, MBA
Sqn Ldr Manish Pokhriyal (Retd), MTech
Sreedhar BN, MBA
Vasanthan AA, MBA

Administrative Officer (Challakere Campus)
Munti Madugu Mudassar, MTech

Security & Firefighting
Jayaraj K, MBA

Hindi Officer (In-charge)
Krishna Kant Kumar, MA

Internal Auditor
Padma R, MA

JRD TATA MEMORIAL LIBRARY

Librarian
Umeshareddy Kacherki, PhD

Deputy Librarian
Suresh B Balutagi, PhD

Assistant Librarians
Ashish Kumar Ahirwal, MLISc
Pradeep P Kavi, AISc

HEALTH CENTRE

Chief Medical Officer
Satish Rao C, MBBS

Senior Medical Officer
Nirmala R, MBBS

Principal Medical Officer
Aditya Malladi, MBBS

Medical Officer
Neethi Raveendran, MBBS

CAMPUS MANAGEMENT & DEVELOPMENT

Project Engineer-cum-Estate Officer
Lt Col Navneet Lobana (Retd), MTech

Deputy Project Engineer
Lenin Ram K, MTech

Sr. Assistant Executive Engineer
G Lohithesh Kumar, MTech

Assistant Project Engineers
Amruth Appachu K, MTech
Karthik P, MTech
Radhika Muthukumar, BE

Gymkhana President
Ambedkar Dukkipati, PhD (IISc)

STUDENT AFFAIRS

Chair, Council of Hostel Wardens
Suja Elizabeth

Wardens
Jayanth GR, IAP
Asha Bhardwaj, IAP
Manoj Varma, CeNSE
Vishal Singh, CPDM
Geetharani K, IPC
Jyothsna Komaragiri, CHEP
Sandeep M Eswarappa, BC
Aravind Penmatsa, MBU
Shashi Jain, MS
Naga Phani Aetukuri, SSCU
Sarasij Das, EE
Sheetal Jain, SSCU
K Jayaraj, Hostel Office

Student Advisors
MS Bobji
Chair & Advisor

Student Counsellors
Ambedkar Dukkipati, CSA
Annapoorni Rangarajan, MRDG
Abha Misra, IAP
Partha Pratim Mondal, IAP
Viswesha Guttal, CES
Harish Seshadri, MA
Digbijoy Nath, CeNSE
Deepakash Das, DBG
Nitin Anand, Academics-II

3.1

Division of *Biological Sciences*

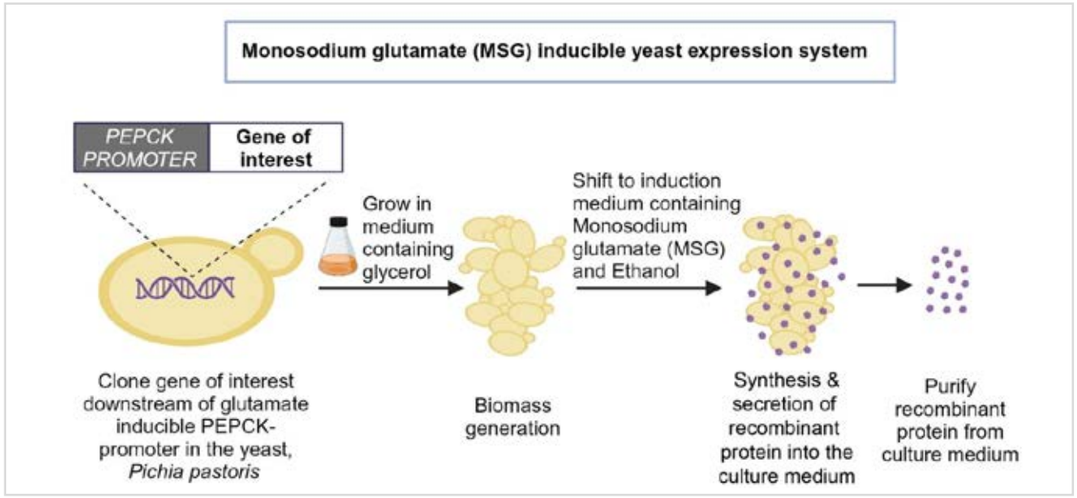
The Division of Biological Sciences forges important links between basic science and innovative research. It is committed to enhancing frontline studies in almost all aspects of modern biology: Neuroscience in health and disease, Infectious Disease, Structural Biology, Oncology, DNA Repair and Genomic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

DEPARTMENTS | CENTRES | UNITS

- DEPARTMENT OF BIOCHEMISTRY
- CENTRAL ANIMAL FACILITY
- CENTRE FOR ECOLOGICAL SCIENCES
- CENTRE FOR INFECTIOUS DISEASE RESEARCH
- CENTRE FOR NEUROSCIENCE
- DEPARTMENT OF DEVELOPMENTAL BIOLOGY AND GENETICS
- DEPARTMENT OF MICROBIOLOGY AND CELL BIOLOGY
- MOLECULAR BIOPHYSICS UNIT

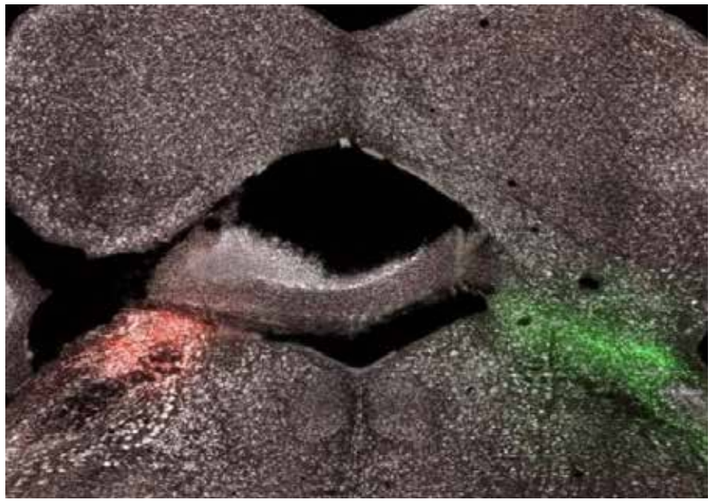


Mass production of recombinant protein

Mass production of recombinant proteins using yeast cell "factories" needs methanol, a compound that requires safe handling, carries the risk of catching fire, and sometimes produces harmful byproducts. Researchers at the Department of Biochemistry have developed an alternative safer process that relies on a common food additive called mono-sodium glutamate (MSG). Adding ethanol helped the cells grow faster, which increased the biomass, and the amount of recombinant protein produced. The researchers hope that this novel, indigenous expression system can be used in biotech industries to mass-produce valuable proteins including milk and egg proteins, baby food supplements and nutraceuticals, apart from therapeutic molecules.

Reference:
Rajak N, Dey T, Sharma Y, Bellad V, Rangarajan PN, Unlocking Nature's Toolbox: glutamate-inducible recombinant protein production from the Komagatella phaffii PEPCK promoter, Microbial Cell Factories (2024).

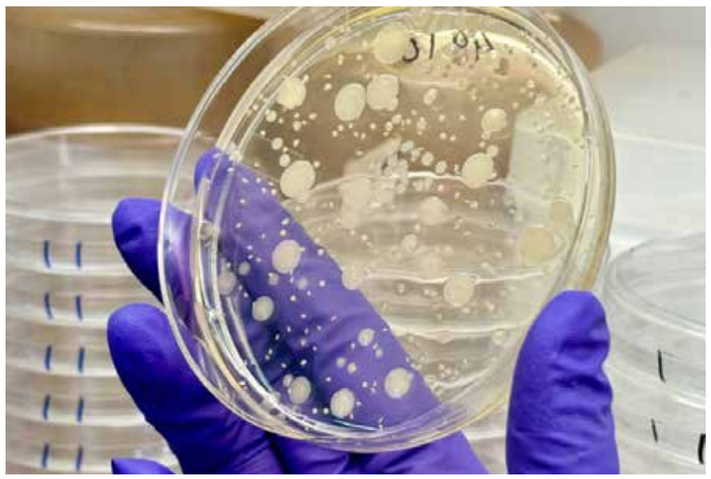
Research **Snapshots**
2024-25



How specific brain regions drive chemotherapy-induced pain response

Chronic physical pain can be debilitating, but feelings of stress, fear, and hunger can sometimes suppress painful sensations. Scientists at the Center for Neuroscience have now found out how different neurons work together to control chronic pain in mice. Working with mice having chemotherapy-induced peripheral neuropathy (CIPN), the researchers discovered that both excitatory and inhibitory inputs converge onto the same set of lateral parabrachial nucleus (LPBN) neurons, which – based on the intensity of the inputs – take the call on whether to reduce licking (when the pain is less) or increase licking (when the pain is more). Such insights can help researchers devise better therapeutic strategies for chronic pain management.

Reference:
Reddy P, Narayan PJ, Chaterji S, Varughese A, Chaudhary Y, Sathyamurthy A, Barik A, Converging inputs compete at the lateral parabrachial nuclei to dictate the affective-motivational responses to cold pain, Pain (2024).



Antimicrobial resistance in soil bacteria without the use of antibiotics

Overuse of antibiotics is currently the primary reason for the rise of antimicrobial resistance (AMR). Researchers at the Department of Microbiology and Cell Biology and Kiel University looked at how the presence of the bacterium Myxococcus xanthus affects the number of antimicrobial-resistant bacteria in soil samples. They found that AMR can surprisingly be found in soil bacterial communities due to microbial interactions too, driven by this species of predatory bacteria. Understanding this phenomenon better might also help predict where such antibiotic-resistant bacteria live in nature.

Reference:

Saha S, Kalathera J, Sumi TS, Mane V, Zimmerman S, Waschina S, Pande S, Mass lysis of predatory bacteria drives the enrichment of antibiotic resistance in soil microbial communities, Current Biology (2025).

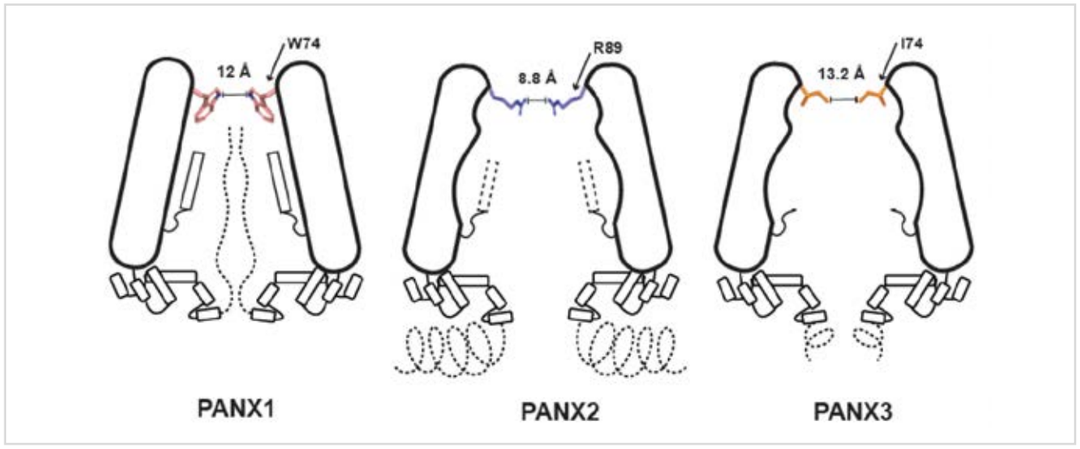
Research **Snapshots**
2024-25

Livestock grazing influences insect populations in the Himalayas

Domestic grazers are increasingly replacing wild herbivores in ecosystems around the world, leading to insidious changes in soil characteristics and vegetation patterns. A long-term study by the Centre for Ecological Sciences in the Spiti valley shows that this replacement can drastically influence the numbers of ground-dwelling arthropods like spiders, as well as that of ticks and mites that can spread vector-borne diseases. Areas grazed by livestock had greatly reduced spider populations, and larger numbers of grasshoppers and disease carriers like ticks and mites. The researchers suggest that steps need to be taken towards “rewilding” native herbivores and improved surveillance of vector-borne disease risks. The findings also underscore the need for effective conservation policies.

Reference:

Baidya P, Roy S, Karapurkar J, Bagchi S, Replacing native grazers with livestock influences arthropods to have implications for ecosystem functions and disease, Ecological Applications (2025).

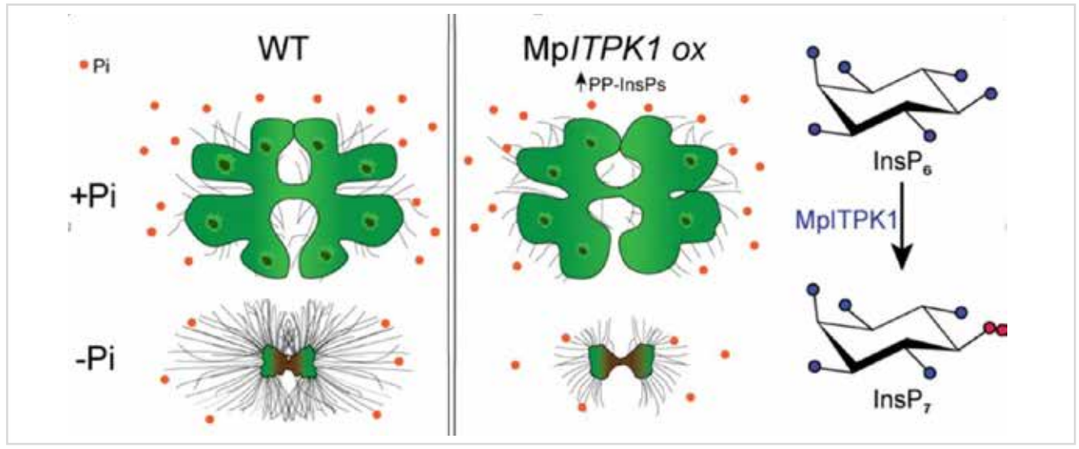


Pannexins as conduits of cellular ATP release

ATP release in cells happens through large-pore ion channels called pannexins, which have been linked to inflammatory conditions. Drugs used to treat gout, like carbenoxolone, target these pannexins. Pannexins are found in three isoforms. Researchers from the Molecular Biophysics Unit used cryo-electron microscopy and electrophysiology to delve into the inner workings of these isoforms. They found that the pore in pannexin 1 has a large aromatic residue, while pannexin 3 has a short hydrophobic residue. As a result, pannexin 3 has a wider pore and is less responsive to inhibition by carbenoxolone, a pannexin 1 inhibitor. The findings underscore how changes in structure alter the pannexins' ability to aid in ATP signalling.

Reference:
Hussain N, Apotikar A, Pidathala S, Mukherjee S, Burada AP, Sikdar SK, Vinothkumar KR, Penmatsa A, Cryo-EM structures of pannexin 1 and 3 reveal differences among pannexin isoforms, Nature Communications (2024).

Research **Snapshots**
2024-25



How land plants have evolved in nutrient-limited environments

Modern agriculture focuses on engineering crop species that can cope better with limited phosphate availability. Inositol pyrophosphates (PP-InsPs) are energy-rich nutrient messengers that control phosphate starvation responses in plants. Researchers at the Department of Biochemistry used the non-vascular bryophyte, Marchantia polymorpha, to study the functional conservation of phosphate homeostasis by PP-InsPs. Under phosphate starvation conditions, both male and female M. polymorpha plants undergo drastic developmental changes, including reduced thallus growth, accumulation of red pigment, and increased rhizoid density. The study shows that the role of inositol pyrophosphates in regulating phosphate starvation responses is likely conserved in all land plants.

Reference:
Pullagurla NJ, Shome S, Liu G, Jessen HJ, Laha D, Orchestration of phosphate homeostasis by the ITPK1-type inositol phosphate kinase in the liverwort Marchantia polymorpha, Plant Physiology (2024).

3.1.1 *Biochemistry*

The Department of Biochemistry, established at IISc in 1921, has been carrying out basic and translational research in diverse areas of biochemistry and molecular biology. The year 2021 was a new milestone in the history of the Department as it completed 100 years of existence. At present, there are 15 faculty members, 2 Honorary Professors, 2 Emeritus Scientists, 90 PhD students, 12 PDF/DST Young Scientists/UGC Kothari Fellows, two administrative staff member, one Technical Assistants, two permanent helpers, and 26 temporary staff members in the Department.

FACT FILE

Established: 1921
Phone: +91-80-2293 2473
Fax: +91-80-2360 0814
Email: office.bc@iisc.ac.in
URL: biochem.iisc.ac.in
Degree programmes offered: PhD and Int PhD

IN NUMBERS

15 Academic Staff
73 PhD students
17 Int PhD Students
65 Publications
18 PhD conferments

Chair: UTPAL S TATU

Current **Research**

Proteins – Structure and Function

(i) Transcriptional and post-transcriptional regulation of carbon metabolism of *Pichia pastoris*

(ii) Mitochondrial protein translocation, biogenesis and turnover with regard to various pathophysiological conditions

(iii) Studying neglected infectious diseases such as rabies and lumpy skin disease to improve diagnosis and treatment strategies

(iv) The enzymes involved in the restriction-modification system in *Heliobacter pylori* and the mismatch repair system from *Neisseria gonorrhoea*

Genome Biology

(i) The molecular mechanisms underlying chromosome synapsis, homologous recombination, DNA repair and genomic stability

(ii) Studies on RAD51 paralogs in mammalian DNA damage responses, genome stability and tumour suppression

(iii) The roles of the Structural Maintenance of Chromosomes (SMC) complexes that mediate higher-order chromatin organisation

(iv) The roles of RAG proteins in genomic instability, understanding mechanism of non-homologous end joining (NHEJ) and identification of compounds with anti-cancer properties

(v) The basis of mRNA fate decisions with a specific focus on translation and mRNA decay

(vi) Mechanism and physiological significance of stop codon readthrough in mammalian system

(vii) Macromolecular interactions that help in 3D genome organisation using single-molecule and super-resolution imaging technologies

(viii) Understanding mechanisms of transplicing-based expression of Hsp90 in *Giardia lamblia*

Systems Biology, Bioinformatics and Metabolic engineering

(i) Mathematical and computational models of biological systems to understand control structures in biochemical pathways, metabolic and regulatory networks, insights from which are being used to understand key perturbations in disease and for biomarker and drug discovery as well as precision medicine

(ii) Secondary metabolites with anti-cancer as well as anti-thrombotic activity from endophytic fungi of *Datura metel, Casia fistula, Catharanthus roseus* and *Mapia foetida*

Cell Biology and Immunology

(i) Thymic atrophy and sepsis – key aspects of host response – during infections

(ii) Host response to tuberculosis using an integrated systems biology approach

(iii) Cytoskeletal forces generated through actomyosin ring machinery during cell division

(iv) Signalling role of inositol phosphates in plants

(v) Role of intracellular RNA sensing mechanisms in inflammatory cell death

(vi) Immunoregulation of inflammatory diseases

Faculty & Staff

PN RANGARAJAN | PhD (IISc), Professor

UTPAL S TATU | PhD (IISc), Professor

DIPANKAR NANDI | PhD (California-Berkeley), Professor

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

SATHEES C RAGHAVAN | PhD (BHU), Professor

NAGASUMA CHANDRA | PhD (Bristol), Professor

SHIKHA LALORAYA | PhD (Wisconsin), Professor

GANESH NAGARAJU | PhD (IISc), Professor

SANDEEP M ESWARAPPA | PhD (IISc), Associate Professor

PURUSHARTH RAJYAGURU | PhD (CCMB), Associate Professor

SARAVANAN PALANI |PhD (Heidelberg), Assistant Professor

DEBABRATA LAHA | PhD (Tübingen), Assistant Professor

KESAVARDANA SANNULA | PhD (IISc), Assistant Professor

MAHIPAL GANJI | PhD (TU Delft), Assistant Professor

PAYEL ROY | PhD (NII, New Delhi), Assistant Professor

Honorary Professors

C JAYABASKARAN | PhD (IISc)

D NARASIMHA RAO | PhD (IISc)

Emeritus Professors

G PADMANABAN | PhD (IISc)

K MUNIYAPPA | PhD (IISc)

3.1.2 *Centre Animal Facility*

The Central Animal Facility (CAF) at the Indian Institute of Science was established in 1971 to cater to the needs of investigators from various departments with research interests in areas like biochemistry, microbiology, reproductive biology, cell biology, immunology, virology, neuroscience, cancer biology, interdisciplinary science, and engineering to accomplish animal research objectives.

FACT FILE

Established: 1971
Phone: +91-80-22932734/ 22932457
Email: office.bc@iisc.ac.in
URL: biochem.iisc.ac.in
Degree programmes offered: Nil

Chair: SATHEES C RAGHAVAN

Current **Research**

The experimental animals are provided to several investigators from around 100 IISc labs who are using laboratory animals for research activities in the Division of Biological Sciences (Biochemistry, Microbiology and Cell Biology, Developmental Biology and Genetics, Molecular Biophysics Unit, Centre for Neuro Science) and other Departments such as Mechanical Engineering, Materials Research Centre, Materials Engineering, Inorganic and Physical Chemistry, Centre for Bioengineering and Centre for Nano Science and Engineering. Researchers from outside IISc also benefit from CAF in various ways.

The CAF is registered with the Committee for Control and Supervision of Experiments on Animals (CCSEA), Ministry of Fisheries, Animal Husbandry and Dairying, Government of India, New Delhi (Registration number: 48/GO/ReRcBiBt-S/ Re-L/99/CPCSEA, 11-03-1999). All activities related to laboratory animal breeding and research at the Indian Institute of Science are performed as per the specified guidelines of CCSEA, New Delhi, as well as in-house institutional guidelines under the direct supervision of Institutional Animal Ethics Committee (IAEC).

New Central Animal Facility (NEW CAF):
A new building for CAF has been established to create a full-fledged National Facility for Laboratory Animal Experimentation. This facility has 36,000 sq ft area and is operational for active laboratory animal research. The facility aims to provide and maintain Specific Pathogen Free (SPF) rodent research models to investigators within IISc and other institutions/ universities from all over India, and investigators from private industries. The new CAF is establishing a transgenic mouse facility to provide services on generating genetically modified mouse models along with cryo-preservation and re-derivation of the precious strains generated and imported.

Research

Pharmacognosy:
Identification of medicinal plants or their active constituents in the context of phytotherapy approach at various levels and management for their medicinal and therapeutic potentiality.

Food Biotechnology:
Focused on metabolic and systems-based biochemical processes in food-related biological systems to produce and improve foods, food ingredients, and functional foods at the processing stage.

Cryobiology:
Development and validation of optimised cryopreservation protocols for gametes and embryos and their assessment of biological viability following post-thaw (in vitro) in terms of pregnancy outcome and well-being of progeny.

Core **Research**

The Central Animal Facility (CAF) breeds, maintains, and supplies various genetically defined inbred strains/outbred stocks of experimental animals for biomedical research at the Institute. The animal species includes New Zealand White rabbits, Wistar rats, Sprague Dawley rats and several strains of mice (Athymic Nude mice, Swiss Albino, BALB/c, FVB/N, CD-1, C57BL/6, C3H/HeJ), including knockout mice (Tlr2 KO, iNOS KO, and so on) and various transgenic mice. In addition to the acquisition and housing of laboratory animals, CAF also provides training to researchers regarding various animal protocols, proper animal care and use of laboratory animals for basic and biomedical research.

Stress Biology:
Antistress consequences of generally employed drugs or phytoconstituents to compare for their protective effects in restrained stress.

Faculty & Staff

SATHEES C RAGHAVAN, PhD

DINESH MB | MVSc, Facility Manager (Acting)

DINESH MB | MVSc, Junior Research Scientist

DEEKSHA PANDIT | MVSc, Junior Research Scientist

SRIJI AP | MVSc Junior Research Scientist

LINA MATHEWS | MVSc, Junior Research Scientist

SHAIK NIKHAT REENA | MVSc, Junior Research Scientist

SAI PRATHYUSHA GAJULA | MVSc, Junior Research Scientist

Associated Scientific Staff

SATHEES C RAGHAVAN | PhD (BHU), Professor

RAMACHANDRA SG | PhD (KVAFSU), Chief Research Scientist

RAVINDRANATH H ALADAKATTI | PhD (Karnatak University)
Principal Research Scientist

3.1.3 *Centre for Ecological Sciences*

The Centre for Ecological Sciences (CES) conducts cutting-edge research in diverse areas of ecology, evolution, behaviour and conservation. We study a range of terrestrial and marine taxa from invertebrates, including insects and molluscs to vertebrates, including fish, herpetofauna, birds and mammals. We employ diverse tools from field-based research, and laboratory experiments to molecular ecology and mathematical modelling.

FACT FILE

Established: 1983
Phone: +91-80-2293 2506, 2360 0985
Email: office.bc@iisc.ac.in
URL: ces.iisc.ac.in
Degree programmes offered: PhD and Int PhD and MSc

IN NUMBERS

11 Academic Staff
1 Scientific Staff
67 PhD students
16 MSc students
74 Publications
5 PhD student conferments
3 Honorary Professors

Chair: KARTIK SHANKER

Current **Research**

We study the interplay between diversity and survival with an emphasis on small populations. Small populations are ubiquitous in nature but are prone to extinction. Models of genetic data from various species suggest that almost all populations have been through a bottleneck in the past and all species were small at some point in time. Hence, all the diversity around us potentially originated from small populations while several others might have faced extinction. We use cutting-edge technology to study evolution in small populations and how they survive.

We have been monitoring eastern Himalayan birds in primary and degraded forests for 15 years. Our results show that, in response to climate change, populations of some species have collapsed dramatically while other species have concurrently become much more common. Our work on mixed-species bird flocks shows that associations between individuals of different species remains stable over time in some groups but not others. Our global analysis of mountain bird species richness indicates that competition between ants and birds at low elevations might

Core **Research**

CES carries out research in animal behaviour, behavioural ecology, bioacoustics, biogeochemistry, biogeography, chemical ecology, climate change, community ecology, ecosystem ecology, forest and grassland dynamics, macroecology, marine ecology, mathematical ecology and modelling, movement ecology, molecular ecology, phylogenetics, phylogeography, plant–animal interactions, population ecology, predator-prey interactions, sensory ecology, stress physiology, and venom evolution.

drive overall patterns of diversity across elevational gradients.

Our research investigates the relationship between snake venom composition and its ecological and biogeographical contexts, focusing on how environmental factors influence venom variability. Using predictive modelling, we demonstrated that climatic conditions can alter venom's biochemical makeup, affecting its efficacy and toxicity. This highlights the need for localised understanding of venom profiles to develop effective antivenoms tailored to specific regional characteristics. Additionally, we explore innovative antivenom strategies, such as synthetic antibodies that neutralise diverse neurotoxic venoms, aiming to improve treatment outcomes and enhance snakebite management.

We studied soil dwelling arthropods in grasslands, forests and human-modified ecosystems. In the high-altitude grasslands of Spiti, we found that replacing wild grazers with domestic livestock has cascading effects on arthropods. This reduces the abundance of predators such as spiders and increases the abundance of grasshoppers, ticks, and mites, which alters the soil food web and raises the risks of vector-borne disease. In the Western Ghats, we found that ground-dwelling ant communities in agroforestry land-use can be as diverse as in forests.

From seasonal tracking of stress responses and diet in the wild, we find that lizards are able to maintain a tight nutrient intake target despite variation in stress responses and resource availability. From manipulative experiments in the lab, we show for the first time that lizards can make risk-sensitive foraging decisions in response to resource uncertainty. Based on our global collaborations in movement ecology, we determined patterns of recovery from wildlife capture, and drivers of pairwise cohesion in wild Canis social groups.

We advanced understanding of collective and ecological dynamics through three studies. We showed how sheep collectively respond to herding dogs, revealing rules of information transfer in flocks. We developed a theoretical framework showing that demographic noise in finite populations can reverse evolutionary selection, reshaping eco-evolutionary predictions. We presented a novel data-driven method to infer underlying stochastic dynamical equations from ecological time series, enabling mechanistic insights from observational data.

Using a long-term dataset from 11 generations in a wild population of the rock lizard, *Psammophilus dorsalis*, we report that exaggerated and costly morphological traits respond sensitively to spatially and temporally changing environmental conditions depending on whether they are under sexual selection or fecundity selection. Our work indicates that the allometric

growth of a weapon in males is affected by temperature, resource availability and the density of competitors and mates during key growth periods, with implications for its evolution under climate change.

We studied the systematics and biogeography of herpetofauna, which revealed new species of shieldtail snakes in the Western Ghats and king cobras across Asia. We continued our decade-long monitoring of sea turtles, sharks and rays across the coast of India. In particular, we examined the diet of sharks on the west coast of India, and assessed levels of microplastic and heavy metal pollution. We conducted molecular analysis of the fauna from 'Autonomous Reef Monitoring Structures' and monitored reef fish in the Andaman Islands.

Work done on the peninsular Indian flying lizard *(Draco dussumieri)* found strong evidence for two independently evolving, geographically distinct northern and southern lineages, suggesting parapatric speciation. A global phylogeny and biogeography of *Hemidactylus* geckos supported their Indian origin and identified multiple hubs of diversification, notably in India and Africa. Microsatellite-based population genetic study on the Himalayan langur revealed an overall lack of population genetic structure and a much higher gene flow along the elevational gradient than across river valleys.

Plant-herbivore-parasitoid food webs associated with the plant family *Rutaceae* in cultivated citrus and curry leaf (simple environment), and unstudied forest understory plants (complex environment) differ. Food web complexity increases habitat complexity, but specialisation does not. We are also exploring the strong role of annual rainfall on the effects of grazing on grassland plant communities.

Faculty & Staff

SUMANTA BAGCHI | PhD (Syracuse), Associate Professor

ROHINI BALAKRISHNAN | PhD (TIFR), Professor

RENEE M BORGES | PhD (Miami), FASc, FNA, Visiting Professor

VISHWESHA GUTTAL | PhD (Ohio), Professor

KAVITA ISVARAN | PhD (Florida), Professor

PRAVEEN KARANTH | PhD (SUNY, Albany), Professor

ANUBHAB KHAB | PhD (NCBS), Assistant Professor

TV RAMACHANDRA | PhD (IISc), Scientific Officer

KARTIK SHANKER | PhD (IISc), Professor

UMESH SRINIVASAN | PhD (NCBS), Assistant Professor

KARTIK SUNAGAR | PhD (Portugal), Associate Professor

MARIA THAKER | PhD (Indiana State), Professor

SASKYA VON NOUHUYS | PhD (Cornell), Associate Professor

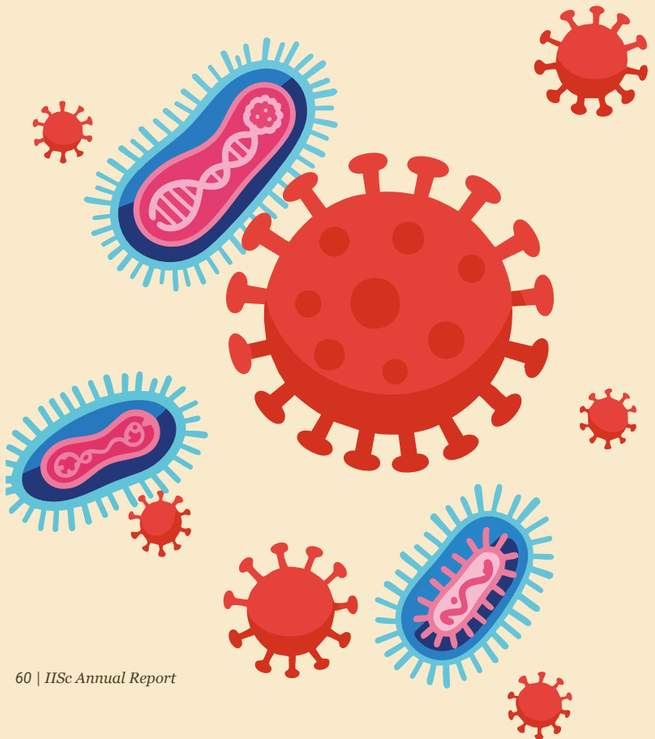
Honorary Professors

RAGHAVENDRA GADAGKAR | PhD (IISc), FASc, FNA, FTWAS

RAMAN SUKUMAR | PhD (IISc), FASc, FNA, FTWAS

3.1.4 *Centre for Infectious Disease Research*

The main goal of the 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 faculty members from other departments and provides a fully equipped and functional laboratory and state-of-the-art Bio Safety Level-3 (BSL-3) facilities to perform research on human pathogens. Research activities in CIDR are spearheaded by faculty members from Biological Sciences with senior-level fellowships such as India Alliance-DBT Wellcome, through which competitive grants have been procured for studies related to infectious disease research. In addition, CIDR received generous funding from the Infosys Foundation in January 2016. CSR grants from Crypto Relief and L&T in the year 2021-22 have enabled the expansion of VBSL-3 and the setting up of a Sequencing facility in CIDR. In 2024-25, a brand-new Animal BSL3 facility was set up at CIDR, with financial support from ANRF/DST India.



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IN NUMBERS

22 Publications

Convener: BALAJI K N

Current **Research**

Amit Singh:
Our group has identified a key role played by hydrogen sulphide (H_2S) gas in suppressing the SARS-CoV-2 virus. Increased H_2S was found to have a direct effect on reducing the rate at which the virus multiplies in SARS-CoV-2-infected human immune cells and animal models such as mice and hamsters. The finding paves the way for developing a more comprehensive host-directed therapy against COVID-19. The study was published in *PLoS Pathogens* (Agrawal et al, 2025). Studies in COVID-19 patients linked lower serum levels of H_2S with increased COVID-19 disease severity and death. Despite this, the systematic understanding of the antiviral effect of H_2S remains circumstantial and poorly understood. Our findings highlight that H_2S-based interventions can be exploited to maintain cellular homeostasis and reduce SARS-CoV-2 spread and lung damage during infection.

Shashank Tripathi:
In the year 2024-25, our lab has contributed to few studies on the development of SARS-CoV-2 vaccines (O neil et al, *Ebiomedicine*; Kumar et al, *Vaccine*; Singh et al, *Process Biochemistry*). We were granted a US patent on the use of a novel natural metabolite, Picolinic Acid, as a broad-spectrum antiviral. In another study, we examined the strain-specific ability of SARS-CoV-2 to cause gut infection and dysbiosis (Nagraj et al, bioRxiv). In a few other important studies, we have developed a broadly protective intranasal vaccine against Influenza A viruses and discovered a broadly protective repurposed antiviral drug against mosquito-borne flaviviruses.

Vidya Mangala Prasad:
Our lab works with pathogenic, enveloped RNA viruses, such as dengue virus, Japanese encephalitis virus and influenza viruses. The lab also works with viral proteins from HIV-1, influenza, SARS-CoV-2, and so on. Our focus is on structurally characterising the viral immune landscape to identify quaternary epitopes as well as the virus infection machinery to delineate protein and membrane conformational changes that occur during virus infection. In 2024-25, our lab has contributed to multiple publications: Ahuja et al, NPJ vaccine, Gupta et al, *Biochimie,* Makam et al, *Faseb Bioadvances,* and Veerabhadraswamy et al, *J. Extracell. Biol.*

Core **Research**

Ongoing 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 focused on the principal immune mechanisms that contribute to reactivation of tuberculosis in the context of HIV infection. Another newly developed area of research is virus-host interactions of emerging RNA viral pathogens including SARS-CoV-2, and viruses that cause influenza and dengue. The overall aim is to understand the molecular basis of viral pathogenesis and translate the knowledge to novel antivirals and improved vaccine candidates.

Associate Faculty

USHA VIJAYARAGHAVAN | PhD, Dean, Professor

BALAJI K N | PhD, Professor

DIPANKAR NANDI | PhD, Professor

BALASUBRAMANIAN GOPAL | PhD, Professor

DIPSHIKHA CHAKRAVORTTY| PhD, Professor

NAGASUMA CHANDRA | PhD, Professor

DEEPAK K SAINI| PhD, Professor

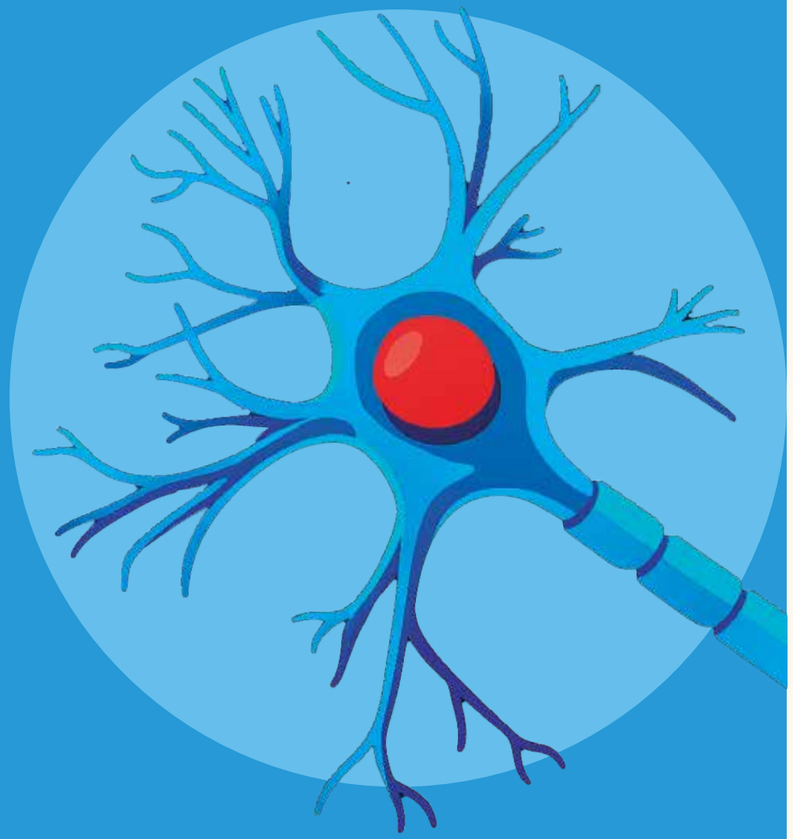
AMIT SINGH | PhD, Professor

SHASHANK TRIPATHI I PhD, Associate Professor

VIDYA MANGALA PRASAD I PhD, Assistant Professor

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 organisation using molecular, cellular, systems, cognitive, and computational approaches. These are the main focus areas of the Centre for Neuroscience (CNS). It recruits faculty members across wide-ranging disciplines to establish a strong programme in basic neuroscience and builds links to existing expertise in IISc as well as with clinical centres to develop translational research. The department currently has 10 faculty members and one faculty fellow.



FACT FILE

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Degree programmes offered:
PhD and Int PhD

IN NUMBERS

10 Academic staff
51 PhD students
35 Publications
6 Int PhD students
5 PhD conferments

Chair: SP ARUN

Current **Research**

SP Arun:
In the last year, we have uncovered several fundamental insights into the neural basis of visual perception. First, we have demonstrated that when humans see an occluded object, they perform a sophisticated form of feature completion to infer the contents behind the occluder (Cherian & Arun, 2024). Second, we have uncovered a novel computation performed by the brain in a localised region which helps us solve property-based visual tasks such as oddball visual search, same-different and symmetry tasks (Jacob et al, 2025). Some ongoing work includes understanding how physical properties of objects are integrated into visual representations, understanding the neural basis of real-world vision, and so on.

Kavita Babu:
We use the model organism *Caenorhabditis elegans* to study the molecular machinery underlying neuromuscular junction (NMJ) function, with a focus on cell adhesion molecules and how they signal at synapses. We are currently assessing the role of claudins at the NMJ. Our laboratory is also very interested in understanding aspects of neuropeptidergic circuits and we are working on multiple projects that will allow us to delineate the role of neuropeptides in the behavioural circuits of *C. elegans*. Our recent research includes a screen with neuropeptide mutants that looks for foraging defects in worms. This screen has yielded multiple hits, a couple of which are being taken further.

Arnab Barik:
I joined CNS in 2020 and have since researched on the circuit basis of pain and itch. We have identified novel circuit mechanisms for stress-induced analgesia. We are able to molecularly define and functionally test a pathway between the septum and the hypothalamus that, in an opioid-dependent way, responds to stress and modulates pain. The manuscript for this work is now published in *eLife*. In another study, we are looking into the licking response, a coping behaviour to painful stimuli. Using viral genetics and transgenic mouse strains, we are able to demonstrate that circuitry centred in the Para fascicular thalamic area is instrumental in pain-induced licking behaviours. This work is published in *Pain*. In another project, we are developing a novel machine-learning based behavioural analytic tool to better understand neural circuits for acute and chronic itch.

Sridharan Devarajan:
Our lab seeks to understand the neural bases of distinct components of attention (sensitivity and bias), supported by the DST SwarnaJayanti Fellowship. In one study (Sengupta et al, *Nature Communications*, 2024), using non-invasive neurostimulation (TMS and tACS), we demonstrated that the right posterior parietal cortex (rPPC) plays a putative causal role in mediating bias reorienting. In a second study (Halder et al, *eLife*, 2025; version of record), using behaviour and EEG recordings, we identified distinct neural underpinnings of sensitivity and bias during a transient attentional deficit, called the attentional blink; the paper was evaluated as an "Important" contribution, reporting "Convincing" evidence. In a third study (Sengupta et al, *PLOS Biology*, 2025, in press), we showed how reward-induced orienting of attention produces distinct behavioural and neural effects on sensitivity

Core **Research**

Movement and cognitive control, neurobiology of disease, neural mechanisms of selective attention, neuronal differentiation and development, neurobiology of learning and memory, molecular organisation of synapse, visual perception and recognition, emotion and reward processing, molecular mechanisms of pain and itch, neural signal processing and oscillations, motor learning, neural basis of complex behaviours.

and bias. In a fourth study (Sunder et al, *Neuroimage,* 2025, in revision), we identified distinct electrophysiological bases of sensitivity and bias in a ubiquitous attention task, called the Posner cueing task. These results advance our understanding of neural mechanisms of attention and may offer the potential to develop targeted therapies for treating specific components of attention disorders.

Ashesh Dhawale:
Our group is interested in how the brain solves complex tasks by trial-and-error learning. In the past year, we have worked towards understanding the role of rodent cortico-striatal circuits and dopaminergic neuromodulation in adaptation of movement kinematics as well as decision-making. We developed a new motor learning task that trains rats to adapt the kinematics of simple, ballistic movements. Through targeted lesions, we demonstrated that both the motor cortex and its downstream target, the sensorimotor striatum, are necessary for motor learning, as is dopaminergic innervation of the sensorimotor striatum. Fibre-photometric recordings of phasic dopamine release in the dorsolateral striatum revealed that this area receives a reward-prediction error signal that drives learning. We also queried the role of the basal ganglia in adaptive decision-making in the context of a multi-choice decision-making task and found that exploration in such tasks relies on the sensorimotor striatum, but not the associative striatum. Moreover, we found a striking similarity between rodent and human exploratory strategies in such multi-choice tasks. We are currently preparing these results for publication. We have also begun performing electrophysiological recordings from the basal ganglia to understand its computational role in trial-and-error learning.

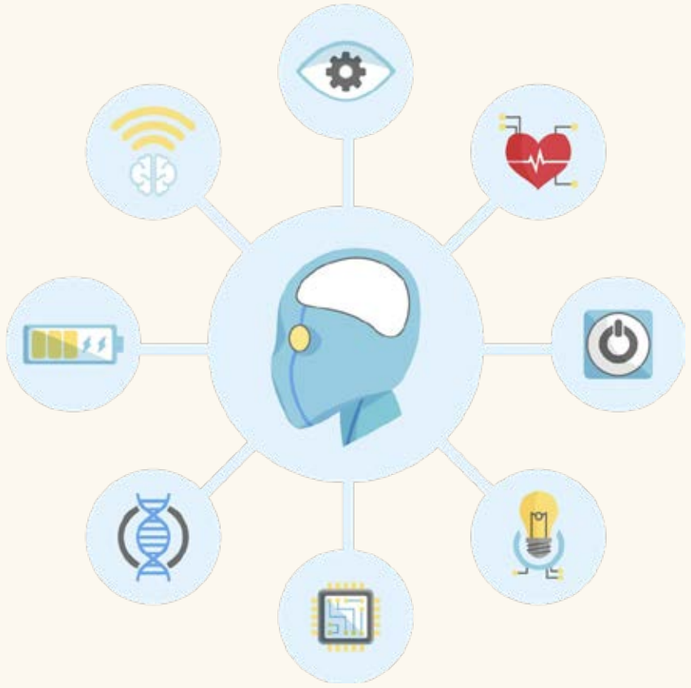
Balaji J:
Life events form enduring memories in our brain. Our lab is interested in understanding how these memories evolve as a function of time and its effects on our ability to retrieve this information. While our previous research has shown that such transformations take shape in the brain and how they can lead to memories of untrue events, in the previous year, our efforts have focused on elucidating the mechanism underlying the formation of false memories. We could show that long lasting memories are often unaccompanied by uncertainty during retrieval. Further, our results show that during such retrieval, memories of events that never occurred are confabulated in the brain and are rapidly consolidated in the brain leading to life-long storage of these false memories. Through genetic manipulations, we could show that these memories indeed require a class of interneuron activity (Parvalbumin positive interneurons). In parallel, other research from our lab shows that interference, the inability of the brain to encode or retrieve information reliably can be averted through modulating the training procedure. In our efforts to take these investigations to human subjects, we have developed a high-density low power, portable and wireless device that is capable of imaging and following the activity of the brain. Our device achieves this by following the cytochrome oxidase activity from the deeper layers of the human brain while the subject is involved in performing a cognitive task.

Aditya Murthy:
Following up on previous behavioural and experimental work that suggested a role for trajectory control in fast eye movements called saccades (Vasudevan et al 2021, 2023), we used a novel approach to study online trajectory control using fingers, saccades, and reach movements. We further tested this approach to validate that online control is impaired in cerebellar patients but also surprisingly revealed online control deficits in Parkinson's disease patients. We also have continued our studies to study the cortical inputs to muscle by selective stimulation of the supplementary motor area in human subjects and observed selective changes in early motor unit activation in some subjects that can explain the role of descending inputs from the SMA in early motor preparation. Interestingly, in this study we also observed a novel role of SMA in motor execution by showing changes in movement kinematics between pre and post stimulation.

Deepak Nair:
The nanoorganisation group has been dedicated to understanding the fundamental processes that govern brain function, with a particular focus on the molecular organisation and regulation of excitatory synapses. Our goal is to unravel how key synaptic molecules contribute to the formation, function, and plasticity of synapses, shedding light on brain development and disorders that span from infancy to adulthood, including conditions such as Alzheimer's Disease. By combining insights from multiple scientific disciplines,

we aim to create detailed, data-driven models that capture the dynamics of synaptic biology across a wide range of spatial and temporal scales from the nanometer level to larger networks, and from millisecond-fast interactions to changes that occur over hours or even longer. These efforts are designed to deepen our understanding of how the brain functions in health and how it becomes disrupted in disease. A significant focus of our work involves developing advanced imaging tools to study synapses in unprecedented detail. By integrating ultra-high and super-resolution microscopy with techniques like optogenetics and calcium imaging, we strive to capture dynamic changes in the molecular organisation of synapses at resolutions as fine as a few tens of nanometres, with millisecond precision. This capability allows us to directly link molecular changes to functional outcomes, offering powerful insights into how synapses operate and adapt. To complement these technological advances, we have been working on using transgenic mouse models and CRISPR-Cas9-based methods for precise labelling of proteins within single cells.

Srikanth Padmala:
In the last year, our research primarily focused on investigating the interactions between reward and emotion in the human brain using behavioural and functional brain imaging techniques. In a functional MRI (fMRI) study, we investigated the impact of negative emotions on reward motivation. We observed that negative emotion counteracts the reward-driven enhancements in visual perception (Jaiswal et al, under review). In a separate behavioural study, we found that the contingency between a successful response and reward outcome plays a crucial role in driving the impact of appetitive and aversive motivation on emotional distraction (Krishnan et al, under review). Finally, in another behavioural study, we investigated the impact of perceptual load on the interference of simultaneous positive and negative emotional distractors. Our findings indicated that the effects of perceptual load on simultaneous emotional distractors are valence insensitive (Thyagaraj and Padmala, under review).



Supratim Ray:
We studied whether visual stimulus-induced gamma oscillations can be induced using auditory stimuli, but found that they elicit a distinct broadband response instead (Gulati and Ray, 2024, *eNeuro*). We recorded gamma responses while monkeys viewed natural images and found that they can be predicted from low-level features such as colour and saturation (Kanth and Ray, 2024, *eNeuro*). In monkeys performing an attention task, we found that behavioural outcome (hit versus miss) and attentional location (left versus right) can be better decoded using low-frequency versus high-frequency signals in the local field potential (Prakash et al, 2024, *eNeuro*). Finally, we built a model in which delayed accumulation and dissipation of inhibition compared to excitation was used to explain variation in gamma peak frequency with changing contrast (Krishnakumaran et al, 2025, Journal of Neuroscience).

Anupama Sathyamurthy:
I started my lab at the *Centre for Neuroscience* in September 2020. Our research is geared towards unravelling the neural circuits underlying motor control. To address this, we use genetic strategies to selectively monitor the activity of distinct classes of neurons in behaving mice and manipulate their activity to determine its effect on sensorimotor control. Towards this, in the past year, we have set up automated tasks to assess visuomotor coordination, dexterous forearm movement, somatosensory responses, and navigation in mice. We have identified three novel and distinct circuits that may underlie each of these tasks. Our current studies are geared towards revealing the anatomical and functional organisation of these circuits and how its dysfunction contributes to disorders.

Faculty

SP ARUN | PhD (Johns Hopkins), Professor

KAVITA BABU | PhD (IMCB, Singapore), Associate Professor

ARNAB BARIK | PhD (Medical College of Georgia), Assistant Professor

SRIDHARAN DEVARAJAN | PhD (Stanford), Associate Professor

ASHESH DHAWALE | PhD (NCBS), Assistant Professor

BALAJI JAYAPRAKASH | PhD (TIFR), Associate Professor

ADITYA MURTHY | PhD (Pittsburgh), Professor

DEEPAK NAIR | PhD (Leibniz Institute for Neurobiology), Associate Professor

SRIKANTH PADMALA | PhD (Maryland), Assistant Professor

SUPRATIM RAY | PhD (Johns Hopkins), Professor

Faculty Fellows

ANUPAMA SATHYAMURTHY | PhD (Augusta University), India Alliance Intermediate Fellow

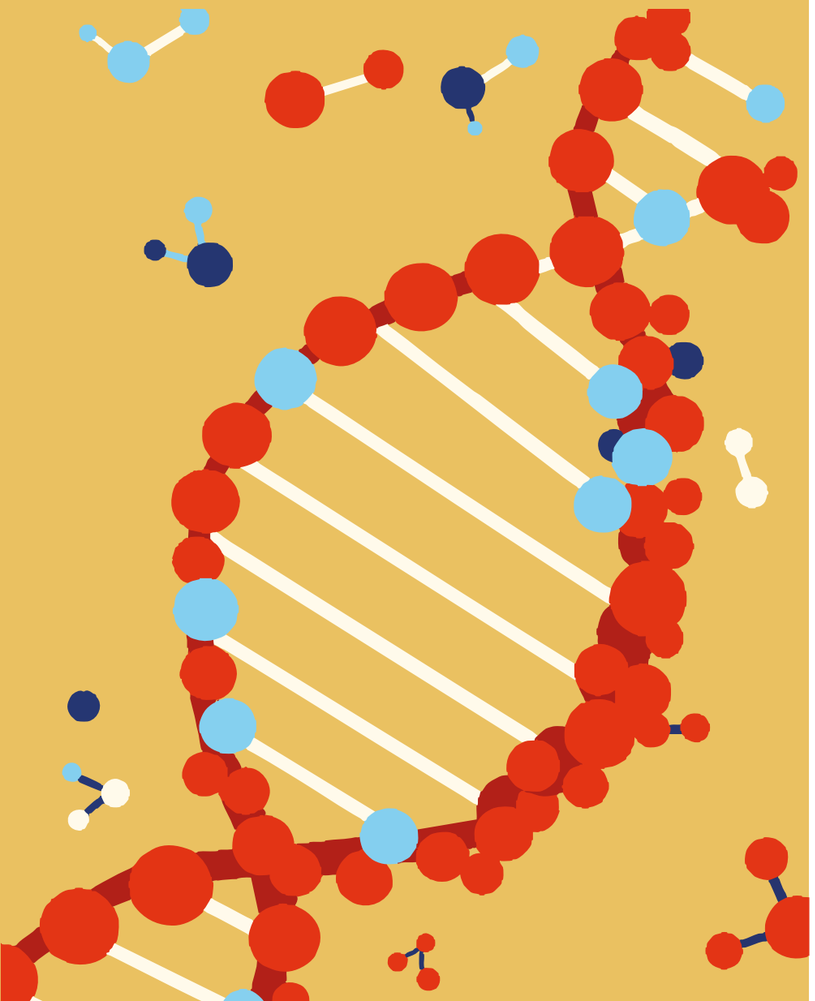
Adjunct Faculty

ANINDYA SINHA | PhD (TIFR, Mumbai), Professor, National Institute of Advanced Studies (NIAS), Bengaluru

SANJAYA VISWAMITRA | Head of Radiology, Sri Sathya Sai Institute of Higher Medical Sciences, Bengaluru

3.1.6 *Developmental Biology And Genetics*

Research in the Department of Developmental Biology and Genetics (DBG) is diverse and ranges from molecular to organismal scales. Groups within the department conduct research in bacterial and human genetics, signal transduction, mammalian reproduction, endocrinology, cell and developmental biology, ageing and metabolic disease, cancer, stem cells, longevity and cryo-electron microscopic analysis of large macromolecular complexes.



FACT FILE

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Degree programmes offered: PhD and Int PhD

IN NUMBERS

11 Academic Staff
54 PhD students
29 Master's Students
11 Int PhD Students
211 Publications (last 5 years)

Chair: UPENDRA NONGTHOMBA

Current **Research**

Signal transduction, infection, and transgenic mouse models to study gastrointestinal function
A novel transgenic mouse has been characterised, harbouring an activating mutation in receptor guanylyl cyclase C that appears to mimic some of the features seen in patients with familial diarrhoeal syndrome. These changes include an altered gut microbiome and increased faecal water content and gut transit. The role of a universal stress protein in modulating biofilm formation in *Mycobacterium smegmatis* has been shown, and the role of a novel phosphodiesterase in mycobacteria that has profound effects in cell physiology and membrane properties has been characterised. We identified a novel protein in Mycobacteria that condenses DNA and binds RNA. We investigated the consequences of expression of hyperactive receptor guanylyl cyclase C in the gut, and identified changes that include alterations in the microbiome and intestinal gene expression.

Cellular signalling and inflammation
Towards understanding ageing and inflammation, research is focused on a class of receptors known as G protein-coupled receptors (GPCRs) and their roles in the cascade of events which occur when cells grow old aka 'aged.' Receptors, however, do not work in isolation, and research is keenly being pursued on the mechanisms by which GPCRs and receptors of other classes cross paths, a phenomenon known as 'crosstalk.' The ramifications of such crosstalk in the context of cellular responses in aged cells are being studied, using live imaging, pharmacological and gene inactivation and metabolomics profiling approaches. Like eukaryotic cells, prokaryotic bacterial cells also possess an extensive internal network of connections that direct specific responses to specific stimuli. In this area, studies are being carried out on two-component signalling (TCS) cascades. We recently reported the presence of intricate networking amongst TCS systems in Mtb. A Raman spectroscopy-based bacterial identification and viability assessment platform has been developed. In the field of bacterial signalling, the role of carbon metabolism has been established in modelling the signal transduction pathways.

Aging and longevity research in the Indian setting:
Extension of healthspan through understanding ageing biology in the Indian population can help improve quality of life in the Indian population as we age. Through groundbreaking science, community partnerships, and innovative policies, we are building a future where all Indians can age healthier. Our discoveries will contribute to the global mission of improving human longevity. To do this, we are collecting signatures from the Indian population through

Core **Research**

Research at the department is diverse and ranges from bacterial and human genetics to signal transduction, developmental biology, cancer, diabetes and stem cell biology. The underlying theme is molecular-level studies of cellular functioning in normal and pathological conditions. We approach this in a variety of ways, using model systems such as Drosophila, transgenic, knockout and humanised mouse models and even direct human population studies.

the BHARAT Study (Biomarkers of Healthy Aging Resilience, Adversity, and Transitions), which is a comprehensive population study investigating the biomarkers of ageing in the Indian population. Through multi-omics and multi-modal analyses, we aim to identify patterns and markers that can predict ageing-related conditions and develop interventions to improve healthspan. On the other hand, there is an effort to understand organ-specific biomarkers that can be compared with novel organotypic senescent models that we build to design interventions to delay ageing. With a multidisciplinary, collaborative approach, the initiative will focus on translating science into real-world solutions for healthy ageing.

Structural biology of translation

In eukaryotic translation initiation, Met-tRNA binds to the 40S ribosome as a ternary complex with eIF2 and GTP. During stress, the delivery of tRNAi is regulated by blocking the formation of the ternary complex. A noncanonical factor, eIF2A, that has an N-terminal nine-bladed β-propeller followed by an intrinsically disordered region (IDR) at the C-terminal can deliver Met-tRNAi or other charged tRNAs to 40S in a codon-dependent, and GTP-independent manner, unlike eIF2 to initiate protein synthesis. However, the details of eIF2A-mediated tRNA delivery remain unknown. We used biochemical, and computational, and in vivo complementation studies to identify regions of yeast eIF2A that are important for its function and show that deletion or even point mutations in these regions are not tolerated in stress conditions. IDR consisting of a conserved short linear motif, a positively charged stretch, and two C-terminus α-helices is sufficient for binding tRNA and 40S, however, conserved N-terminal nine-bladed β-propeller is essential for eIF2A function in vivo. Furthermore, eIF2A binds to entire cellular tRNA pool suggesting eIF2A can deliver tRNAs based on the codon present at the ribosomal P-site and pull-down assays suggest that eIF2A interacts with ribosomal proteins near the P-site, providing invaluable insights into its role in translation initiation.

Host-microbe interaction

Research was carried out to understand how sensing/perception in a complex environment shapes adaptation in prokaryotes and eukaryotes, ensuring their survival. A genetically tractable eukaryotic model, *Caenorhabditis elegans,* has been utilised to understand how sensory neurons and G-protein coupled receptors allow sensing of microbes in the environment leading to adaptation in the worm's behaviour or its physiology, to optimise its survival. It was found that *C. elegans* uses olfaction as the means to distinguish between some species of bacteria. Volatiles that are perceived as threat allow worms to run away (flight response), lay their eggs far away from threat cues and allow them to mount a defensive physiological response. Also, *Pseudomonas aeruginosa,* a Gram-negative bacterium, has been utilised to understand how its large genomic repertoire of two-component sensors and response regulators (136 genes) regulates quorum-dependent processes, namely swarming motility, and biofilm formation. We also identified 18 two component systems in *Pseudomonas aeruginosa* as regulators of biofilm formation on endotracheal tubes. This sheds lights on genes which affect disease pathology in patients suffering from ventilator-associated pneumonia. We identified and studied an olfactory G protein Coupled Receptor STR-2 as a regulator of lipid metabolism and longevity in *C. elegans*. We also studied the role of lipid breakdown as fuel for facilitating innate immune response of *C. elegans* to bacterial and fungal pathogens of medical importance.

Microbiome-mediated insect adaptation

Microbiomes constitute important components of animal health, development, and adaptation. In insects, microorganisms can form extreme and highly intricate symbiotic associations. The emergence and maintenance of such symbiotic interactions is an important but understudied and underappreciated aspect of adaptation. Using insects such as scale insects that are pests on many important crops and using scarab beetles that are important agents of nutrient recycling in terrestrial landscapes, symbiotic associations between insects, bacteria, and fungi are being studied. Current research focuses on acquisition and transmission of primary and secondary symbionts, their metabolic integration with host physiology, their role in digestion and detoxification, host adaptation and evolution.

Epigenetic regulation during mammalian embryogenesis and stem cell differentiation

Epigenetic regulation plays an important role in development. Often, dysregulation of epigenetic regulation associated with diseases. How epigenome and epitranscriptome regulate the gene expression to drive lineage specification during pre-implantation development and gastrulation remains poorly understood. Recently, we have discovered that m6A RNA methylation plays an important role in setting up three early embryonic lineages (embryonic stem cells, trophoblast stem cells and extra-embryonic endoderm stem cells) during preimplantation development. Currently, we are exploring the crosstalk between epigenome and epitranscriptome during the early embryonic lineage specification. On the other hand, many X-linked genes have been implicated to contribute to early embryogenesis. Recently, we have shown that two X-chromosomes in female cells coordinate with each other to fine tune the X-linked gene expression dosage

relative to autosomal dosage during early embryogenesis. We are now exploring the underlying mechanisms involved in transcriptional coordination between two X-chromosomes during early embryogenesis.

Climate change and maternal child health

Recently, drastic changes in climate patterns have been detrimental to the global healthcare sector. Growing evidence suggests that deteriorating global warming conditions will adversely affect pregnant women who undergo vast metabolic and physiological adaptations. To address this issue, especially in India where pregnant mothers are exposed to prolonged summer heat (>40°C), we created a mouse model system resembling human pregnancy adversities, including frequent pregnancy loss, low neonatal birthweight and mortality. Transcriptomic investigation revealed embryonic defects starting post-implantation, mainly contributed by dysregulated placental development. Further, we are investigating how heat-humidity stress perturbs the healthy microbiome and epigenome, thereby disrupting maternal-child health.

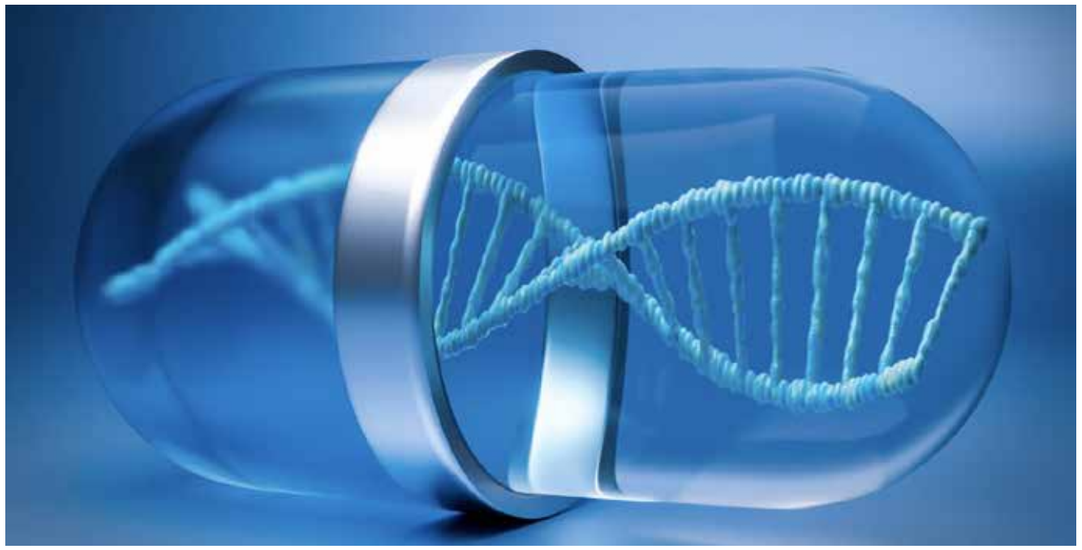
Muscle development

The LIM domain, constituted by two tandem *C2H2* zinc finger motif proteins, regulate several biological processes. They are usually found associated with various functional domains like the homeodomain, kinase domain and other protein binding domains. LIM proteins that are devoid of other domains are called LIM only proteins (LMO). LMO proteins were first identified in humans and are implicated in development and oncogenesis. A novel role for LIM only protein Beadex (LMO2) has been identified in the development of crystal cell blood formation in Drosophila melanogaster.

It is shown that the Drosophila gene CG9650 is involved in muscle patterning through regulation of Notch and Wingless pathways (Saraoj Jawkar, PhD thesis). It was also shown that *Croton tiglium L.*, which has been used in Ayurvedic and Chinese herbal medicinal formulations from ancient times, can cause genotoxicity (Yumnamcha et al, 2020).

Molecular reprograming of Adipose tissue and metabolic disease

Adipose tissue is categorised into white adipose tissue (WAT) and brown adipose tissue (BAT). While WAT expands massively during obesity and ageing with lipid overload, brown fat, a distinct tissue, dissipates energy as heat through uncoupled respiration, increasing energy expenditure and insulin sensitivity. Thus, increasing the activity of brown adipose tissue (BAT) is considered an attractive therapeutic strategy to help reduce insulin resistance, obesity, and associated metabolic diseases. Recently, we identified a small molecule, sesaminol, as an inducer of brown adipose function. Besides, sesaminol holds the promising capacity to combat diet-induced obesity and metabolic dysfunction-associated fatty liver disease (MAFLD). Unlike genetic manipulation, small molecules that can induce BAT function are safer and more attractive therapeutic targets for developing anti-obesity regimens. Our research interest also centres on the impact of brown and/or beige fat function on age-related obesity and insulin resistance. Our recent study reveals that ageing and β3-adrenergic stimulation affect the physicochemical properties of mitochondrial membrane and brown fat function. Further



mechanistic studies demonstrate the potential role of EBF2, a brown fat-specific pioneering transcription factor, in regulating the diurnal oscillation of brown fat function, mitochondrial membrane lipids, and homeostasis.

Islet environment and hormone secretion during type-2 diabetes

Patients with diabetes have high blood glucose levels either because their pancreas does not produce sufficient insulin, or their body cells do not respond to signals from insulin that tell them to use up glucose. Current treatments, therefore, rely on supplying insulin bolus to such patients. However, recent studies have shown that fluctuations in the levels of other hormones also have a role.

To understand these changes, we focus on the islet environment where glucagon, somatostatin, exosomes, and glucose transporters maintain glucose homeostasis which is affected during diabetes. We have been able to discover that there is a decrease in somatostatin secretion (Kothegala et al, *IJMS,* 2023), glucagon (Gandasi et al, *Diabetologia,* 2023) and exosome secretion (Priyadarshini et al, *JEXB,* 2024) during type-2 diabetes. Some of these ER-stress related (Makam et al, *Biomedicines,* 2022) effects can be decreased by treatment of islet cells with a chlorophyll-derived compound called Pheophorbide A (Paul et al, *Front. in Endo.,* 2024). With these studies, we aim to identify newer treatment targets that can manage the secretion of hormones in islet cells during diabetes.

Omics-based biomarkers have the potential to revolutionise personalised health monitoring by predicting biological age (BA) and resilience. No validated systems currently exist that can accurately assess the biological age of an organ like the pancreas. Establishing a framework for integrating these data across genomic, proteomic, and metabolic domains to assess overall health and predict the onset of metabolic diseases like diabetes would provide insights into the determinants of aging and metabolic dysregulation leading to type-2 diabetes. This work is done in collaboration with the Longevity India initiative.

MicroRNAs in oral cancer

miRNAs play a critical role in the progression of various diseases, including oral squamous cell carcinoma (OSCC). The aim of our study is to identify novel tumour suppressor miRNAs, which are silenced by DNA methylation and investigate their roles in OSCC pathogenesis. We have treated OSCC cells with 5-Azacytidine to reactivate tumour suppressor miRNA genes silenced/downregulated due to DNA methylation. At 5 days post-treatment, total RNA was isolated from 5-Azacytidine and vehicle control treated cells and subjected to the microRNA microarray analysis, using Agilent

human miRNA microarray chips with 2,459 miRNAs. Of the 50 miRNAs which were found to be upregulated following the treatment, we have explored the role of miR-6741-3p in detail. The results indicated that miR-6741-3p directly targets the oncogene SRSF3. The tumour-suppressive role of miR-6741-3p was established by various in vitro assays and in vivo study in NU/J athymic nude mice. Based on our observations, we have proposed that miR-6741-3p may serve as a potential biological target in tumour diagnostics, prognostic evaluation, and treatment of OSCC and perhaps other malignancies.

Cancer stem cells

Cancer stem cells (CSCs) are a subpopulation of cancer cells with stem cell-like properties that with play a crucial role in drug resistance and metastasis. Metastasis, the spread of tumour from the primary site to distant organs, is the major cause of cancer-associated deaths. Two key processes that aid in this process are 1) the pithelial-to-mesenchymal transformation that enables cancer cells to become more migratory and invasive, and 2) anoikis resistance which enables cancer cells to death triggered by matrix detachment. Work done so far has identified a key role for the cellular energy sensor, AMP-activated protein kinase (AMPK), in both these processes, thereby linking cancer stemness, EMT and anoikis resistance. Further, AMPK activation causes metabolic re-wiring by activating catabolic and inhibiting anabolic processes. By identifying AMPK as a key switch in metastasis, the work highlights metabolic vulnerabilities of metastatic cancer cells, which can be targeted.

Hypoxia is a hallmark of the solid tumour microenvironment and contributes to tumour progression and therapy failure. The developmentally important Notch pathway is implicated in the maintenance of cancer stem/progenitor cells in tumour hypoxia. Yet, the mechanisms that lead to Notch activation under hypoxia are not fully understood. Hypoxia is also a stimulus for AMP-activated protein kinase (AMPK), a major cellular energy sensor. In a study, we show that pharmacological as well as hypoxia-triggered AMPK activation led to stabilisation of intracellular Notch1 via Fyn kinase. AMPK inhibition under hypoxia affected self-renewal and drug resistance adversely, suggesting that hypoxia-induced AMPK activation might potentiate breast cancer aggressiveness through the Notch pathway.

We are currently focused on developing novel AMPK-inhibitors to test their potential in curbing metastasis.

Cancer glycobiology

The relationship between cancer (breast and ovarian) cells and their tissue microenvironments in the context of invasion and metastasis is being investigated using approaches including experimentation and computation to understand how changes in glycans that contribute to cell and tissue structure are aberrantly regulated and in turn affect cancer cell phenotypes. The lab's publications highlight the complexity of the tumour microenvironment in governing the invasion of breast and ovarian cancer epithelia and the manner of their migration.

The group has strived to uncover the role of glycans at distinct scales: evolutionarily shaping the primary structure of a protein by evolving residue neighbourhoods distinct from disordered stretches and conferring negative charge through sialic acids to the local ECM neighbourhoods around cancer cells, with implications both for immune cell interactions and theragnostic applications.

Small RNA-mediated epigenetic regulation of host-pathogen interaction

RNA interference (RNAi) is a conserved pathway across all eukaryotic species. Even though proteins involved in the RNAi pathway are well conserved, there is a degree of plasticity introduced by the presence of multiple homologs of DICER or AGOs depending on the presence of different types of sRNAs and their functions in different species. However, there are exceptions to this conservation, with unicellular protozoa like *Plasmodium falciparum*, among others, lacking the RNAi pathway altogether. Certain other parasitic protozoa have been shown to possess either siRNAs or miRNAs. A common feature of the RNAi pathway in these organisms is the lack of canonical RNAi factors. Both DICER and AGO in most of these protozoa lack conservation of various conserved domains, including the helicase and dsRNA binding domains in DICER or the conserved PAZ or MID domains involved in sRNA binding in AGOs. Despite their discovery, how sRNAs are produced using these atypical RNAi factors in vivo and their function in these neglected protozoan parasites remain to be investigated. The group is using Toxoplasma gondii as model to address: A) How are small RNAs synthesied using minimal and atypical RNAi machinery? B) What is the role of the small RNA pathway in the life cycle of parasites? C) How do small RNAs regulate host-pathogen interaction? Our group is also investigating circulating miRNA in toxoplasmosis patient samples and their potential as prognostic biomarkers and therapeutics.

Faculty & Staff

RAMRAY BHAT | MBBS (Calcutta), PhD (NYMC), Associate Professor

NIKHIL GANDASI | PhD (Sweden), Assistant Professor

SRIMONTA GAYEN | PhD (Calcutta), Associate Professor

TANWEER HUSSAIN | PhD (CCMB), Associate Professor

ARUN KUMAR | PhD (BHU), FASc, FNASc, Professor

UPENDRA NONGTHOMBA | PhD (Mysore), Professor and Chair

SONA RAJAKUMARI | PhD (Austria), Assistant Professor

ANNAPOORNI RANGARAJAN | PhD (NCBS), FNASc, Professor

DEEPAK K SAINI | PhD (AIIMS), Professor

SHANTANU P SHUKLA | PhD (IISc), Assistant Professor

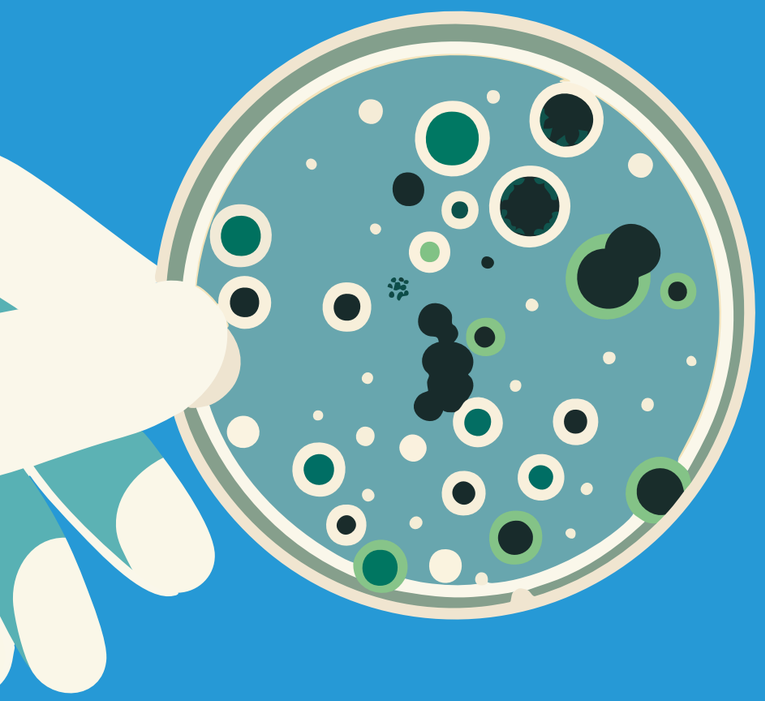
MEETALI SINGH | PhD (IISc), Assistant Professor

SANDHYA S VISWESWARIAH | PhD (IISc), FASc, FNA, FTWAS, Honorary Professor

3.1.7

Microbiology And Cell Biology

The Department of Microbiology and Cell Biology (MCB) is 82 years old, and its origin goes back to the Pharmacology and Fermentation Technology Laboratory started in 1941. Currently, MCB has 17 faculty members (8 Professors, 3 Associate Professors, 4 Assistant Professors, 1 Honorary Professor and 1 Principal Research Scientist).



FACT FILE

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URL: mcb.iisc.ac.in
Degree programmes offered: PhD, Integrated PhD, BSc (Research), and MSc (Life Sciences)

IN NUMBERS

15 Academic staff
1 Scientific staff
85 PhD students
23 Int PhD students
11 PhD conferments
3 Office staff
1 Technical staff

Chair: SAUMITRA DAS

Current **Research**

The department has demonstrated commendable research performance over the past year, with notable publications, securing competitive research grants, and initiating national and international collaborations.

Saumitra Das's group has been studying the biology and pathogenesis of RNA viruses. They have successfully deciphered the role of miR22 in Coxsackievirus B3 (CVB3) virus replication and pathogenesis; the results will help in developing an effective antiviral target against CVB3. They have demonstrated how host protein PSPC1 (an important component of paraspeckles) is exploited by HCV to regulate ribosome assembly during translation of viral RNA. More importantly, their effort in developing a VLP-based HCV vaccine has moved one step forward towards human trials. Preclinical studies in the pig model showed promising results with the VLP immunogenicity and safety; the candidate vaccine is now up for testing in the non-human primate model at Emory Vaccine Research Centre in collaboration.

Shashank Tripathi's group focuses on the development of broadly protective vaccines against respiratory RNA Viruses (influenza and SARS-CoV-2), the development of broad-spectrum antivirals against respiratory and mosquito-borne RNA viruses, and the elucidation of novel forms of mammalian antiviral innate immunity and viral evasion of the same.

Sudha Kumari's group focuses on several aspects

Core **Research**

At MCB, researchers explore how cells work – from fighting infections and chronic diseases to unlocking the secrets of growth and development. Their research spans four core areas: cancer and chronic diseases, microbiology and immunology, molecular and cellular biology, and plant developmental biology, with a common goal of better understanding life science for a healthier, more sustainable future.

of immunotherapy. Healthy immunity relies on active immunosurveillance. They use a highly interdisciplinary approach to investigate immunosurveillance by lymphocytes, and how they are dysregulated in diseases to eventually inform immunotherapies from a fundamental cell biology standpoint. The broad areas of their research are investigating signalling at the immunological synapse and immunosurveillance in ovarian cancer.

Dipshikha Chakravortty's group is investigating Salmonella division within host-derived vacuoles. They are exploring quorum sensing in compartmentalised bacteria, assessing the effects of polyamines and SCFAs on virulence, and examining bile acid stress and persistent carrier state. They are also studying antimicrobial resistance and alternative treatments, unraveling mechanisms of extraintestinal infections, analysing membrane remodelling in virulence/ resistance and investigating Salmonella-gut microbiome interactions.

Samay Pande's group focuses on antimicrobial resistance, antimicrobial strategies, experimental evolution, bacterial interactions, bacterial predation, evolution of lifecycles and multicellularity. They have explored how bacterial interactions (predation, starvation-induced lysis, and population bottlenecks) shape antimicrobial resistance. Predation history constrained resistance evolution in *E. coli*, while lytic events enriched resistant soil isolates. Bottleneck experiments in *M. xanthus* revealed distinct evolutionary outcomes across cooperative traits, highlighting ecological and demographic drivers of resistance.

Umesh Varshney's group focuses on the role of MutTl in two-component signaling (TCS) mediated regulation of gene expression, nucleotide homeostasis, and survival fitness of *Mycobacterium tuberculosis.* They also studied global initiation of translation with a non-methionine amino acid in *Escherichia coli.* They showed that Mycobacterial MutT1 Nudix hydrolase domain functions as protein phosphatase and regulates nucleoside diphosphate kinase function. They also showed that the two isoforms of initiator tRNAs in *Escherichia coli* have functional significance, and that lamotrigine mediated rescue of RsgA deficient *E. coli* reveals a new role of IF2 in ribosome biogenesis.

G Subba Rao's group studies vesicular transport between the organelles, organelle contacts, biogenesis, and associated pathogenesis. They illustrated the localisation and function of Arf-like GTPase 15 (Arl15) in mammalian cells. They have shown that Arl15-GFP localistes primarily to the Golgi and a cohort to the cell surface. Molecularly, they demonstrated that Arl15 functions in the cargo transport from the Golgi to the cell surface and regulates cell adhesion. Sachin Kotak's group focuses on the mechanism of cell division, mitosis, nuclear and chromatin organisation. During cell division in animal cells, once chromosomes are segregated, a cleavage furrow forms to partition the genome and cytoplasmic contents. This process is driven by an equatorially localised RhoA-regulated actomyosin network. However, how this machinery is spatially confined to the equatorial cortex remains poorly understood. Interestingly, they recently uncovered a key role for the polar membrane-localised LIN-5/GPR-1/2 complex in ensuring proper cleavage furrow formation and successful cytokinesis.

Shovamayee Maharana's group focuses on RNA metabolism, and RNA-RNA binding protein phase separation. They are investigating the role of cellular RNA in the function and formation of RBP condensates in the cells, understanding the phase behaviour of prion-like RBPs in ageing, mapping RNA metabolism during cellular stress, understanding phase behaviour of prion-like RBPs with pathogenic RNA, and delineating role of RNA properties in prion-like RBPs aggregation.
Naresh Loudya's group focuses on chloroplast biogenesis and chloroplast-to-nucleus communication. Chloroplasts are semi-autonomous organelles that carry out photosynthesis, which sustains life on Earth. Chloroplast development and function require the import of thousands of nucleus-encoded cytosolic proteins. Using a genetic screen, they have identified a negative regulator whose loss-of-function improves chloroplast development in the protein import mutant. Additionally, they are investigating the role of a TPR protein during early chloroplast development.

Faculty & Staff

RKN BALAJI | PhD (Indian Institute of Science), FNA, FASc, FNASc, Professor

DIPSHIKHA CHAKRAVORTTY | PhD (National Center for Cell Science), FNA, FASc, FNASc, Professor

SAUMITRA DAS | PhD (Indian Institute of Chemical Biology), FNA, FASc, FNASc, Professor & Chair

SACHIN KOTAK | PhD (Goethe University), Associate Professor

SUDHA KUMARI | PhD (National Center for Biological Sciences), Assistant Professor

NARESH LOUDYA | PhD (Royal Holloway University of London), Assistant Professor

SHOVAMAYEE MAHARANA | PhD (National Center for Biological Sciences), Assistant Professor UTPAL NATH | PhD (National Center for Biological Sciences), FNA, FASc, FNASc, Professor

SAMAY PANDE | PhD (Max Planck Institute), Assistant Professor

AMIT SINGH | PhD (International Center for Genetic Engineering and Biotechnology), Professor

KUMAR SOMASUNDARAM | PhD (Madurai Kamaraj University), FNA, FASc, FNASc, FAMS, Professor

G SUBBA RAO | PhD (Jawaharlal Nehru University), Professor

NAGALINGAM RAVI SUNDARESAN | PhD (Indian Veterinary Research Institute), Associate Professor

SHASHANK TRIPATHI | PhD (International Centre for Genetic Engineering and Biotechnology), Associate Professor

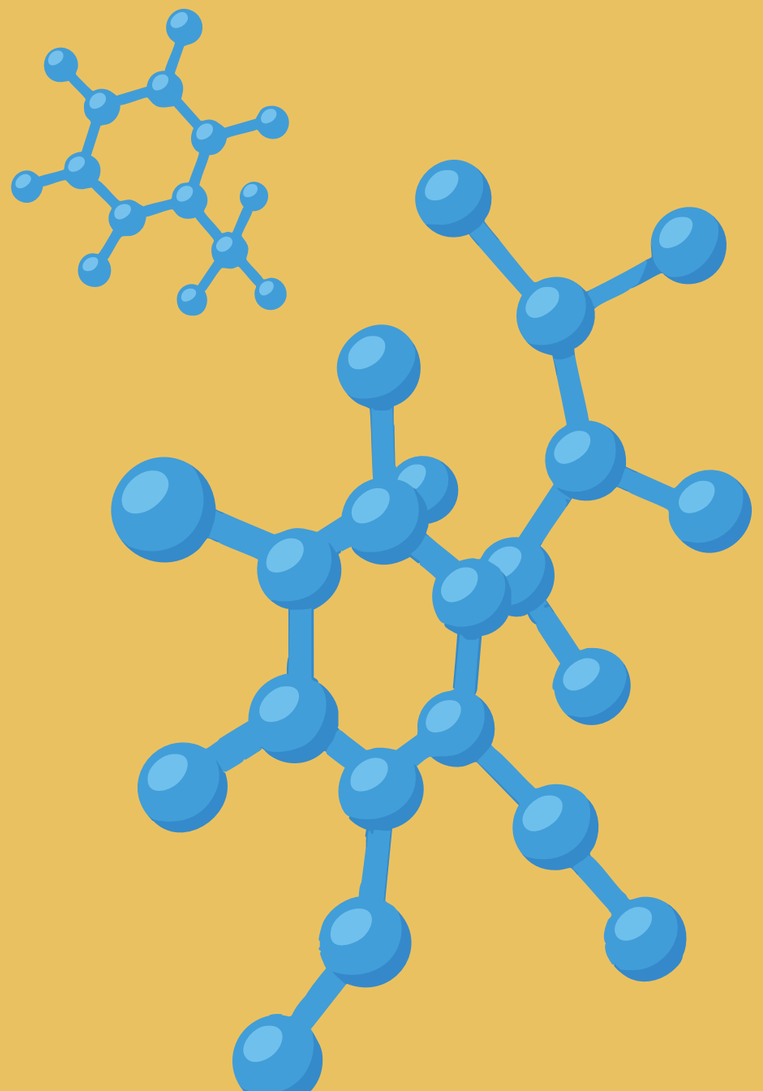
USHA VIJAYRAGHAVAN | PhD (Caltech), FNA, FASc, FNASc, Professor

UMESH VARSHNEY | PhD (University of Calgary), FNA, FASc, FNASc, Honorary Professor

WILLIAM R SURIN | PhD (Lucknow), PRS

3.1.8 *Molecular Biophysics Unit*

The Molecular Biophysics Unit (MBU) is engaged in frontline research in contemporary areas of 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 understanding biological activity in molecular terms.



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Degree programmes offered: PhD and Int PhD

IN NUMBERS

13 Academic Staff
61 PhD Students
13 Int PhD Students
62 Publications
07 PhD Conferments
02 Int PhD Conferments

Chair: RISHIKESH NARAYANAN

Core **Research**

Protein folding and dynamics; structural biology of proteins, nucleic acids, carbohydrates and molecular interactions using X-ray crystallography, NMR spectroscopy and CryoEM; biophysical mechanisms of bacterial communication and cellular entry of viruses; computational modelling and dynamics of biological membranes; bioactive peptide/ protein design, vaccine design; ion-channels and neurophysiology; computational neuroscience.

Current **Research**

Amit Baidya's lab works on bacterial nanotubes that serve as a conduit for inter-cellular exchange of cytoplasmic material such as amino acids, toxins, antibiotic resistance markers and plasmids among different species (bacterial-bacterial interaction), including human host cells (host-pathogen interaction).

- Identification of components of the nanotube apparatus
- Understanding the genetic regulation and structure-function relationships of the components of nanotubes
- Elucidation of the cellular circuitry that determines the assembly of these nanotubes
- Understanding of the underlying mechanisms of intra- and inter-kingdom crosstalk

Aravind Penmatsa's laboratory seeks to understand the molecular machinery involved in the transport of neurotransmitters and antibacterial compounds using X-ray crystallography and electron cryomicroscopy and other biophysical tools.

- Structures of multi-drug efflux transporters from a superbug *Staphylococcus aureus* were determined and single-domain camelid antibodies were used to block them
- Insights into the inhibition specificities of chronic pain inhibitors that target neurotransmitter transporters have been examined
- The architecture of the GABA transporter was elucidated through cryoEM and an epitope transfer strategy aided in this process to use a Fab as a fiducial marker for structure reconstruction

Ashok Sekhar's lab is involved in the experimental characterisation of biomolecular dynamics and its relation to function and malfunction using NMR spectroscopy.

- Deciphering the function of intrinsically disordered DNA binding domain of the cytidine repressor
- Pinpointing the different modes of dynamic regulation of the mammalian circadian clock
- Elucidating the mechanism of interconversion between the two folded conformations of metamorphic proteins
- Developing and applying new NMR methods for characterising molecular dynamics in glycans

Anand Srivastava's lab is involved in theoretical and computational biophysics research. It focuses on developing statistical mechanics and molecular simulations tools to understand the behaviour of complex biophysical systems.

- Uncovering the principles that govern lateral organisation in membranes
- Modelling the various protein-mediated vesicular transport pathways
- Exploring processes that regulate membrane composition and cell-organelles size
- Exploring the sub-cellular organisation principles in terms of "membrane-less organelles", which are cellular coacervate rich in RNA and intrinsically disordered proteins

Balasubramanian Gopal's lab studies the formation, function and regulation of the bacterial RNA degradosome, a biomolecular liquid condensate. It is an active area of investigation due its crucial role in modulating the cellular phenotype and associated pathology.

- Recent studies have focused on Staphylococcus aureus RNA degradosome involving RNases, PNPase and a helicase, CshA, to understand their role in regulating cellular transcript levels
- Understanding the phenotypic switch between the persistent and the virulent states of Staphylococcus aureus

Giriraj Sahu's lab focuses on elucidating the structural and functional association of neuronal ion channel multiprotein complexes in the regulation of neuronal excitability in brain physiology and pathophysiology.

- Factors contributing to adrenergic and cholinergic neuromodulation of principal pyramidal brain neurons
- Role of ER-PM junctional proteins in the modulation of neuronal intrinsic excitability in physiology and pathophysiology such as, epilepsy and ageing
- Development of novel antiepileptic drug targets to restrict the increase of excitatory drive in acquired epilepsy
- Physiological modulation of neuronal voltage gated calcium channels

Jayanta Chatterjee's lab focuses to increase the therapeutic index of synthetic peptide-based drugs by improving membrane permeability and metabolic stability while re-engineering their 3-D conformation.

1. Extending the thioamide modification of the polypeptide backbone in synthetic peptides to improve their bioavailability
2. Developing physiologically stable miniproteins to detect and inhibit factors responsible for tumorigenesis

Mahavir Singh's group focuses on studying the protein-nucleic acid interactions that govern chromatin remodelling and telomere DNA maintenance and bacterial toxin-antitoxin (TA) systems that regulate persistence during antibiotic stress.

- Role of hnRNPA1 in recognition and unfolding of telomere DNA and RNA G-quadruplex structures has been studied
- Structure and function of type II and type III bacterial TA systems and their mechanism of assembly has been elucidated

Rishikesh Narayanan investigates the robustness of biological systems to pronounced heterogeneities and perturbations central to an organism's survival. In the context of neural-circuit heterogeneities, three general mechanisms that confer robustness to neurophysiological systems have been identified.

- Degeneracy confers similar and precise function despite widespread parametric variability
- Stochastic resonance, the ability of an optimal level of noise to enhance a specified functional outcome
- A negative feedback loop that acts as a stabilising mechanism for multiple functions across different scales

Raghavan Varadarajan's lab probes protein stability and gene function using deep mutational scanning and applies this to the design of immunogens for viral vaccines.

- Vaccine formulations for influenza and COVID-19 have been developed in collaboration with the Bengaluru based startup, Mynvax. These are expected to enter Phase 1 clinical trials later this year.

Siddhartha P Sarma's lab is involved in the characterisation of protein and peptide structure, function, protein-ligand interactions and dynamics using NMR spectroscopy.

- Structure and function studies of novel neurotoxic disulphide rich toxins from animal venom
- Development of new NMR methods to establish disulphide linkages in peptides

Somnath Dutta's group focuses on the structural studies of bacterial toxins, bacterial secretion systems and bacterial efflux pumps using single particle cryo-electron microscopy (cryo-EM).

- The structural basis of pore formation in lipid membranes by bacterial porins from *Vibrio cholera* and *Staphylococcus aureus* and translocation of virulence factors through secretory systems in *Mycobacterium tuberculosis* have been determined
- Structural and functional characteristics of efflux pump systems in Escherichia coli have been determined

Vidya Mangala Prasad's lab is interested in understanding the structural mechanisms of enveloped virus entry using methods such as cryo-electron tomography, single particle cryo-EM and sub-tomogram averaging.

- Elucidating the physical mechanisms and structural intermediates formed during cellular entry by enveloped viruses like dengue and Zika viruses
- Understanding the structural basis of interaction between flaviviruses and cellular factors
- Identifying epitopes involved in antibody recognition of dengue and Zika viruses

Faculty & Staff

AMIT K BAIDYA | PhD (CSIR-IICB), Assistant Professor

JAYANTA CHATTERJEE | PhD (TU Munich), Associate Professor

SOMNATH DUTTA | PhD (NICED), Assistant Professor

B GOPAL | PhD (IISc), FASc, FNASc, FNA Professor

M GOVINDARAJU | PhD (Nagarjuna), Scientific Officer

RISHIKESH NARAYANAN | PhD (IISc), FASc, FNA, Professor

ARAVIND PENMATSA | PhD (CCMB), FNASc, Associate Professor

VIDYA MANGALA PRASAD | PhD (Purdue), Assistant Professor

P RAMASAMY | MSc (Bharathidasan), Scientific Assistant

GIRIRAJ SAHU | PhD (IIT-Madras), Assistant Professor

SIDDHARTHA P SARMA | PhD (Maryland), Professor

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

MAHAVIR SINGH | PhD (Technical University), Associate Professor

ANAND SRIVASTAVA | PhD (Ohio State), Associate Professor

RAGHAVAN VARADARAJAN | PhD (Stanford), FASc, FNA, Professor

Emeritus Faculty

P BALARAM | PhD (Carnegie Mellon), FASc, FNASc, FNA, FTWAS, Professor

DIPANKAR CHATTERJI | PhD (IISc), FASc, FNASc, FNA, FTWAS, Professor

MANJU BANSAL | PhD (IISc), FASc, FNASc, FNA, Professor

MRN MURTHY | PhD (IISc), FASc, FNASc, FNA, FTWAS, Professor

K SUGUNA | PhD (IISc), Professor

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

SARASWATHI VISHVESHWARA | PhD (New York), Professor

SIKDAR SUJIT K | Dr MedSci (Kyushu), FASc, Professor

3.2

Division of *Chemical Sciences*

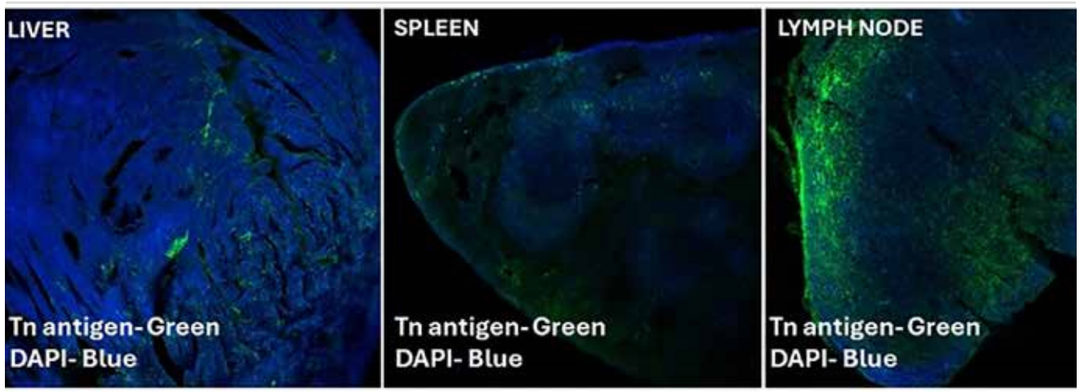
The Division of Chemical Sciences has consistently maintained its position among the top 50 chemistry departments in world rankings over the past decade. It is a globally competitive Division with clear focus on top quality research in specific current areas such as bio-inorganic chemistry and chemical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

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.

DEPARTMENTS | CENTRES | UNITS

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



Hitchhiking of synthetic antigen stimulates antibody production against cancer cells

Researchers at the Department of Organic Chemistry have developed a synthetic antigen that can bind to serum albumin, a natural protein in blood, and travel to lymph nodes, where it can trigger an immune response against cancer. Unlike previous methods which use bulky artificial carriers that may cause side effects, this approach makes use of the body's own proteins. The team synthesised a truncated carbohydrate antigen found on cancer cells and combined it with long-chain, oil-loving chemical to form bubble-like micelles. When this compound was injected into mice, it accumulated largely in lymph nodes and triggered strong antibody responses, even at low doses. A second dose produced even higher levels of antibody production. The method could aid in developing vaccines for multiple cancers.

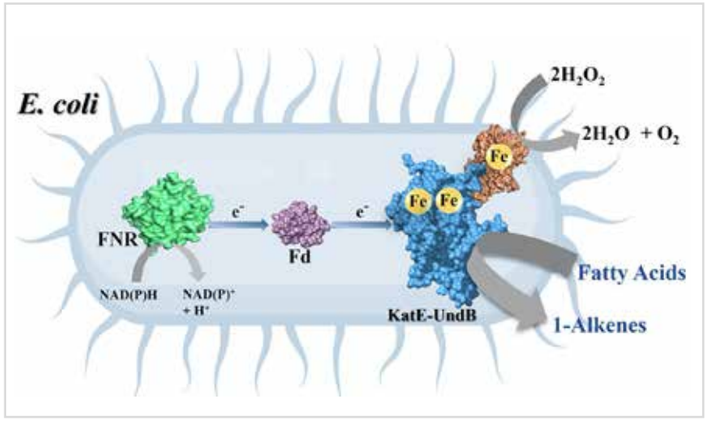
Reference:
Thekke Veettil K, Jayaraman N, Lymph Node Targeting Mediated by Albumin Hitchhiking of Synthetic Tn Glycolipid Leads to Robust In Vivo Antibody Production, Advanced Healthcare Materials (2024).

Research **Snapshots**
2024-25

Agri waste based surfactant for industrial synthesis

Researchers at the Department of Inorganic and Physical Chemistry have developed a sustainable surfactant, CNSL-1000-M, derived from an agricultural waste product called cashew nut shell liquid (CNSL), to catalyse chemical reactions in water instead of toxic organic solvents. When added to water, the bio-based surfactant forms micelles with tiny water-free pockets which can protect water-sensitive substrates and catalysts. CNSL-1000-M led to 80% higher product yields in water compared to reactions carried out in organic solvents. It can also help replace expensive catalysts like palladium with inexpensive nickel complexes and facilitate reactions at lower temperatures. The team aims to scale up this aqueous micellar technology for broad industrial applications, promoting sustainability in chemical manufacturing.

Reference:
Keshari P, Yadav R, Mata P, Hazra S, Micelles enabled nickel-catalysed p-arylation of aromatic phosphine oxide in water under mild conditions, ACS Sustainable Chemistry & Engineering (2024).

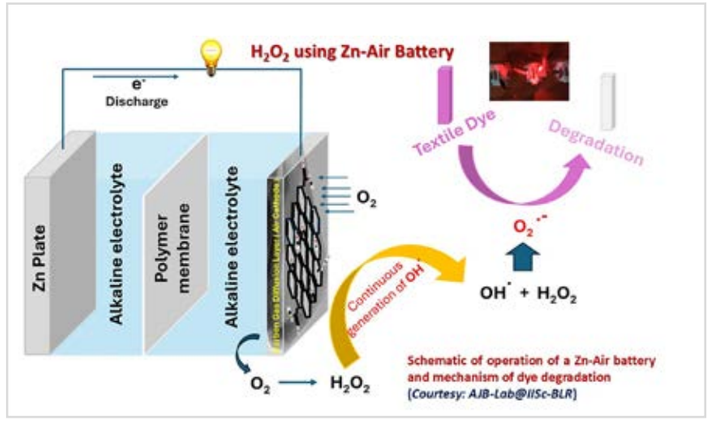


Engineered biocatalyst for making “drop-in” biofuels

Researchers at the Department of Inorganic and Physical Chemistry have developed an enzymatic platform that efficiently converts naturally abundant and inexpensive fatty acids into 1-alkenes – valuable hydrocarbons that can be used as “drop-in” biofuels. The team earlier identified the enzyme UndB, which catalyses this conversion at high speed but loses activity quickly due to hydrogen peroxide (H_2O_2) buildup. In the new study, they overcame this by adding catalase, which breaks down H_2O_2, boosting UndB's activity 19-fold. They further engineered a fusion protein combining UndB and catalase by introducing a fused genetic code via plasmids into *E. coli* bacteria, which would then act as a “whole cell biocatalyst", converting fatty acids and churning out alkenes.

Reference:
Iqbal T, Murugan S, Das D, A chimeric membrane enzyme and an engineered whole-cell biocatalyst for efficient 1-alkene production, Science Advances (2024).

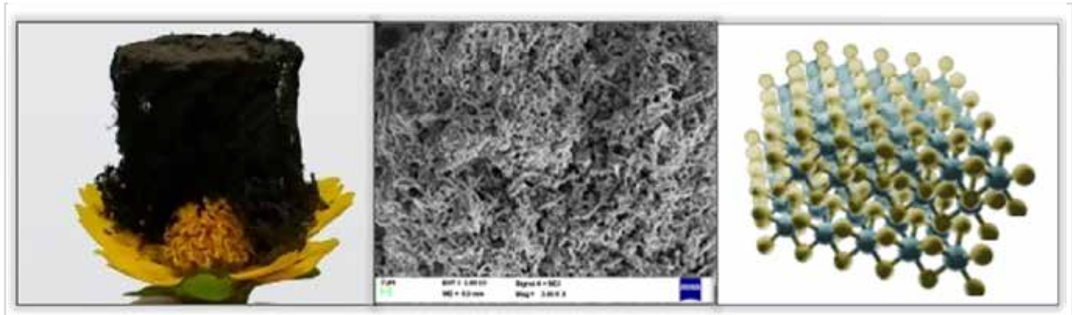
Research **Snapshots**
2024-25



Using batteries to produce hydrogen peroxide from air for industrial applications

Researchers at the Solid State and Structural Chemistry Unit and Interdisciplinary Centre for Energy Research have developed a low-cost, energy-efficient method to produce hydrogen peroxide (H_2O_2) using a zinc-air battery. This offers a sustainable and affordable alternative to traditional, metal-catalyst-based methods. The battery has zinc as the anode and ambient air as the cathode. When the battery discharges, oxygen from ambient air gets reduced at the cathode, producing H_2O_2. The battery also stores energy, offering a dual purpose. Though metal-air batteries are challenging to handle due to their three-phase system, the researchers believe the method is scalable and can have other applications, like generating electricity in remote locations.

Reference:
Behera A, Bhattacharyya AJ, Employing a Zn-air/photo-electrochemical cell for in situ generation of H2O2 for onsite control of pollutants, Small Methods (2025).



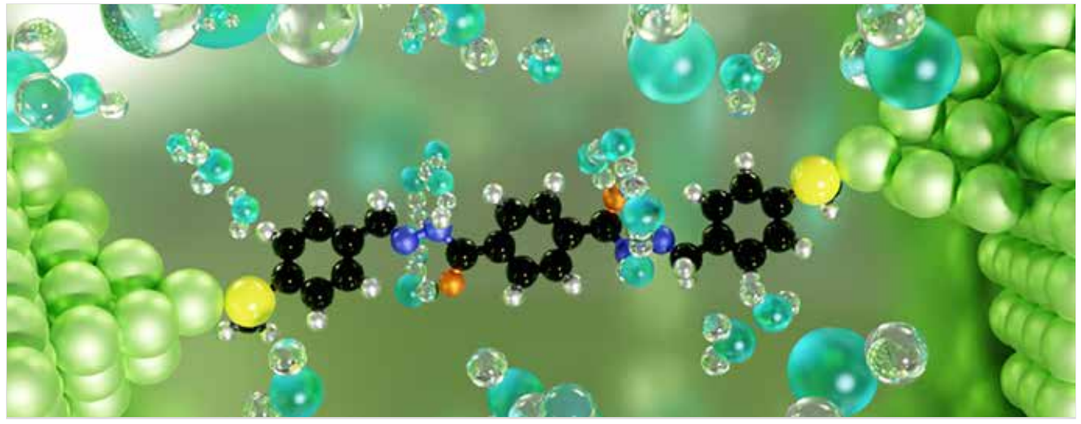
MoS_2 aerogel placed on flower, SEM image, 3D-structure of MoS_2 aerogel (from left to right)

Reusable aerogel that absorbs harmful HCl gas

Researchers at the Department of Organic Chemistry, in collaboration with ISRO, have developed a reusable, lightweight aerogel made from molybdenum disulphide (MoS_2) to absorb the plumes of toxic hydrochloric acid (HCl) gas released during rocket launches. MoS_2, which is typically discarded as industrial waste, is also a low-cost raw material. The team freeze-dried ammonium tetrathiomolybdate to form a 3D structure and then annealed it with 2% hydrogen-argon gas to produce the highly porous aerogel. The aerogel absorbed 65.88% of HCl in tests, with the MoS_2 layers breaking H–Cl bonds to enhance uptake. Currently, the material is being evaluated for use at rocket launch sites to reduce environmental impact.

Reference:
Kayal A, Mondal A, Subramanian S, De M, facile synthesis of a reusable MoS2 aerogel for efficient HCL gas absorption, ChemistrySelect (2024).

Research **Snapshots**
2024-25



Reactions in artificial enzymatic nanopocket

Researchers at the Department of Inorganic and Physical Chemistry and Materials Research Centre have mimicked enzyme active sites using a custom-designed break junction setup to study how electric fields influence chemical reactions. The team used two atomically sharp gold electrodes to create an enzyme active site-like environment around a single molecular junction in solution, by applying an electric field across them. This nano pocket with a single molecule trapped in between can then be manipulated to initiate chemical reactions in potential organic molecules. This allows scientists to probe transformations simultaneously by tracking changes in the conductance signature of single molecules at high temporal resolution.

Reference:
Sreelakshmi PA, Mahashaya R, Leithether S, Rashid U, Hamill J, Nair M, Rajamalli P, Kaliginedi V, Electric field-induced sequential prototropic tautomerism in enzyme-like nanopocket created by single molecular break junction, Journal of American Chemical Society (2024).

3.2.1 *Inorganic and Physical Chemistry*

Established more than a century ago in 1909, when the Institute was founded, the Department of Inorganic and Physical Chemistry (IPC) has demonstrated scientific excellence in both basic and applied research.

FACT FILE

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Degree programmes offered:
PhD, Int PhD, MSc

IN NUMBERS

17	Academic staff
3	Scientific staff
92	PhD students
22	Int PhD students
2	MS students
74	Publications
10	PhD conferments
6	Int PhD conferments
1	MS conferments

Chair: S SAMPATH

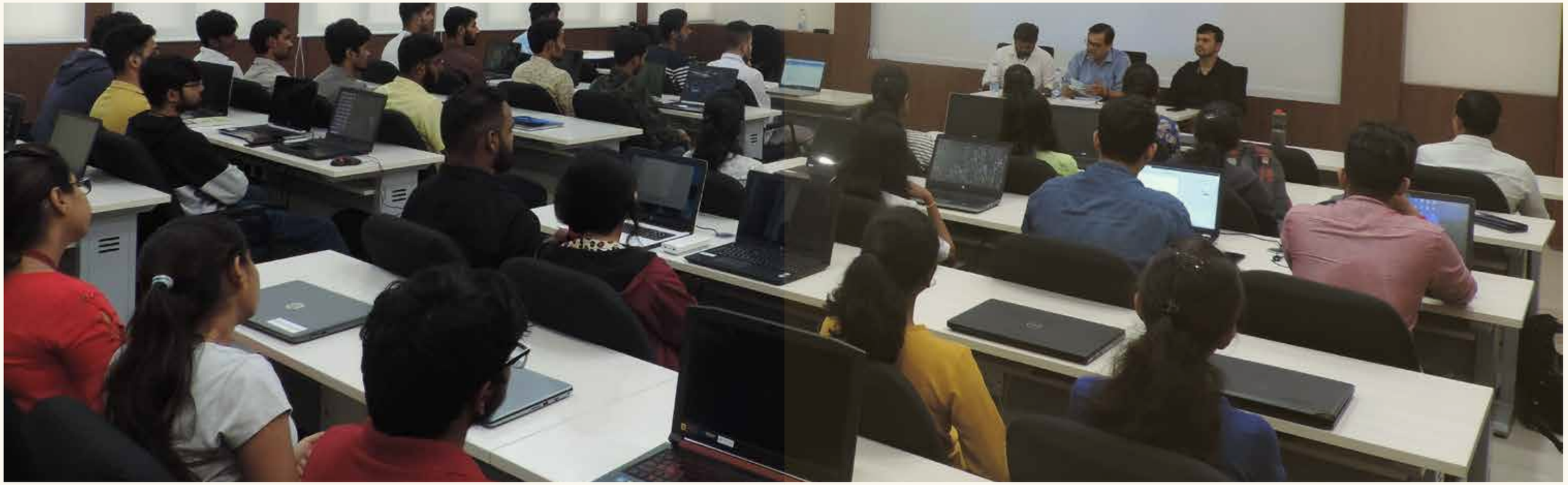
Current **Research**

Bio and Medicinal Inorganic Chemistry
IPC is actively working on developing novel enzymes and phytochemicals for biocatalysis and therapeutic biology. The reaction mechanism, activity, and kinetics of membrane-bound metalloenzymes that are responsible for biosynthesis of 1-alkanes in bacteria have been established. Novel glycoside hydrolase enzymes have been identified that exhibit excellent activity against biofilms of pathogenic bacteria. This may lead to the development of a first-in-kind enzyme therapy against biofilm-associated microbial infections. A tri-terpenoid phytochemical compound, squalene, has been isolated from plants, which exhibits anti-inflammatory properties as well as metalloenzyme downregulation.

Chemical Dynamics and Spectroscopy
Using a home-built pulsed nozzle Fourier transform microwave spectrometer, rotational spectra of the first complexes of 1-fluoronapaphtahlene-(H_2O)1,2 have been recorded. Initial results indicate that the complex with two water molecules may have the water in two different sites, which is rather uncommon. In another work, a combination of Raman spectroscopy and artificial intelligence has been employed for the quick identification of bacterial pathogens. This has the potential to translate into an efficient, cost-effective solution for accurate identification of causative bacteria.
Collaborative efforts on quantum light-matter interaction in department have demonstrated that vibrational strong coupling significantly enhances the

Core **Research**

Ongoing 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 focused on the principal immune mechanisms that contribute to reactivation of tuberculosis in the context of HIV infection. Another newly developed area of research is virus-host interactions of emerging RNA viral pathogens including SARS-CoV-2, and viruses that cause influenza and dengue. The overall aim is to understand the molecular basis of viral pathogenesis and translate the knowledge to novel antivirals and improved vaccine candidates.



electrical conductance of undoped intrinsically insulating, amorphous polymers such as polystyrene, poly(benzyl mecthacrylate) and various other polystyrene type polymers *(J. Am. Chem. Soc., 2024)*. The technique can also be used to enhance the conductance of small aromatic molecules. Based on this, a prototype device has been developed, and an Indian patent application has been filed. In another experiment, we show that the strong coupling of electronic transitions can suppress the ground state intermolecular interactions and thereby modify the photophysics of Chlorophyll derivatives. A highly sensitive broadband ultrafast circular dichroism spectrometer is currently under development in IPC to investigate chirality, spin and magnetism at femtosecond timescales.

In a collaborative effort between IPC, Aerospace Engineering at IISc and University of Rennes, France, the potential of shock waves in early formation of molecules after the Big Bang has been shown, leading to important publications in astronomy and astrophysics.

Theoretical and Computational Chemistry

Nuclear quantum effects were studied in selected systems to explore their role in the structure, potential energy landscape, and spectroscopy. For molecules with weak intramolecular interactions, the NQEs were weak except in selected regions at low temperatures. For a strongly H-bonded molecule, the NQEs were strong at both ambient and low temperatures, showing ZPE and tunnelling effects in the respective cases. In separate work, excited state dynamics of a multi-conformer molecule were explored with a view to explore ultrafast proton transfer events and possible dual fluorescence behaviour.

The photoionisation time-delay in linear conjugated molecules was computed using the Wigner scattering approach. We found that, in general, there are two contributions to the ionisation time-delay: quantum-like and classical-like. The quantum contribution originates from interferences between various ionisation pathways that belong to different cationic eigenstates, while the classical contribution is due to time delays associated with individual pathways and originates due to electron-electron correlations in the molecule. The quantum contribution scales up rapidly with the conjugation length, leading to larger time delays in longer molecules, in corroboration with recent experiments.

A model of a self-interacting finitely extensible Gaussian chain that evolves stochastically under the action of random thermal fluctuations and an external fluid velocity gradient has been developed to understand the response of collapsed polymers to the effects of linear mixed flow. The role of Basset (or backflow) forces in various dynamical phenomena, in particular enhancing transmission of a Brownian particle, has also been calculated analytically. Lastly, the electronic requirements for the formation of borophenes are currently being explored computationally. Their properties promise to rival those of graphenes.

Polymer Chemistry

A modular strategy to prepare crosslinked amphiphilic gels using peripherally clickable hyperbranched polymers (HBP) and PEG-diazides was developed, and these were utilised to anchor catalytically active metal species, such as Cu, Pd and Au. These gel-anchored catalysts functioned very effectively to catalyse reactions, such as azide-alkyne, Suzuki coupling and reduction reactions; the main advantage was that the gels can be given a solvent-wash and reused multiple times with little loss of activity. The modularity of this approach permits one to easily vary the crosslink density by changing the PEG length, the hydrophobic domain size by varying the nature of hyperbranched polymer, and it also permitted the installation of a molecular jacket around the catalytic site, by co-clicking with a desired mono-azide segment. The nature of the molecular jacket was shown to influence the reaction rate, depending on the compatibility of the reactant with the molecular jacket. Based on this approach, crosslinked amphiphilic coatings, bearing terpyridine ligands, were anchored on to surface-functionalised glass vials, which was later coordinated with Cu, PD or Au, and used as reaction vessels to catalyse reactions. Thus, the reactant solutions could be simply stirred in these vials, the product solutions poured out and vials could be rinsed and reused multiple times. Such catalytic glass vials could be very useful for ligating/labelling biological macromolecules using a simple – Stir-Pour-Rinse-Reuse protocol.

Organometallic and Coordination Chemistry

Single atom Pd on Cu_2O has been developed and some preliminary results have been obtained on C-C and C-N cross coupling reactions with ppm level Pd loading under aqueous micellar conditions.

Certain new and novel iridium dinitrogen and dihydrogen complexes bearing pincer ligand have been synthesised and characterised. These complexes were found to show exceptional hydrogenation catalytic activity under mild conditions. An unusual iridium pincer complex with hydride and H_2 ligands trans-disposed to one another was found to exhibit dynamical H-atom site exchange between the H_2 and the hydride sites through metal-ligand cooperativity mechanism, which is unprecedented.

Development of cost-effective, earth-abundant, less toxic base metal catalysts or main group catalysts for the synthesis of organoboranes has been demonstrated. Considerable effort has been committed to the preparation of organoboranes employing cost-effective, earth abundant and less-toxic non-precious metals (Cu, Ni, Fe). Recently, an efficient catalyst system based on Co(II)-NHC complex for the borylation of pyridine derivates and internal alkynes has been developed.

Supramolecular Chemistry/ Catalysis

In a recent report, Mukherjee's group has shown that the fate of a chemical can be controlled by the shape of the reaction vessel. In a Pd(II) cage of octahedral shape anthrone undergone oxidative C-C coupling to form di-anthrone, while the same reaction under identical reaction condition in a Pd(II) cage of different shape showed the formation of simple anthraquinone. DFT study was done to corroborate this unusual observation (*JACS*, 2023) of different fates of a reaction by changing the shape of the reaction vessel. In another project, Mukherjee's group has reported the first example of a water-soluble square orthobicupola architecture. Such a large structure was characterised by usual techniques (NMR, ESI-mass spectrometry) including single crystal X-ray diffraction. The cage was used as a molecular vessel for photocatalytic oxidation of aryl- and alkyl-thio compounds to their corresponding sulfoxides selectively without formation of any trace of toxic sulfones as byproducts (*JACS*, 2024).
In the area of micellar catalysis, a biodegradable surfactant has been developed using cardanol, a biowaste. Preliminary results have shown that its aqueous solution can be used as a green and sustainable alternative of toxic organic solvents. Amino acids-based chiral micelles have been developed and the effect of chiral confinement on asymmetric transfer hydrogenation is being investigated.

Nanomaterials and catalysis

Pd-Zn bimetallic nanoparticles capped by hexadecyl amine were obtained via solvated metal atom dispersion and co-digestive ripening. They were found to be highly catalytically active for the semi-hydrogenation of acetylene to ethylene. The selective hydrogenation of pure acetylene takes place at room temperature with greater than 85% selectivity towards ethylene. This is the highest reported ethylene selectivity with substantial conversion, under very mild conditions (room temperature and atmospheric pressure) in comparison to the literature reports wherein the reaction conditions are a lot harsher.

Nearly monodisperse Ag and Au nanoparticles were prepared using digestive ripening in the presence of [C18BIm]Br ionic liquid. This process effectively transformed a polydisperse sample under mild conditions within a brief time frame. Herein, the capping ligand ionic liquid plays a dual role as a stabilising agent, which inhibits the particles against aggregation, and more importantly as a digestive ripening agent.

Main Group Chemistry

The Lewis acidic diboron compounds often display an interesting reactivity and have witnessed significant interest by the unusual reactivity of these compounds. Based on the literature report, we envisioned that more Lewis acidic diboron reagent may facilitate the rapid formation of trifluoromethyl and boron centred radicals.
We have developed a protocol to synthesise trifluoromethyl boronates from alkenes by the mutual activation of the Togni II and the bis(catecholato)diboron reagents in the absence of any catalyst and additives. This reaction enables synthesising a series of trifluoromethylated alkyl boronates using unactivated alkenes, including natural products and drug derivatives, in a regioselective manner. Moreover, the synthetic utility of the boronic ester present in the product allows access to a range of trifluoromethyl containing compounds.
We have also extended this protocol for the synthesis of α-trifluoromethylated ketones through trifluoromethylation of the corresponding catecholboron enolates of α, β-unsaturated ketones. The reaction of 1,4 hydroborated product of enones with the Togni II reagent affords the α-trifluoromethylated ketones without any catalyst and additive.

Electrochemistry, Surfaces and Interfaces

In the field of CO_2 electrocatalysis, operando Raman spectroscopy and online mass spectroscopy have been used to demonstrate the CO_2 reduction on Nickel-yttria-stabilised zirconia (Ni-YSZ) cermet surface and the mechanism of catalyst deactivation has been explored. A series of Co-doped copper oxide catalysts with varying Co/Cu ratios supported on Au has been developed which exhibit a remarkable oxygen reduction reaction activity with very low H_2O_2 selectivity.

As part of instrument development, home built Scanning Tunneling Microscopy (STM-BJ), mechanically controllable break junction (MCBJ) and EGaIn Large area junction setups with unique single/ensemble molecule conductance measurement capabilities has been developed in the department. Employing home built MCBJ setup, several interfacial reactions have been probed.

Protein Chemistry, Biocatalysis, Signal and Energy Transduction, Multiscale Simulations, Quantum Chemistry

The Sirohiwal Research Group works at the intersection of chemistry, biology, and physics, addressing fundamental questions about the molecular mechanisms that drive biological processes. Our focus is on understanding the structural and functional complexity of proteins and how biomolecular events are coordinated across a wide range of time and length scales.

Using a bottom-up approach, we study systems ranging from elementary particles such as electrons and protons to larger biomolecular assemblies, including protein-protein interactions. Our research employs advanced multiscale computational methods, including quantum mechanics/ molecular mechanics (QM/MM), non-adiabatic and classical molecular dynamics (MD), computational spectroscopy, and machine learning.

Faculty & Staff

ELANGANNAN ARUNAN | PhD (Kansas State U), FASc, FNASc, FRSC Professor

ABHISHEK SIROHIWAL | PhD (MPI für Kohlenforschung), Assistant Professor

ANOOP THOMAS | PhD (IISER TVM), Assistant Professor

DEBASIS DAS | PhD (U Michigan), Associate Professor

K GEETHARANI | PhD (IIT Madras), Associate Professor

UPENDRA HARBOLA | PhD (JNU), Associate Professor

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

KALIGINEDI VEERABHADRARAO | PhD (U Bern), Assistant Professor

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

PARTHA SARATHI MUKHERJEE | PhD (Jadavpur U), FASc. FTWAS, Professor

SANJAY PRASAD | MTech (Anna), Principal Research Scientist

S RAMAKRISHNAN | PhD (U Massachusetts), FASc, Professor

SAI G RAMESH | PhD (U Wisconsin), Associate Professor

C RANJAN | PhD (Cornell University), Assistant Professor

SOUMEN GHOSH| PhD (Michigan State University), Assistant Professor

SUSANTA HAZRA| PhD (IIT Delhi), Assistant Professor

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

S SANDYA | PhD (Kerala), Principal Research Scientist

P THILAGAR | PhD (IIT Kanpur), Professor

P. T. WILSON | Technical Officer

HONORARY/EMERITUS FACULTY

AG SAMUELSON | PhD (Cornell U), Emeritus Professor

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

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

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

M NETHAJI | PhD (Madras), Emeritus Professor

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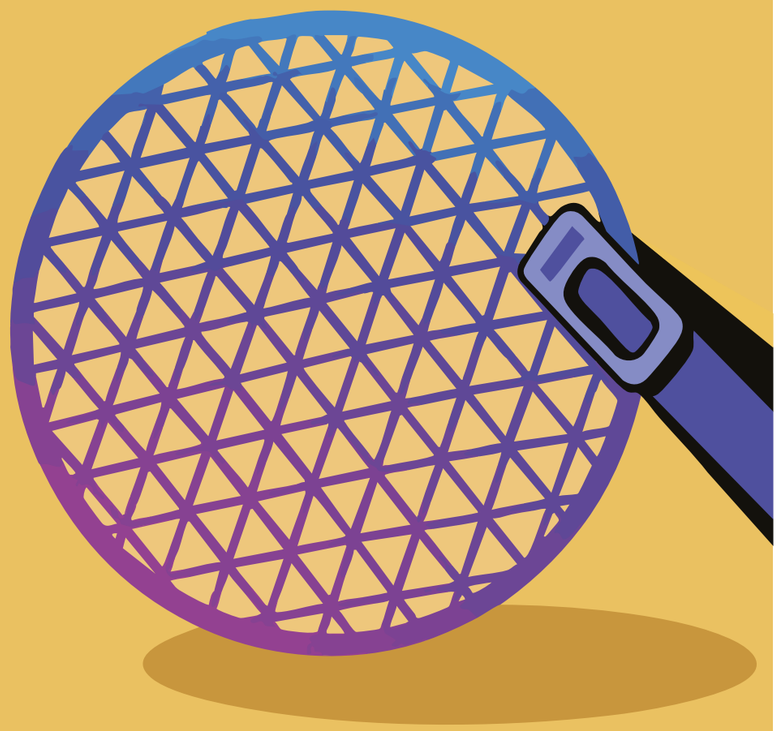
P K DAS | PhD (Columbia U), FASc, Emeritus

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

S UMAPATHY | PhD (U Otago), FASc, FNASc, FNA, FRSC Professor

3.2.2 *Materials Research Centre*

Since its establishment in 1978, the Materials Research Centre (MRC) has served as a vibrant hub for interdisciplinary research, focusing on various domains of materials science and technology, particularly electronic, functional materials and devices. Guided by the inspiring motto, "From basic science to device prototypes," the centre consistently strives to translate fundamental scientific knowledge into tangible advancements, encapsulating its unwavering commitment to pushing the boundaries of research and innovation.



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IN NUMBERS

9 Faculty members
80 Graduate students
60 PhD students
9 Int PhD students
190 Publications

Chair:
ABHISHEK K SINGH

Current **Research**

Energy Harvesting Materials
Faculty of the centre are involved in addressing 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. Nanostructurisation of transition metal silicides is carried out for high temperature thermoelectric application.

2D Materials and Metamaterials
Faculty 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 focused effort is aimed towards gaining the ability to modify the band gaps of these materials in a controlled and non-invasive way. Meta-structure-based materials are being explored for perfect absorbers at IR and microwave frequencies.

Core **Research**

MRC focuses on diverse research areas, including semiconducting materials for OLEDs, gas sensing, and ferroelectric materials, as well as magnetic materials. The centre also explores biomaterials for musculoskeletal applications, catalytic materials for water splitting and purification. The centre also focuses on Li-ion/Na-ion batteries, hydrogen storage, fuel cells, thermoelectrics, and meta-materials.

Organic light emitting diodes for flexible displays
MRC faculty are also involved in various organic materials development, such as light emitting especially thermally activated delayed fluorescence emitters, hyperfluorescence, dendrimer-based emitters, nano materials-based emitters, electron transporting, and host materials for OLED application and single photon emitters for quantum computing. The main focus is on purely organic and solution-processed device fabrication for cost-effective OLED displays and lightings.

Chemistry at the materials biology interface
Researchers at MRC have a strong focus in exploring chemistry of materials to interface with biology using synthesis, computation and analytical tools. The ultimate goal of sustainable healthcare is being targeted through the development of biosensors, enzyme mimetics, biocatalysts, biologics delivery vehicles, and regenerative medicines.

Biomaterials for musculoskeletal reconstruction and regenerative engineering
They are developing next-generation implants and bioengineering solutions to address unmet clinical needs for musculoskeletal, dental, and neurosurgical applications. Encompassing experimental discovery, theoretical predictions, computational analysis, and clinical translational research, a strong foundation has been laid biomaterials science and regenerative engineering; thereby impacting human healthcare.

Nanostructured Materials for Energy and Environment Applications
MRC is also involved in designing nanostructured-based catalysts for water splitting, water purification, batteries and fuel cells. Few faculty members are associated with the development of materials for gas sensing applications at room temperature, infra-red and UV detection.

Ferroic and quantum model materials at atomic scale
Faculty of the centre are working on ferroelectric, magnetic and quantum materials for exploring the platform for the devices like rf filter, resonators, broadband, ferroelectric memory, dielectric energy storage and quantum communications. Faculty are also working magnetic thin films to bring attention to the industry for room temperature device application as non-volatile memories or into low power nanoelectronics devices.
Significant advances and innovations

Our department stands at the forefront of technological, scientific, and scholarly advancements, driving groundbreaking developments across multiple fields. With a strong focus on efficient energy harvesting materials, our research efforts have resulted in remarkable breakthroughs. By utilising state-of-the-art density functional theory-based methods, we have effectively tackled the challenges associated with their development. Furthermore, our ongoing extensive study has yielded invaluable guidelines for designing high ZT thermoelectric materials and efficient hydrogen and Li storage materials, even under ambient conditions. In addition, our department has made significant contributions to the field of nanostructurisation techniques, particularly in the areas of transition metal oxides, nitride, and semiconducting thin films, unlocking their immense potential for industrial applications. These achievements reflect our unwavering commitment to advancing scientific knowledge and driving transformative progress in several areas, including the development of new CMOS devices for enhanced transistor performance, high dielectric energy storage, pioneering theoretical approaches for quantum materials and machine learning, the advancement of ferroelectric devices, and the revolutionising of healthcare.

Faculty & Staff

N RAVISHANKAR | PhD (IISc Bangalore, India), Professor

BIKRAMJIT BASU | PhD (Katholieke Universiteit Leuven, Belgium), Professor

ABHISHEK KUMAR SINGH | PhD (Tohoku University, Sendai, Japan), Professor

KARUNA KAR NANDA | PhD (IOP Bhubaneswar, India), Professor

PRABEER BARPANDA | PhD (Rutgers, NJ, USA), Associate Professor

BALARAM SAHOO | PhD (University of Duisburg, Germany), Associate Professor

SUBINOY RANA | PhD (University of Massachusetts Amherst, MA, USA), Associate Professor

P RAJAMALI | PhD (IIT Madras, India) Assistant Professor

SUJIT DAS | PhD (Martin Luther University Halle-Wittenburg and IFW Dresden, Germany), Assistant Professor

3.2.3 *Department of Organic Chemistry*

The Department of Organic Chemistry (OC) is one of the oldest departments in IISc, which started in the year 1911. The core strength of the Department lies in the broad areas of organic chemistry, covering all aspects of organic synthesis and application of organic chemistry principles at the interface of biological and materials chemistry.

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IN NUMBERS

10	Academic Staff
3	Honorary Professors
3	INSA Senior Scientists
90	PhD Students
15	Int PhD Students
80	Publications
3	Int PhD Conferment
12	PhD Conferment

Chair: N JAYARAMAN

Current **Research**

Sharvan Kumar:
Synthesis of stable highly electron-deficient/rich organic compounds and their radical ions for preparation of next-generation optoelectronic devices, conductivity, and magnetism are the major focus. A few electron-deficient compounds are synthesised, and studies await to be undertaken.

Vignesh Palani:
From the inception of medicine, secondary metabolites have been used to treat human diseases. These natural products continue to inspire the development of improved synthetic design and new methodologies. The group explores reaction methodologies with high selectivity and efficiency to propel the creation of elegant synthetic strategies. Synthesis of monoterpenoid kopsifolines by involving a desymmetrising asymmetric methodology is pursued. The group is working on a photomediated 1,3-carbonyl transposition on saturated carbocycles.

Durga Prasada Hari:
The first strain-enabled radical spirocyclisation cascade for the synthesis of functionalised spirocyclobutyl lactones and –lactams are accomplished and highlighted through the synthesis of a family of bis-spirocyclic scaffolds (*Chem. Sci.*, 2024; *Org. Lett.*, 2024). Very recently, we have developed a highly stereoselective method for the synthesis of functionalised skipped dienes by harnessing the carbene reactivity of bicyclo[1.1.0]butane (BCB) using rhodium-carbene chemistry.

Garima Jindal:
Garima Jindal's group explores the reaction mechanisms of metal and enzyme catalysed reactions. The group uses a combination of physical

Core **Research**

Aryne chemistry; asymmetric catalysis; biochemical methods biophysical chemistry; chemica biology; C-H activation and functionalisation; carbohydrate chemistry; computational chemistry; enantioselective catalysis; enzyme sensing; -helical turn mimics; hydrogels; green chemistry; n-heterocyclic carbenes; lanthanide photoluminescence; macromolecular chemistry; medicinal chemistry; natural product synthesis; organic materials chemistry; organic synthesis; organocatalysis; peptides; photocatalysis; stereoselective synthesis; strain release chemistry; supramolecular chemistry; synthetic methodologies; total synthesis; transition metal catalysis.

organic methods to study the catalytic cycle and origins of stereoselectivity. The research is primarily focused on carbene insertion reactions catalysed by cytochrome P450s and a range of transition metals. The group has recently shown how an overlooked enol mechanism is the key to obtaining stereoselectivity in stepwise X-H insertion reactions. The group also uses spectroscopic methods and deuterium labelling studies to characterise key intermediates of a catalytic cycle.

Mrinmoy De:
We developed several functionalised nanomaterials based on transition metal dichalcogenides (TMD) and applied towards nano-antibiotics and nanozymes. The nanozyme activity was also explored towards antimicrobial activity and detection of biomarkers. Recently, we have developed several strategies for strain selectivity in nanomaterial-based antibacterial agents. Those strategies are based on different proportions of positively and negatively charged functionalised ligands, tethered amino acids/peptides, conjugation of Ni-nanocluster, photo-controlled gating of selective bacterial membrane interaction, and so on. Along with that, we have also developed several semiconducting nanomaterials for photocatalytic applications in C-C coupling and organic transformation.

AT Biju:
We have demonstrated the N-heterocyclic carbene (NHC)-catalysed aldimine umpolung/6π-electrocyclisation cascade to access the tetracyclic dihydrochromeno indoles and applied to the formal synthesis of a Hepatitis C Virus (HCV) NS5A inhibitor. NHC-catalysed imine umpolung for the cross-coupling of quinoxalin-2-ones with isatins; aza-benzoin route to directly access -keto amino acid derivatives via interrupted Polonovski strategy were revealed. Lewis acid-catalysed reactions of bicyclo[1.1.0]butanes (BCBs) for the synthesis of various sp3-rich molecules. A selective Alder-ene reaction of bicyclo[1.1.0]butanes with arynes for the synthesis of arylated cyclobutenes was uncovered.

EN Prabhakaran:
Synthesis and NMR, CD and FT-IR conformational analyses of double HBS-constrained shortest β-sheets from unnatural tripeptide sequences, as GS mimics were carried out. Complete characterisation of steric interactions at the Xaa-cisPro peptide bond, from first crystal structures of homologous Piv-cisPro containing peptides were conducted. Characterisation of trajectory of the Pro···Aro CH/π interactions from first direct evidence for the Type turns in crystal and solution structures of short homologous Xaa-cisPro-Yaa peptides. First evidence for the attenuation of cis/trans isomerism energy at amide bonds through lock in rotation of acyl-carbonyl sigma bond.

Santanu Mukherjee:
We have devised two different strategies for enantioselective alpha-allylic alkylation of unsaturated carbonyl and related compounds. One of these strategies involves an iridium-catalysed enantioselective allylic alkylation of alpha-phosphonato-carbonyls followed by Horner-Wadsworth-Emmons olefination. In another strategy, 4-cyano-3-oxotetrahydrothiophene (c-THT) is used as a safe and easy-to-handle surrogate of acrylonitrile. This two-step process consists of an iridium-catalysed enantioselective allylic alkylation of c-THT followed by retro-Dieckmann/retro-Michael fragmentation under alkaline conditions. Both these reactions result in the formation of skipped dienes in a highly enantioselective manner.

KR Prasad:
Studies towards the total synthesis of natural products of therapeutic significance continues be the focus of research activity of KR Prasad and group. Total synthesis macrolactone natural products AKML-B and belizentrin is currently underway.

N Jayaraman:
A new synthetic method for glycosylations, leading to oligosaccharide synthesis, involving 3-thiocresyl-prop-1-enyl (TCP) glycosides, is accomplished. Chiral self-assembly of biphenyl-cored carbohydrate bolaamphiphiles and molecular dynamic simulation-derived mechanistic insights are investigated in detail. Lymph node targeting mediated by albumin hitchhiking of synthetic Tn glycolipid leads to robust in vivo antibody production is established, thereby opening a new direction to vaccine development. Trivalent dialkylaminopyridine-catalysed site-selective mono-O-acylations of partially-protected pyranosides are established.

Faculty & Staff

AT BIJU | PhD (Kerala), FASc, Professor

MRINMOY DE | PhD (U Massachusetts), Associate Professor

DURGA PRASADA RAO HARI | PhD (U Regenburg), Assistant Professor

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

GARIMA JINDAL| PhD (IIT Bombay), Assistant Professor

SHARVAN KUMAR | PhD (JNU New Delhi), Assistant Professor

SANTANU MUKHERJEE | PhD (U Cologne), Professor

VIGNESH PALANI | PhD (UC Berkeley), Assistant Professor

EN PRABHAKARAN | PhD (IIT Kanpur), Professor

KAVIRAYANI R PRASAD | PhD (Pune), Professor

Honorary professor

S BHATTACHARYA

Honorary professors and INSA senior scientists

TUSHAR KANTI CHAKRABORTY

UDAY MAITRA

INSA senior scientist

S CHANDRASEKARAN

3.2.4
Solid State and Structural Chemistry Unit

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

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PhD and Int PhD

IN NUMBERS

10 Faculty members
3 Principal Research Scientists
1 Honorary faculty member
8 Emeritus professors
93 PhD students (including
22 Int PhD students)
104 Publications
4 Int PhD conferments
5 PhD conferments

Chair: SATISH PATIL

Current **Research**

Research theme at SSCU broadly falls under three verticals: Quantum Technologies, Sustainable Materials, and Semiconductor Materials. Collaborations within SSCU and across departments aim to create synergy between these verticals.

Materials Design
Vanadium dioxide is a prototypical correlated oxide with a temperature-dependent metal-to-insulator transition with a concomitant crystal symmetry change. In this work, the authors design and synthesise modulation-doped VO2-based thin film heterostructures that closely emulate a textbook example of filling control in a correlated electron insulator *(Nature Comms,* 2023). Satish Patil and coworkers were able to elucidate the dark triplet pair states in singlet fission in a variety of tailored molecules. Their finding has direct implications for new mechanistic insights into dark states in organic materials *(Nature Comms,* 2025).

Finding stable analogues of three-dimensional (3D) lead halide perovskites has motivated the exploration of an ever-expanding repertoire of two-dimensional (2D) counterparts. The authors explore a new A-site cation, 4,4'-azopyridine (APD), whose size and hydrogen bonding properties endow the corresponding (APD) PbI4 2D compound with the lowest bandgap and exciton binding energy of all such compounds, 2.19 eV and 48 meV, respectively *(JACS,* 2023).

Spectroscopy
Vivek Tiwari and group showed that a synergy between high- and low-frequency vibrations in singlet fission molecules can enhance the rate of fission of singlet photo-excitations into two triplet photo-excitations. Their finding has interesting implications for synthetic chemists in terms of design on novel molecules that can harness vibronic coupling to achieve singlet fission photovoltaics *(PNAS,* 2023).

The Magnetic Resonance Group research is focused on developing new magnetic resonance spectroscopic methods and techniques to elucidate structural and dynamical details of renewable energy materials such as semiconductors for solar energy harvesting, catalysts for biomass energy conversion reactions, and electrolytes.

Theory
We have proposed a unified tropical geometric framework to study different facets of non-Hermitian systems. We expect that our formalism will stimulate further exploration in different fields of non-Hermitian physics and various topics in modern mathematics through the lens of tropical geometry

Devices
Quantum photonic devices require robust sources of single photons to perform basic computational and communication protocols. Thus, developing scalable, integrable, and efficient quantum light sources has become crucial for the realisation of quantum photonic devices. The authors show the emergence of quantum-emitter-like anti-bunched emission behaviour when multiple quantum dots are located in the vicinity of plasmonic particles *(JPCL,* 2024).

Core **Research**

SSCU is a world-renowned premier centre with highly interdisciplinary research, spanning frontier areas lying at the intersection of Chemistry, Physics, and Materials Science. We develop nanomaterials and organic materials for solar cells, light-emitting diodes, photodetectors, batteries, catalysts for fuel cells, molecular magnetic materials, and soft biomaterials. We also specialize in developing novel spectroscopic techniques, such as ultrafast time-resolved and NMR methods, for characterising materials on fundamental and applied levels. To complement this experimental expertise, our faculty also develops theoretical and computational methods spanning areas of biophysics and condensed matter physics. In general, our faculty work at the interface of experiment and theory in a very interdisciplinary setting, as reflected in the composition of the SSCU faculty and students.

Faculty & Staff

RAO, CNR | PhD (Purdue), Bharat Ratna| Founding Professor, Professor for Life
NAGA PHANI B AETUKURI | PhD (Stanford), Associate Professor
SHEETAL KUMAR JAIN | PhD (Aarhus), Assistant Professor
ABHISHAKE MONDAL | PhD (Paris), Associate Professor
AWADHESH NARAYAN | PhD (Trinity College), Associate Professor
S NATARAJAN | PhD (IIT Madras), FASc, FNASc, FNA, Professor
ANSHU PANDEY | PhD (Chicago), Professor
SREEDHARA MB |PhD (JNCASR, Bengaluru), Assistant Professor
SATISH A PATIL | PhD (Wuppertal), FASc, Professor
GOVARDHAN REDDY | PhD (Wisconsin), Associate Professor
VIVEK TIWARI | PhD (Boulder), Assistant Professor

Principal research scientist

A GOVINDARAJ | PhD (Mysore)
C SHIVAKUMARA | PhD (IISc)
R SATHISHKUMAR | MTech (Madras)

DST faculty

RUPALI RAKSHIT

Honorary professors

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

Emeritus professors

BIMAN BAGCHI | PhD (Brown), FASc, FNASc, FNA, FTWAS
GAUTAM R DESIRAJU | PhD (Illinois), FASc, FNASc, FNA, FTWAS
S YASHONATH | PhD (IISc), FNA, FASc
S RAMASESHA | PhD (IIT Kanpur), FASc, FNA, FTWAS
AK SHUKLA | PhD (IIT Kanpur), FNA, FNASc, FASc, FNAE, FECS, FISE
MS HEGDE | PhD (IIT Kanpur), FASc
TN GURU ROW | PhD (IISc), FNA, FASc, FRSc
N SURYAPRAKASH | PhD, FNASc

3·3

Division of *Electrical, Electronics and Computer Sciences*

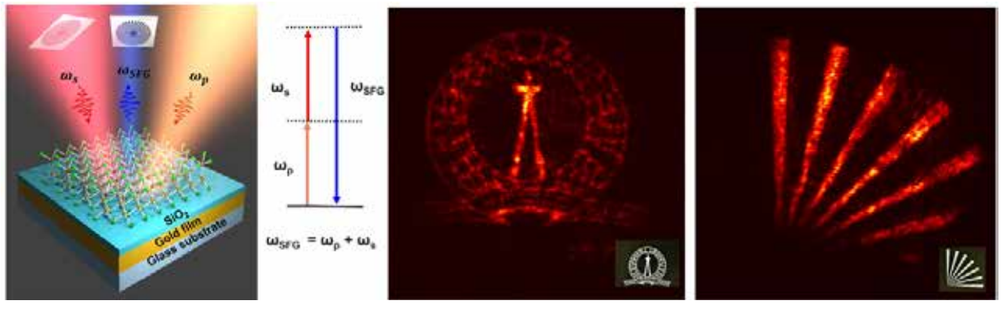
The Division is assiduously seeking fundamental advances in the following core areas: Signal Processing, Communications, Networks, Microelectronics and Devices, Photonics, Theoretical Computer Science, Computer Systems and Software, Artificial Intelligence and Machine Learning, Control and Optimisation, 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. The Division is also actively participating in Institute level programmes on Smart Energy, Smart Water, Smart Cities, and Devices for Healthcare, and Electronics for the Strategic Sector.

DEPARTMENTS | CENTRES | UNITS

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

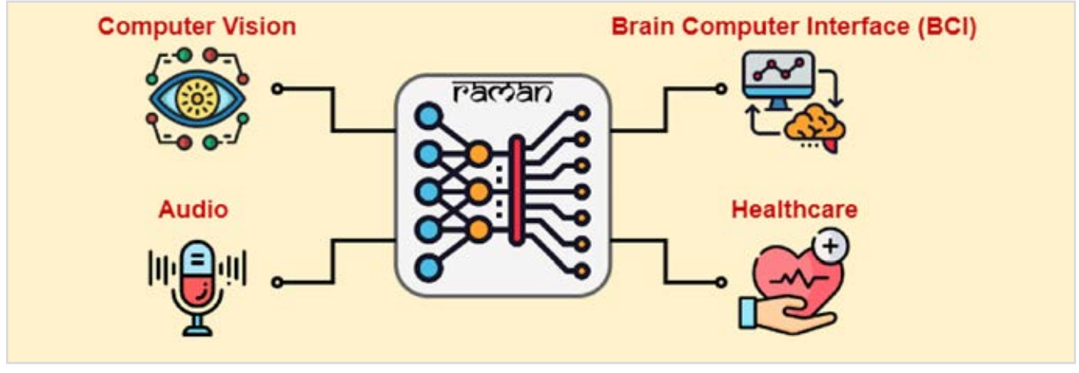


Turning infrared light visible

Researchers at the Department of Electrical Communication Engineering have fabricated a device to increase or "up-convert" the frequency of short infrared light to the visible range. Up-conversion of light has diverse applications, especially in defence and optical communications.
In a first, the team used a 2D material to design a non-linear optical mirror stack, combined with widefield imaging capability. When an input infrared signal is fed along with a pump beam onto the mirror stack, it results in a mixing of the frequencies, leading to an output beam of up-converted frequency, but with the rest of the properties intact. The team was able to up-convert infrared light of 1550 nm to 622 nm visible light.

Reference:
Manattayil JK, Lal Krishna AS, Asish Prosad A, Bag U, Biswas R, Raghunathan V, 2D Material Based Nonlinear Optical Mirror for Widefield Up-Conversion Imaging from Near Infrared to Visible Wavelengths, Laser & Photonics Reviews (2024).

Research **Snapshots**
2024-25

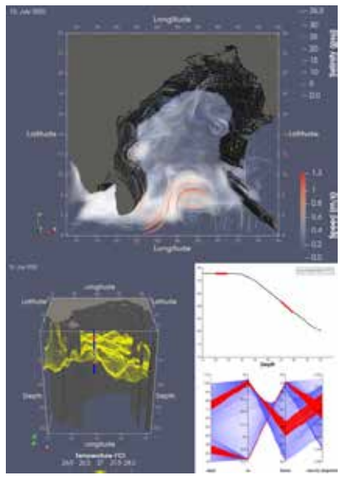


AI co-processor for edge computing

Researchers at the Department of Electronic Systems Engineering, IISc have developed an AI co-processor called RAMAN, or Re-configurable And sparse tinyML Accelerator for infereNce. RAMAN can be configured to run ML models for various applications such as object recognition, speech identification, brain-computer interfaces, and so on.
It can easily be adapted to run diverse ML models for low-power inference applications. RAMAN incorporates a novel dataflow inspired by Gustavson's algorithm to reduce memory access, and performs memory optimisation, such as peak activation memory reduction, by leveraging cache to reduce memory size. It can also be integrated within larger Systems-on-Chips, with diverse applications in vision, BCI, and acoustics.

Reference:
Krishna A, Nudurupati SR, Chandana DG, Dwidevi P, van Schaik A, Mehendale M, Thakur CS, RAMAN: A Re-configurable and Sparse tinyML Accelerator for Inference on Edge, IEEE Internet of Things Journal (2024).

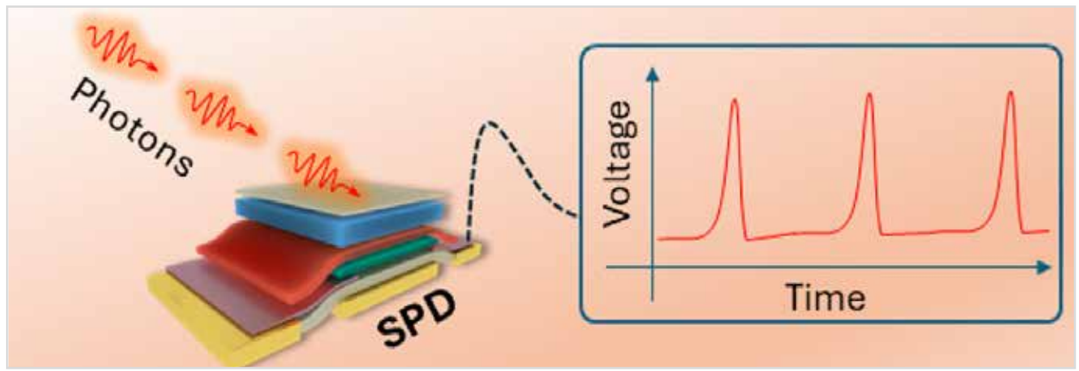
3D, interactive, and scalable visualisation of ocean data



Researchers in the Department of Computer Science and Automation in collaboration with the Centre for Atmospheric and Oceanic Sciences and the Department of Computational and Data Sciences have developed pyParaOcean, one of the first visualisation systems to support visual analysis of high-resolution 3D time-varying ocean data. It is designed to be a scalable and adaptable system, and has helped document salinity movement within the Bay of Bengal. pyParaOcean offers specialised modules for common oceanographic analysis tasks and incorporates data representations to support parallel computation on CPU clusters and GPU accelerators. A unique design feature is that its modules seamlessly integrate with ParaView, a popular general purpose visualisation software, thereby ensuring a user friendly system.

Reference:
Jain T, Singh U, Singh V, Boda VK, Hotz I, Vadhiyar SS, Vinayachandran PN, Natarajan V, A scalable system for visual analysis of ocean data, Computer Graphics Forum (2025).

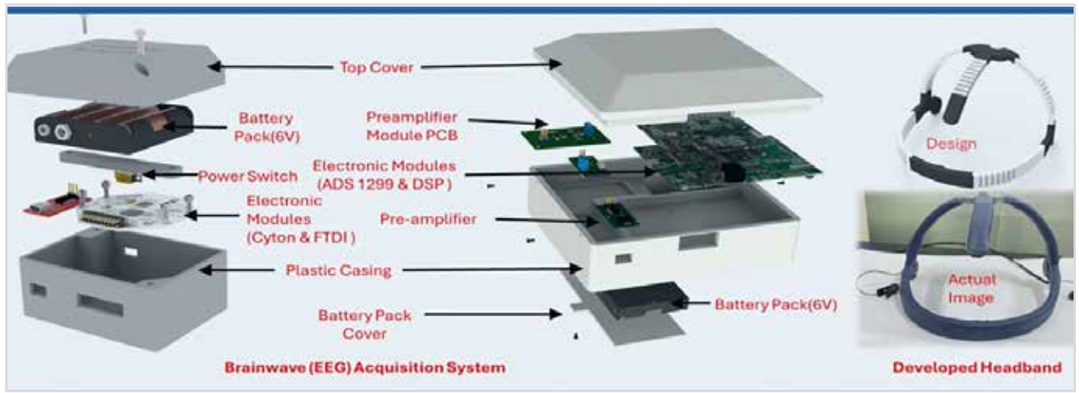
Research **Snapshots**
2024-25



Detecting single photons at room temperature

Single Photon Detectors (SPDs) play a crucial role in spectroscopy, astronomy, bioimaging, and sensing applications. Researchers at the Department of Electrical Communication Engineering have designed a room-temperature SPD capable of operating at 1,550 nm using thin layered materials and their van der Waals heterojunction. They achieved this by coupling a low bandgap (≈ 350 meV) absorber to a sensitive van der Waals probe that is capable of detecting discrete electron fluctuation. The device exhibits an overall quantum efficiency of 21.4% for unpolarised light (estimated to reach 42.8% for polarised light), and a small dark count rate (<1 KHz) at room temperature. This work has the potential to impact several key quantum technology applications.

Reference:
Abraham N, Watanabe K, Taniguchi T, Majumdar K, Room temperature single photon detection at 1550 nm using van der Waals heterojunction, Advanced Functional Materials (2024).

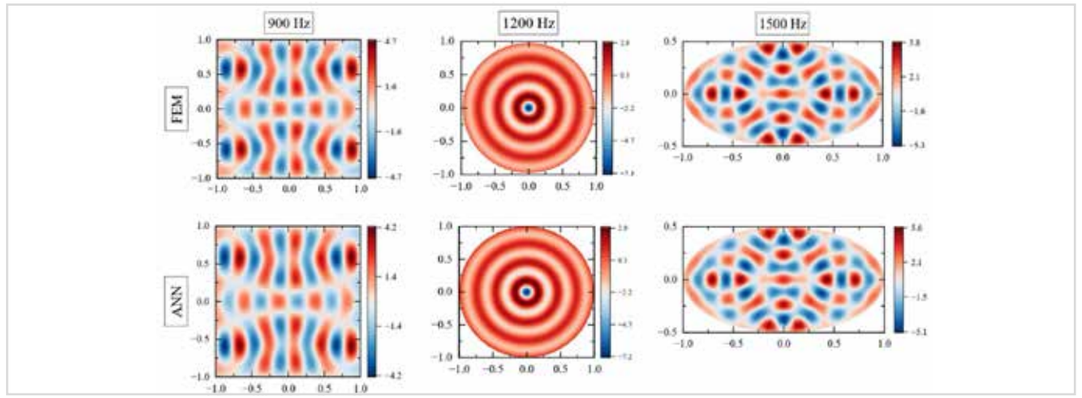


Novel auditory-evoked brainwave analyser for automated hearing screening

Researchers at the Department of Electronic Systems Engineering and clinical collaborators from KIMS Hubbali have developed and validated an innovative system for automated extraction of electrical signals in the brain (EEG) related to hearing, using a customised headband. The setup consists of a custom-made headband with just three electrodes strategically placed to capture evoked brain waves in the form of EEG. The system is portable, easy to operate, adjustable for different head sizes, and uses adaptive filtering to eliminate non-neural noise. It uses special resins to ensure a robust electrode skin interface without making the subject feel uncomfortable. By changing the electrode positions, it can also be tweaked to track electrical signals related to visual stimuli.

Reference:
Joshi RK, Manu KS, Hari RS, Krishan AA, Jayachandra M, Dandinarasaiah M, Pandya HJ, Automated ABR and MMN extraction using a customised headband for hearing screening, Biomedical Signal Processing and Control (2024).

Research **Snapshots**
2024-25



Physics-driven machine learning models for acoustics

Conventional simulation methods are often slow, costly, and may take days or even weeks to deliver results for real-world problems. To overcome this, researchers in the SPIRE Lab, Department of Electrical Engineering, are turning to physics-informed machine learning — an approach that combines scientific laws with artificial intelligence. These advanced models are being applied to a wide range of problems, from analysing sound patterns in the human vocal tract and lungs for medical diagnostics, to designing low-emission aircraft engines that run on cleaner fuels like hydrogen and ammonia.

Reference:
Veerababu D, Ghosh PK, Solving 2-D Helmholtz equation in the rectangular, circular, and elliptical domains using neural networks, Journal of Sound and Vibration (2025).

Veerababu D, Ghosh PK, Neural network based approach for solving problems in plane wave duct acoustics, Journal of Sound and Vibration (2024).

3.3.1

Department of Computer Science and Automation

Established in 1969 as the School of Automation and renamed as the Department of Computer Science and Automation in 1986, the department is engaged in cutting edge research in three broad streams: Theoretical Computer Science; Computer Systems and Software; and Intelligent Systems.

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Degree Programmes offered: PhD, MTech, MTech (AI), MTech (AI-Online), MTech (Research)

IN NUMBERS

25 Professors, Associate Professors, and Assistant Professors,
4 Affiliated Faculty
94 PhD students (includes 14 External Registrants)
24 MTech (Res)
135 MTech
24 MTech (AI)
13 M Tech (AI-Online)

Chair:
VINOD GANAPATHY

Current **Research**

CSA faculty made contributions across the entire gamut of computer science, some of which we highlight below:

Constructed a second price (Vickrey) auction protocol (SPA), which does not require any auctioneers and ensures total privacy in the presence of rational parties participating in the auction. In particular, the confidentiality of the highest bid and the identity of the second highest bidder are protected. We model the bidders participating in the second price auction as rational, computationally bounded and privacy-sensitive parties. These are self-interested agents who care about winning the auction more than learning about the private bids of other parties. A rational party does not deviate from the protocol arbitrarily but does so only for its own individual 'advantage' – without any consideration for others. Such an advantage is modelled using suitable utility functions.

Bin packing is a fundamental problem in computer science and optimisation. Best-Fit is a widely used algorithm for bin packing, and it has been studied by many stalwarts (including Turing Award winners such as Ullman, Yao, Karp, etc.) of computer science. Kenyon, in 1996, conjectured that the most practical algorithm for bin packing is to apply Best-Fit into randomly permuted items. This conjecture also initiated a subarea of beyond worst-case analysis called random-order arrival. In their recent SODA paper, Arindam and his students (PhD student KVN Sreenivas and BS student Anish Hebbar) made the first progress on the conjecture after three decades. This is the

Core **Research**

Ongoing 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 focused on the principal immune mechanisms that contribute to reactivation of tuberculosis in the context of HIV infection. Another newly developed area of research is virus-host interactions of emerging RNA viral pathogens including SARS-CoV-2, and viruses that cause influenza and dengue. The overall aim is to understand the molecular basis of viral pathogenesis and translate the knowledge to novel antivirals and improved vaccine candidates.

first instance of a SODA paper co-authored by an IISc UG.

Established the NP-hardness of testing equivalence to depth two arithmetic circuits, also known as sparse polynomials. The result, which is obtained via direct reduction from the 3SAT problem, provides supporting evidence for NP-hardness of the Minimum Circuit Size Problem (MCSP) for homogeneous depth three arithmetic circuits. Proving the hardness of MCSP for both Boolean and arithmetic circuits is a long-standing open problem in complexity theory. This work has appeared in the proceedings of the 51st EATCS International Colloquium on Automata, Languages and Programming (ICALP 2024).

Addressed fairness in resource allocation and machine learning contexts. Continued to contribute to the interface of Computer Science and Mathematical Economics with a focus on (i) Collective Welfare as Algorithmic Objectives: The goal here is to revisit standard performance metrics (e.g., regret) with a fairness lens. (ii) Fair Division under Constraints: This thread of work addresses the impact of combinatorial constraints on existential and algorithmic fairness guarantees.

Introduced the notion of Continuous Scatterplot Operator (CSP) as a means to query and interactively analyse bivariate fields. Demonstrated their use in the study of electronic transitions in a comprehensive application study. As a follow-up to previous work on computational methods for tracking salinity movement in the ocean, we introduced an advection-based feature definition that represents the movement of high salinity water, developed algorithms to track their evolution over time, and used them to establish observations in the Bay of Bengal. Developed novel algorithms for simplifying the Jacobi set of bivariate fields and for constructing a topological descriptor called the time-varying extremum graph, with applications to tracking features in time-varying scalar fields. Proposed a geometric optimisation criterion for homology cycles that represent holes in topological spaces, and polynomial-time algorithms for computing optimal cycles.

Studied secure multiparty computation in the asynchronous setting with perfect security and optimal resilience (less than one-fourth of the participants are malicious). It has been shown that every function can be computed in this model [Ben-OR, Canetti, and Goldreich, STOC 1993]. Despite 30 years of research, all protocols in the asynchronous setting require communication complexity for computing a circuit with C multiplication gates. In contrast, for nearly 15 years, in the synchronous setting, it has been known how to achieve communication complexity (Beerliova and Hirt; TCC 2008). The techniques for achieving this result in the synchronous setting are not known to be sufficient for obtaining an analogous result in the asynchronous setting. Closed this gap between synchronous and asynchronous secure computation and showed the first asynchronous protocol with communication complexity for a circuit with C multiplication gates.

Focused on the problem of design and analysis of variants of digital signature schemes that are quantum-safe. After some initial investigation in the multivariate quadratic (MQ) setting, we have initiated work in lattice-based signatures. We look at the problem of designing ID-based and other signature schemes with tight security reduction. To that end we revisited some existing generic approaches and identified some critical gaps in the security definition as well as the security reduction. We addressed this gap by rigorous security proofs under the standard security definition. In addition, we are exploring the problem of quantum money where stronger security guarantees are possible based on quantum mechanical principles, as well as various privacy-enhancing protocols, like identification, that can additionally be quantum-safe.

Provided an approximate linear programming formulation for a multi-agent cooperative Markov decision process and provided a numerical scheme for its solution. The approximate LP incorporates function approximation not just on the value function but also on the constraints. In yet another work, we developed families of generalised simultaneous perturbation-based zeroth-order stochastic optimisation

algorithms where the number of function measurements used in the estimator decides the level of accuracy of the resulting gradient estimate. In the class of actor-critic algorithms, it has been observed that running a few recursions of the critic update in between two successive updates of the actor results in improved performance. We presented a hybrid optimisation algorithm that optimises in the continuous space of parameters as well as the discrete space of the number of instants and suggests optimally the number of steps to follow in between two successive critic updates.

Made progress on the following problems:

- Inference problems on graphical models
- Model editing
- Machine learning for quantum physics

1. The total colouring conjecture (TCC) is a classical problem. A weakened version of TCC was known to be true for graphs of chromatic number at most 4. We extended the result to the case where the chromatic number is at most 5. This was a long-pending case. Also studied the total colouring conjecture, connecting it to Hadwiger's conjecture.

2. We proved new bounds on the anti-Ramsey numbers of star graphs via maximum edge q-colouring. Erdős introduced this problem in the seventies and there has been renewed interest recently.

3. Presented a near-linear time algorithm for parcel delivery using drones.

4. Another applied problem we worked on was the use of graph theory in quantum physics. There was a question raised by the Nobel Prize-winning Anton Zeilinger and his student Mario Krenn. We made some interesting progress on that problem.

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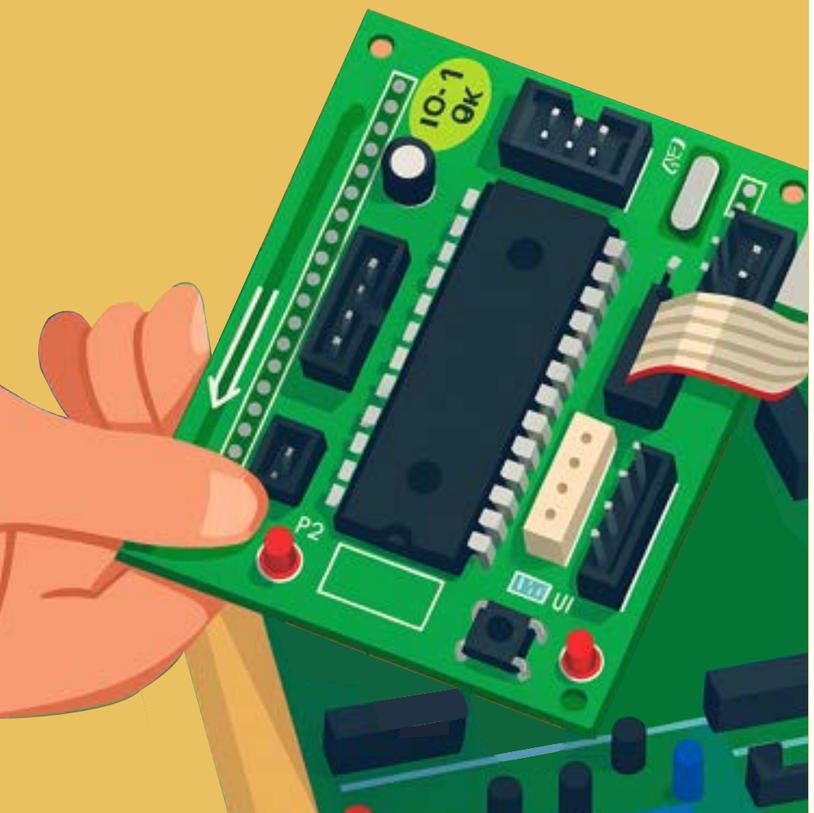
3.3.2 *Electrical Communication Engineering*

Started modestly as a Communications Laboratory in 1923 in the then Department of Electrical Technology, the ECE Department was made a formal entity in 1947. The department has been conducting cutting-edge research on information theory, coding theory, 5G and beyond communications, communication networking, signal processing, video analytics, machine learning, quantum communications, nanoelectronic devices, photonics, electromagnetics, RF sensors, and security, and privacy in CPS. In addition to contributing to the research and development workforce of the country in the above areas, the department has nurtured close engagement with public and private sector industries over many years. The department hosts research talks, webinars, workshops, and other events on cutting-edge topics of interest to researchers, industry, and the general public.



FACT FILE

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IN NUMBERS

25 Academic staff
3 Honorary professor
124 PhD students
169 MTech students in ECE, MVLSI, SP, and AI programmes
39 MTech ECE (online students)
2 MTech (Res) students
264 Publications

Chair:
NEELESH B MEHTA

Current **Research**

Communication, Signal Processing, Machine Learning
Proposed interleaved pilots in Zak-OTFS to significantly extend the region of predictable operation in doubly selective channels. Showed superior performance of Zak-OTFS over OFDM for high-mobility scenarios in next-generation wireless systems. Developed a prototype of an OTFS system using SDRs. Proposed novel channel estimation and equalisation methods for OTFS and underwater acoustic communication. Designed IRS-based solutions to address beam split and spatial wideband effects in wireless networks. Demonstrated consistent performance gains from distributed IRS in multi-operator and out-of-band scenarios. **Characterised** the fundamental trade-off between the time and energy allocated to pilots and data, accuracy of channel estimates, and data rate in an IRS-aided system.

Showed that the new full-duplex capability can prevent an access point from becoming a bottleneck in Wi-Fi networks. Developed an AI/ML-based wireless communication system by estimating channel, IF carrier, symbol rate, carrier frequency offset, symbol timing offset, and recognising modulation classification format for several communication systems. Developed advanced ZCZ sequences for interference-resilient data transmission in QS-CDMA and NOMA, and for joint CFO and STO estimation in RIS-assisted systems.

Enhanced wireless communication and imaging systems through advanced methods such as symbol detection in quantised MIMO, RIS-aided beamforming, DFRC parameter estimation using evolutionary algorithms, and Pareto-based transmission selection. Proposed innovative sparse precoding, antenna allocation, and neural precoding techniques to enhance joint sensing and communication performance in distributed systems.

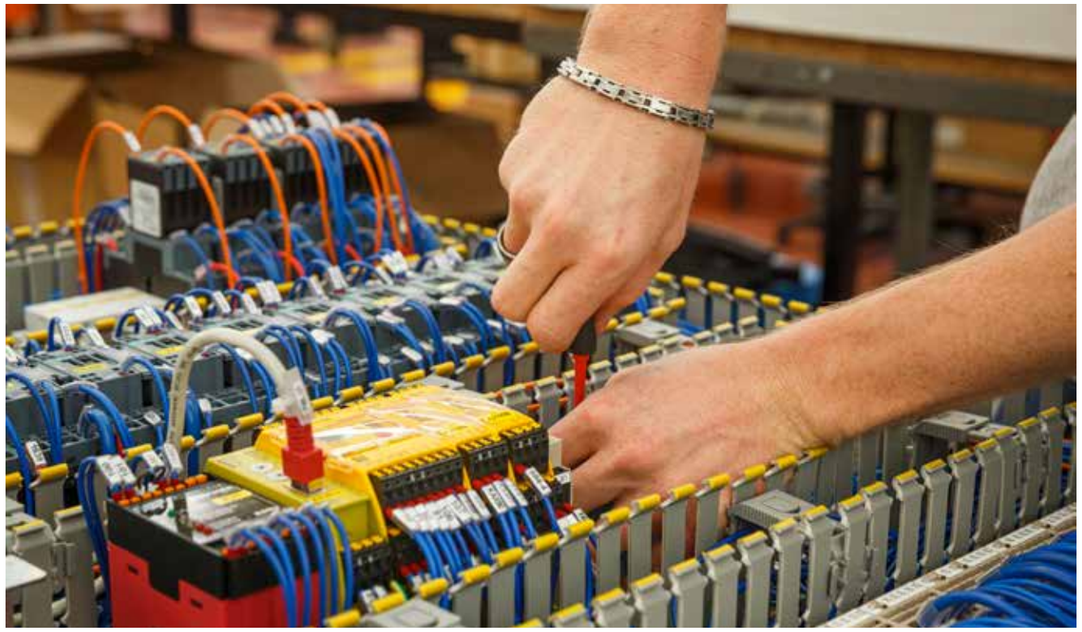
Designed hierarchical and multi-access coded caching schemes using combinatorial designs and PDAs, achieving low subpacketisation and coding delay. Approaches led to improved privacy and efficient content delivery. Developed function-correcting codes for noisy channels and locally bounded functions. Developed methods for estimating weight enumerators and sizes of constrained subcodes of Reed-Muller codes using sampling techniques. Derived bounds for the permanent of non-negative matrices using Bethe and Sinkhorn methods, contributing to both coding and matrix analysis fields.

Designed novel approaches for signal sampling and reconstruction over product graphs and cell complexes. Pursued advancements in image and video quality assessment (IQA/VQA), focusing on the use of generative models, vision-language models, and semi-supervised learning techniques. Specific innovations include enhancing underwater video quality using generative models and improving dynamic view synthesis with factorised motion fields.

Machine Learning, Artificial Intelligence, Optimisation, Control, and Networks
Proposed a heterogeneity-aware sampling of servers that outperforms power-of-d load balancing when the sampling is uniform. Developed a model to optimise power and performance in multi-core CPUs with different types of cores by balancing workload and frequency and validated it by experiments on heterogeneous core CPU systems. Proposed an optimal CUSUM algorithm under Markovian observations. Worked on deriving delay-optimal polling policies.

Core **Research**

Communications, Information Theory, Coding, Networks, Signal Processing, Machine Learning, Artificial Intelligence, Photonics, Electromagnetics, Nanoelectronic Devices, and Quantum Communications



Proposed efficient distributed MAC protocols (QZMAC and EZMAC) and demonstrated their performance on a TelosB testbed. Proposed an Open and Flexible Distance Learning (OFDL) for Indian learners using cluster algorithms. Studied linear bandits with side-observations in social networks to improve user recommendations by leveraging responses from users and their neighbours. Proposed an algorithm that exploits the social graph structure and achieves asymptotically optimal regret performance.

Developed a symmetry-invariant learning framework using mixed model components and bandit-based discovery, achieving efficient and accurate function learning. Proposed robust algorithms for best arm identification and uncertainty-aware policy optimisation in RLHF, with strong theoretical and empirical validation.

Addressed central questions pertaining to the non-availability of large-scale data, modelling of long-range dependency, and mitigation of biases in generative modelling in under-constrained environments. Research on AI and deep learning addressed challenges in healthcare, environmental monitoring, and computational models. Explored neural operators for forecasting and physical systems modelling, generative methods for histopathological image segmentation, and intelligent wearable sensors for health monitoring. Introduced a quality-graded platform (MIDAS) for AI-driven healthcare and highlighted the need for robust digital data protection policies in medical research and health systems. Developed human factors-based modelling framework for mimicking a bus driver that incorporates important aspects of bus driver behaviour.

Nanoelectronics, RF, Microwaves, Photonics, and Lasers

Proposed an interleaved, low footprint antenna arrangement solution for automotive MIMO Radar (77 GHz) applications. Proposed a low-profile, quad-beam flat-panel metasurface antenna using 1-bit coding, achieving 11.7 dBi gain—suitable for 6G and radar applications. **Utilised** a Binary Particle Swarm **Optimisation** for designing a reconfigurable unit cell, multiport antenna, and a feed network for 2-D monopulse pattern generation. Developed a wideband, dual-feed microstrip antenna with a feed network to achieve pattern diversity. Extensive research on circuits and signal processing in radar and RF systems, addressing harmonic suppression in CMOS frequency doublers, chirp demarcation in FMCW Radars. Study on Upper Limb Swing Analysis Using FMCW Radar. Developed machine learning-based models for **characterising** conducted emissions from programmable microcontrollers. Proposed efficient system-level **modelling** techniques for open-loop Bulk Current Injection (BCI) testing to improve EMI/EMC compliance processes. Enhanced bandwidth of Extended Interaction Klystrons using novel ridge-loaded cavity designs for high-power microwave applications.

Pursued advancements in optical resonators, sensors, and photonic devices, particularly for sensing and communication applications. Also explored advanced optical modulation techniques, machine learning-assisted biosensing, and the optimisation of grating couplers for infrared transmission. Demonstrated resonantly enhanced frequency conversion in germanium-based dielectric metasurface platform.

Showed that the presence of magnetic inhomogeneity is averaged out at high exciton scattering rates, leading to improved exciton **polarisation.** Demonstrated a room temperature single photon detector at 1550 nm using van der Waals Heterojunction, with a quantum efficiency exceeding 20% and a dark count rate of 720 Hz. Proposed and developed a novel two-dimensional layered material-based nonlinear optical mirror device to perform widefield upconversion. Demonstrated field implementation of high-dimensional quantum key distribution (QKD) across the IISc campus.

Experimentally demonstrated that cascaded Raman fibre lasers — operating at a fixed in-band power ratio of 98% — exhibit a distinct U-shaped Relative Intensity Noise (RIN) characteristic that sharply contrasts with rare-earth doped fibre lasers. Has the potential to lead to a low-cost pathway to dramatically reduce intensity noise while still delivering sufficient spectral bandwidth (~400 nm) for most OCT and low-coherence applications. Proposed a scheme for wavelength to intensity-based interrogation technique using fibre fused demultiplexer as an edge filter, for FBG based sensing applications. Proposed schemes for monitoring point-to-multipoint fibre networks.

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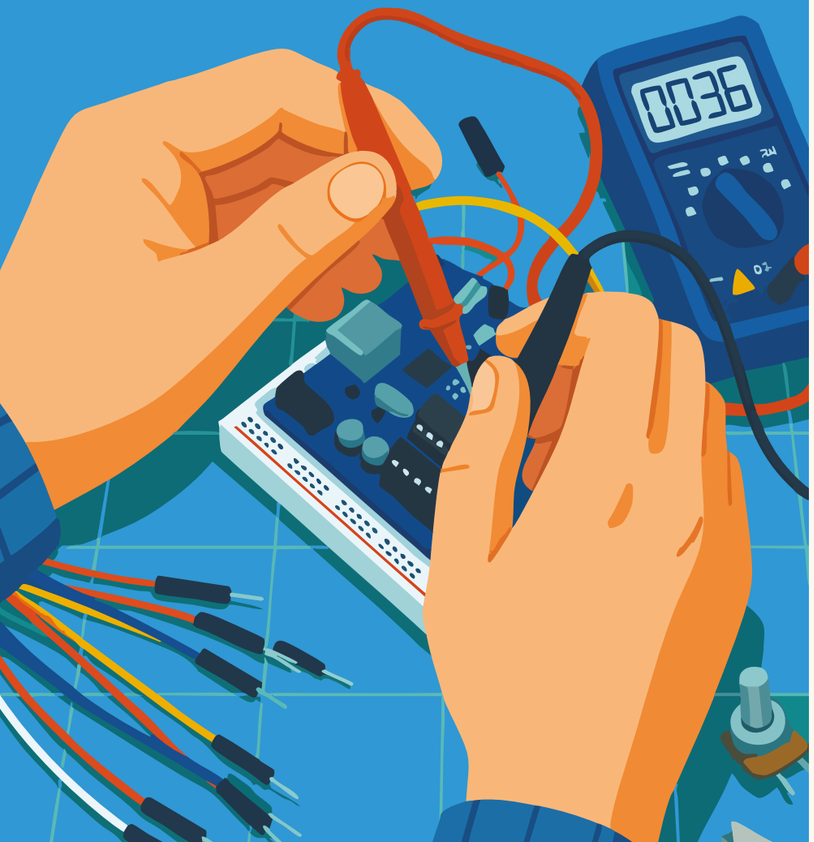
VIKRAM SRINIVASAN | PhD (UC San Diego), Adjunct Faculty

3·3·3 *Electrical Engineering*

The Department of Electrical Engineering was started in 1911 (then known as Department of Electro-Technics and subsequently changed to Department of Electrical Engineering in 1913), just two years after the founding of Indian Institute of Science. Initially, students were admitted for a post-graduate diploma, known as the Diploma of the Indian Institute of Science (DIISc). Subsequently, the diploma programme was replaced by ME degree programme, which is a post-BE programme, and which has been named as MTech programme recently. The doctoral programme began in the 1950s. In 1970s, the MSc (Engineering) degree, a master's programme by research was introduced to supplement the research activities. MSc (Engineering) programme was recently renamed as MTech (Research).



FACT FILE

Established: 1911
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Email: office.ee@iisc.ac.in
URL: ee.iisc.ac.in
Degree Programmes offered: PhD, MTech (Research), MTech (Electrical Engineering), MTech (Artificial Intelligence) jointly with EECS Division, MTech (Signal processing) jointly with ECE

IN NUMBERS

22 Academic Staff
82 PhD Students
68 MTech (EE)
28 MTech (AI)
24 MTech (SP)
03 MTech (Res)
187 Publications

Chair: UDAYA KUMAR

Current **Research**

Power Systems:
An open-source, heterogeneous, resource-constrained hardware platform is developed for the application of edge computing in the smart grid using a unique hardware platform called Parallella, which hosts a Zynq SoC (dual-core ARM + FPGA) and a 16-core co-processor called Epiphany. The raw waveform data is sent to a cloud server over a bandwidth-limited communication channel using a custom anomaly-aware data compression algorithm implemented on the ARM. Phasor measurement algorithms are implemented on the FPGA. A parallel power quality measurement algorithm is implemented on the Epiphany. In the area of power system protection, a simple linear programming algorithm running in the central master controller to coordinate the relays using three different IEEE standard curves is developed.

Power Electronics:
Research in power electronics has been at multiple levels, namely, component, subsystem, power converter, common applications, and niche applications. Component-level activities have focused on characterisation and modelling of wide bandgap (WBG) power semiconductor devices, high-frequency power magnetics, and magnetic materials for high-speed electrical machines, including the development of the required characterisation setups. Subsystems developed include gate drivers, protection circuits, active and passive filters, digital controller hardware, and monitoring systems. WBG device-based inverters for electric vehicle (EV) motor drives, ac-dc power factor correction converters, power converters for partial power processing, single-stage single- and three-phase ac-dc isolated converters for EV chargers, and reconfigurable EV chargers that can cater to 2, 3, and 4-wheeler segments have been developed successfully. Development of switched capacitor multilevel inverters for PV applications has been initiated. Power electronic interfaces and fast equaliser circuits for electrochemical storage elements such as Li-ion, hydrogen electrolyser and ultracapacitors have also been developed. Major achievements include high-voltage power supplies for next-generation x-ray systems, which reduce stray dose and improve image quality, novel high-frequency soft-switching power conversion with high-step-down gain for powering next-generation processors, and compact low-droop pulsed power supplies for ground-based and airborne phased array radar systems. Novel pulse width modulation (PWM) techniques for multi-phase motor drives, current and torque control techniques for switched reluctance motor, output power control techniques for switched reluctance

Core **Research**

The research work of the Department of Electrical Engineering falls into two major fields, namely i) Power and ii) Systems and Signal Processing. The area of power includes power systems, power electronics and high voltage engineering. The systems and signal processing research area includes machine learning, real-time systems, medical imaging, image and video processing, medical signal processing, digital health, speech and audio signal processing, control and its application to robotics, networked control and multi-agent systems.

generator, and control of multi-port dc-dc converters are other research highlights.

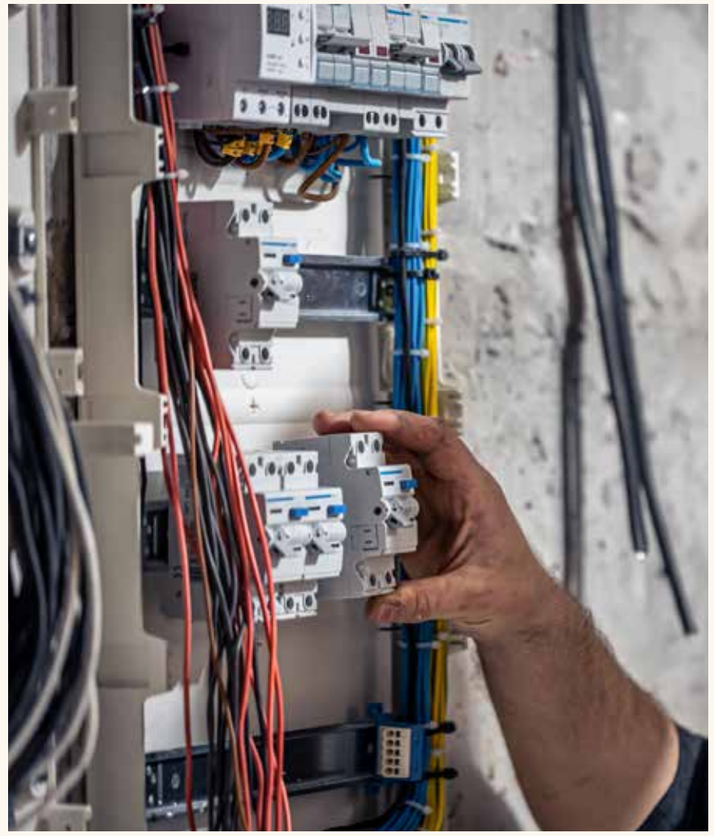
High Voltage Engineering: Work has been initiated to design and develop pulsed power sources for coilgun-based electromagnetic launchers, electromagnetic manufacturing as well as liquid food microbial inactivation. Research based on cold plasma techniques has successfully reduced numerous gaseous pollutants using a cascade of discharge plasma treatment with ozone treatment. In a new initiative, the cold plasma is employed to treat the seeds for a better yield. Pollution-induced flashover studies on EHV/UHV transmission insulators, condition monitoring of HV apparatus, corona, HVAC and HVDC studies on multi-stress ageing on composite insulators and polymeric housed surge arresters, development of superhydrophobic coatings for polymeric insulators and studies on high-temperature high-current low-sag (HTLS) conductors have been pursued. In the area of high-voltage transformers, closed-form analytical expressions have been derived that correlate the harmonic sum of squares of natural frequencies (i.e., both SCNF and OCNF) of a 1-ph, 3-ph, Y- or Delta-transformer winding to its elementary inductances and capacitances for any possible condition of the neutral terminal. A novel model has been developed for the simulation of the lightning attachment to the aircraft. Work is initiated towards efficient numerical field simulation of the lightning stroke current and field distribution in aircraft. A computationally efficient scheme has been developed for the space plasma and conducting cube interaction.

Systems and Signal Processing: New robustness results have been proved for learning multi-class and multi-label classifiers under label noise. The transfer learning method has been suggested for CNNs using the novel concept of a bank of filter trees. A distributed algorithm for rigid registration of point sets has been designed, and uniqueness results for rigid registration have been observed.

One of the focus areas of research in computer vision is cross-modal matching, i.e., given data from one modality (ex. image-text), the goal is to retrieve semantically meaningful data from another modality (ex. photo-sketch). Work is in progress on challenging problems, including classifying data from unseen classes (zero-shot learning), detecting data from unseen classes (novelty detection), and semantic segmentation of urban scenes to aid autonomous driving.

Recent advances in large language models (LLMs) have enabled a convergence of affective computing and multimodal modelling. The department has focused efforts on understanding and generating human emotions in multimodal data. Emotion modelling has been enhanced through techniques that align high-level linguistic representations with low-level multimodal signals, allowing models to better perceive and respond to emotional cues in conversation. At the same time, efforts in LLMs have also advanced to uncertainty calibration, where we have introduced losses that guide models to express appropriate confidence levels, improving their ability to detect and abstain from incorrect or ambiguous outputs. These uncertainty-aware adaptations are achieved using efficient input-sampling methods, which perturb the input to elicit the local behaviour of the model. Further, a thread of work focusing on fine-tuning strategies of LLMs has found that efficient label encoding in classification tasks allows improved generalisation of these models. Together, these approaches create a new generation of language models that are not only emotionally perceptive but also capable of reliable, calibrated reasoning in diverse and dynamic application settings.

In the area of digital signal processing, the research work carried out includes speech representation learning, Visual speech recognition, and articulatory modelling. Approaches for acoustic source localisation, new risk minimisation strategies for speech signal denoising. New and robust techniques for spectro-temporal modelling of the speech signal have been developed. It has been discovered that a new class of signals that can be reconstructed from their magnitude spectrum and established Hilbert integral relations. Advanced techniques for robust extraction of several parameters of the voice box from speech acoustics have been developed. Improved understanding of articulation during different modes of speech has been developed.



In the area of image processing and deep learning, the research work includes the development of new wavelet-based reconstruction strategies for unlimited sampling, which is a new sampling strategy that promises to offer an unlimited dynamic range. A new regularisation method has been developed which has the power to eliminate a large amount of noise without suppressing image resolution. Further, a novel type of regularisation for reconstructing images from highly under sampled non-uniform spatial point measurements with application to speeding up confocal microscopy has been developed. Further, a novel type of multicomponent regularisations, that are adaptive to the data that undergo reconstruction, has been developed. Based on these regularisations, numerical studies that confirm their potential to compete with deep learning methods have been performed. Further, a novel type of regularisation for images recorded as a function of time has been developed for fluorescence microscopy images; for the first time in the literature, this regularisation is not blind to the fact that motion characteristics of biological samples vary spatially and temporally.

The topics of information extraction from audio, including recognition of the spoken content, the speaker, and the language/accent, are pursued. Further, healthcare based on acoustic data is explored to identify sleep disorders, neurological disorders like ALS, respiratory disorders like asthma, as well as for viral infections in the respiratory pathway like COVID-19.

In the area of controls, we have developed fundamental design and analysis techniques for resource aware event-triggered control. We have also developed highly scalable, near-optimal, and provably safe algorithms for the coordination of robots' trajectories at intersections in warehouses. We have also developed new models for opinion dynamics of resource aware utility maximising agents in social networks.

We have developed an observer for sensor fault reconstruction of the linear time-invariant systems under resource constraint scenarios. Formation control with collision avoidance has also been developed for multiple quadrotors using adaptive and robust control methodology.

Faculty & Staff

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KAUSHIK BASU | PhD (Minnesota), Associate Professor

SOMA BISWAS | PhD (Maryland), Associate Professor

KUNAL NARAYAN CHAUDHURY | PhD (EPFL), Associate Professor

SARASIJ DAS | PhD (Western Ontario), Associate Professor

SRIRAM GANAPATHY | PhD (Johns Hopkins), Associate Professor

PRASANTA KUMAR GHOSH | PhD (USC), Associate Professor

VENU MADHAV GOVINDU | PhD (Maryland), Associate Professor

GURUNATH GURRALA | PhD (IISc), Associate Professor

VISHNU MAHADEVA IYER | PhD (North Carolina) Assistant Professor

VINOD JOHN | PhD (Wisconsin), Professor

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B SUBBA REDDY | PhD (IISc), Chief Research Scientist

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L SATISH | PhD (IISc), Professor

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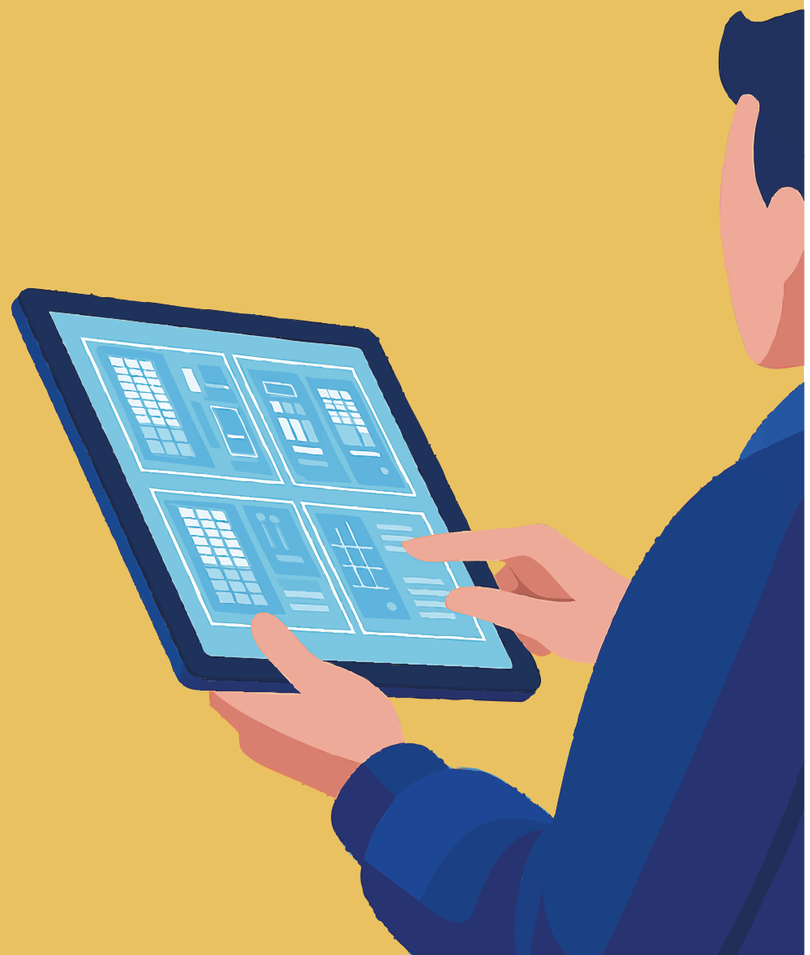
M JOY THOMAS | PhD (IISc), Assistant Professor

KIRAN KUMARI | PhD (IIT Bombay), Assistant Professor

3·3·4 *Electronics Systems Engineering*

Department of Electronic Systems Engineering
The Department of Electronic Systems Engineering nurtures educational research with the theme "Atom to System", which encompasses nanoelectronics, signal and information processing, neuromorphic integrated circuits, diagnostic and healthcare devices, communication networks and Internet-of-Things, and power electronic drives and renewable energy systems. It runs three MTech programme: MTech in Electronic Systems Engineering, MTech in Electronics Product Design and MTech in Microelectronics and VLSI jointly with ECE.



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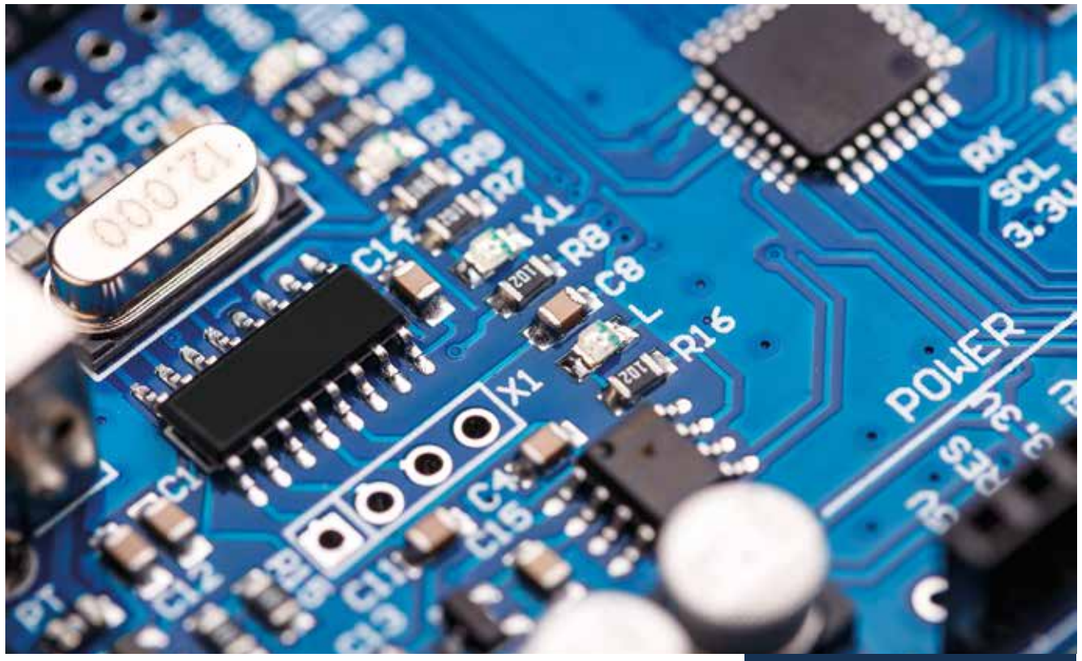
MTech (EPD)
MTech (MVLSI) along with ECE

IN NUMBERS

25 Faculty & Staff
84 PhD students
200+MTech students
71 publications in journals
73 publications in conferences
15 patents
2 public IPs
5 PhD conferments

Chair: L UMANAND



Current **Research**

In nanoelectronics, we employed reactive molecular dynamics and first principles-based calculation to elucidate the fundamental mechanism of non-volatile resistive switching in monolayer molybdenum sulphide with passive electrodes. We also worked on energy storage at nanoscale, where we apply bottom-up and top-down global minima search techniques to assess the potential of monoelemental 2D materials for Li-ion battery electrodes.

In the broad area of signal and information processing, several specific topics being worked on. In physical data storage, 2D algebraic codes have been developed for correcting random and burst errors. This result can pave the way for codes over multi-dimensional storage channels, customised for QR codes and so on. A patent of Reed Solomon decoders was approved. In quantum information processing, techniques for node failure recovery in quantum networks have been developed, as well as modified graph states that are resilient to eavesdropping; further, fundamental work has been carried out on entanglement-assisted Reed Solomon quantum codes. In neural networks and learning systems, an original theory for spatio-temporal neural memories based on self-organisation has been developed. In music signal processing, a theory towards algorithmic synthesis of South Indian classical music has been developed.

In the neuromorphic engineering and IC design area, the following

Core **Research**

Research in the department encompasses a spectrum of areas, including nanoelectronics, signal and information processing, neuromorphic engineering, IC design, reconfigurable computing, hardware security, healthcare technologies, biomedical engineering, networked embedded systems, Internet-of-Things, communication networks, power electronic drives, and renewable energy systems. It hosts and co-hosts very popular M Tech programmes in Electronic Systems Engineering, Electronic Product Design, Microelectronics and VLSI, and Artificial Intelligence.

have been developed: unlimited dynamic range analogue to digital converters (full IP); handheld, low-cost electronic device for rapid, real-time fluorescence-based detection of Hg2+ using aptamer-templated ZnO quantum dots; mixed-signal hybrid neuromorphic processor with memristive synaptic crossbar for cognitive computing; neuromorphic vision, and ultra-low power machine learning accelerator.

Work in reconfigurable computing has seen the development of hardware accelerators for capsule network-based deep reinforcement learning, high throughput hardware for Hoeffding Tree Algorithm with Adaptive Naive Bayes Predictor, 2-way Superscalar RISC-V CPU with caches, virtual memory with CoreMark and Dhrystone benchmark values of 3.84/ MHz and 1.0603 DMIPS/MHz respectively.

A world-class clean room (Nanofab for Advanced Microsystems and Biomedical Devices for Clinical Research) has been established, focusing on developing advanced healthcare technologies. To solve critical problems in healthcare, the group developed advanced technologies combining expertise in microengineering, biomedical engineering, electronic system design, additive manufacturing, sensor interfacing, and calibration. The work at BEES Lab resulted in portable semi-automated systems for the label-free diagnosis of breast and brain cancer and heart tissue anomalies, sensor-integrated intubation catheter for tracheal airway assessment, ablation catheter prototype integrated with microsensor for force and haptic feedback, electronic modules, flexible and rigid microdevices for surface and deep brain recording and stimulation for neuro-therapeutic and diagnostic applications, compact table-top electronic nose system for detection of liver cirrhosis from breath, and lab-on-PCB devices for rapid detection of SARS-CoV-2 virus and cancer biomarkers have been developed and validated on animal or human models. These patent-pending technologies were developed and validated in close association with a strong network of clinicians and surgeons across the country and abroad through the establishment of MoUs, collaborative research grants, and industry support. The focus is now on translating these to markets.

Work in biomedical engineering has led to patent applications for the fabrication of microneedles, a device for the measurement of cervical dilatation, and a portable analyser for in situ testing of the degradation of stored coconut oil. Work in the Networked Embedded Systems and IoT area has resulted in the following outputs: Design and construction of an IoT data management algorithm for efficient data storage and reconstruction, a neural network architecture for speech-to-text decoding, RF localisation algorithms using a hybrid approach consisting of finger printing with cooperative schemes, construction of sensor rich projectiles for remote monitoring and intrusion detection, RFID-based tracking of first responders inside a building, and acoustic signature-based physically unclonable functions for device identification.

In the context of Industrial Cyber-Physical Systems, a security testbed has been implemented for showing the importance of application context awareness in security mechanisms to detect and mitigate cyber-security threats. The idea is to propose a robust and secure framework, as well as intelligent security mechanisms to manage complex manufacturing plants. In other work, an “Energy Router” has been developed for use in smart grid applications. A network of energy routers consists of DC loads as well as DC energy sources. The Energy Router can differentiate between loads by assigning priorities to them, and can route the power on demand, from sources to loads, through the network by making or breaking the connections in the electrical domain. An ESE faculty member is also part of the team that is developing a metal 3D printer using Electron Beam Generator technology, the first of its kind in the country.

Faculty working in Communication Networks have worked on problems in optimal virtual network function placement and traffic steering, lightweight and energy-optimal scheduling algorithms for wireless networks, energy-optimal VM allocation and VM migration in data centre networks, server pricing and service scheduling in server farms as well as design and control of tactile cyber-physical systems.

The Renewable Energy Systems area has seen work leveraging faculty expertise in power electronics and led to significant contributions in solar photo voltaic-based systems, like grid connection and maximum power point tracking, and induction generation systems that can be applied to wind and micro hydel plants. Specific mention can be made of solar cookers, roof-top photovoltaic integration to the departmental grid and ballast-free pico hydel generation.

Faculty & Staff

JOY KURI | PhD (IISc), Professor

SANTANU MAHAPATRA | PhD (EPFL), Professor

L UMANAND | PhD (IISc), Professor

SHAYAN GARANI SRINIVASA | PhD (Georgia Tech), Professor

MAYANK SHRIVASTAVA | PhD (IIT Bombay), Professor

ARUP POLLEY | PhD (Georgia Tech), Associate Professor

KURUVILLA VARGHESE | MTech (IISc), Chief Research Scientist

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

TV PRABHAKAR | PhD (TU Delft), Chief Research Scientist

CHANDRAMANI SINGH | PhD (IISc), Associate Professor

HARDIK J PANDYA | PhD (IIT Delhi), Associate Professor

CHETAN SINGH THAKUR | PhD (Western Sydney), Associate Professor

VIVEKA KONANDUR RAJANNA | PhD (IISc), Assistant Professor

UTSAV BANERJEE | PhD (MIT), Assistant Professor

DEBAYAN DAS | Assistant Professor

CHANDRASEKHAR CM | Assistant Professor

V NAGA KRISHNA | Scientific Officer Gr I

P RAMACHANDRAN | Scientific Officer Gr I

VASANTA K B | Scientific Assistant

GV SATHISHA | Scientific Assistant

KALPANA B V | Scientific Assistant

GAYATHRI PR I Technical Assistant

SAHID P I Technical Assistant

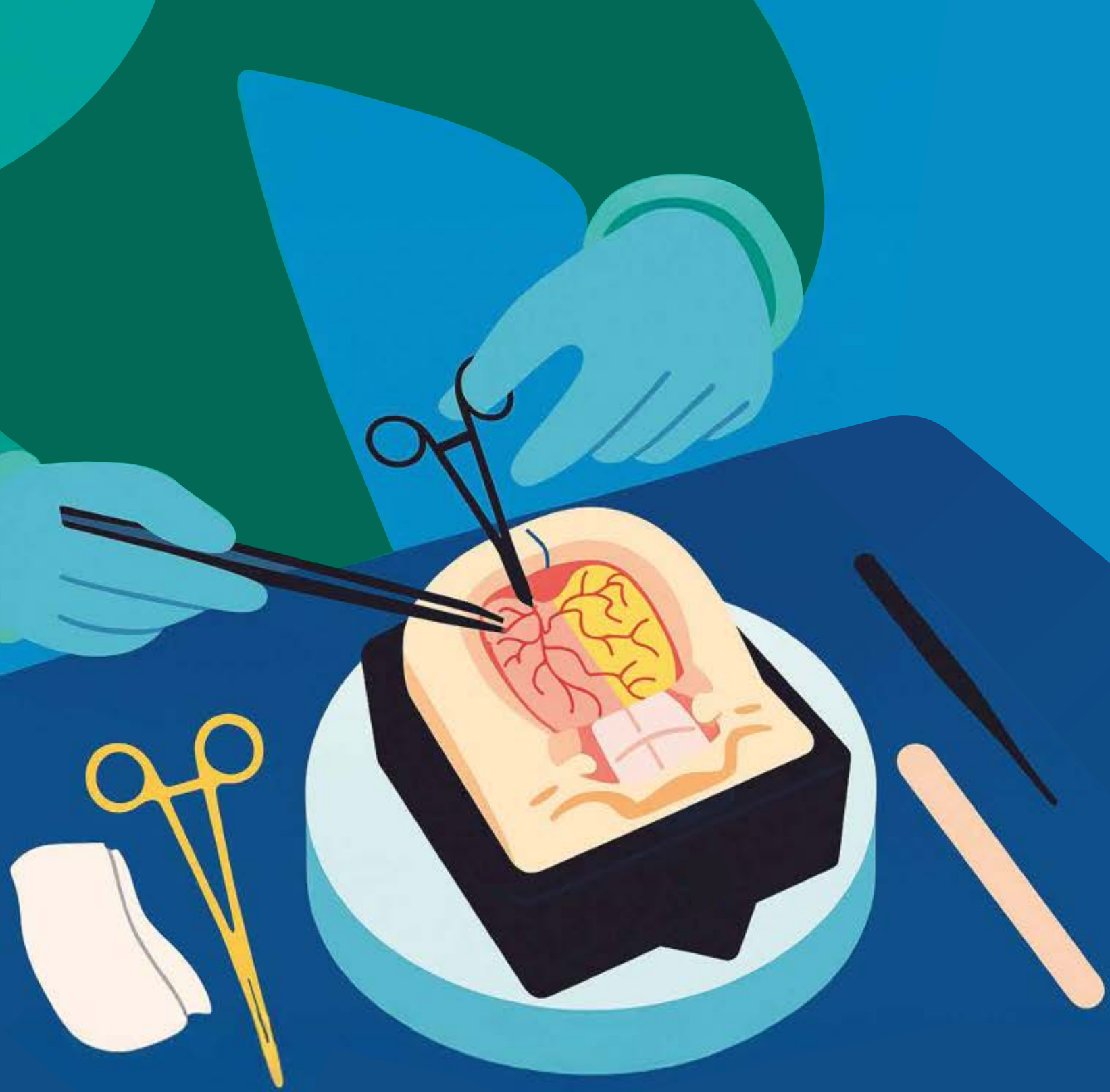
TANGERALA RAMA ASUTHOSH I Technical Assistant

AKSHAY P I Technical Assistant

BUSI RAMAKRISHNA REDDY I Technical Assistant

PRAKASH BARAMANI| Administrative Assistant

PERUMALLA PRADEEP CHANDRA | Administrative Assistant



3·4

Division of *Interdisciplinary Sciences*

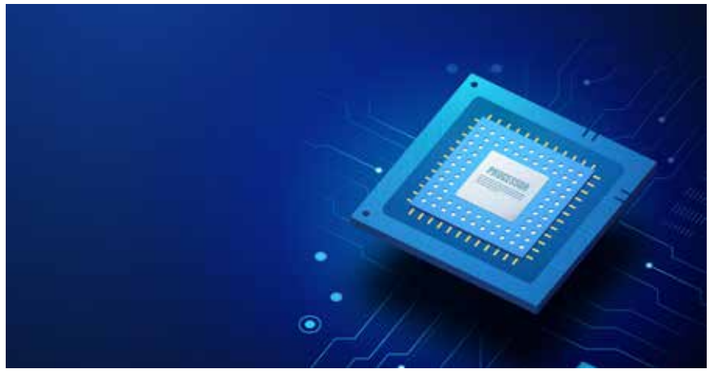
Interdisciplinarity is the characteristic feature of the research carried out in this Division. Specific research areas include Bioengineering, Urban infrastructure and transportation, Nanoscale materials, Nano devices and systems, Economics, Finance, Human resource management, Marketing, Optimisation, 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 component 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.

DEPARTMENTS | CENTRES | UNITS

- DEPARTMENT OF BIOENGINEERING
- CENTRE FOR SOCIETY AND POLICY
- 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
- SUPERCOMPUTER EDUCATION AND RESEARCH CENTRE



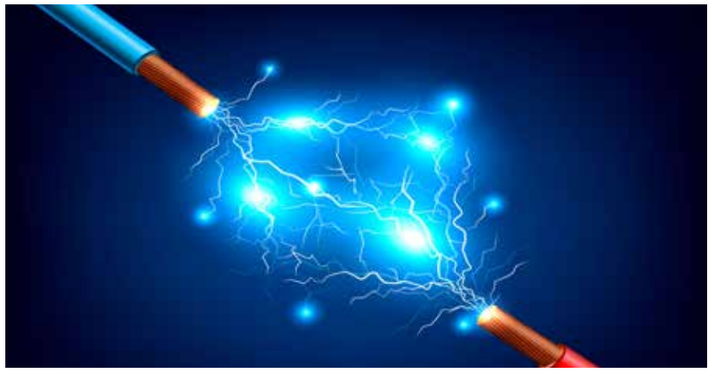
Neuromorphic platform presents huge leap forward in computing efficiency

In a landmark study in Nature, researchers at the Centre for Nano Science and Engineering and collaborators have developed a brain-inspired analog computing platform capable of storing and processing data in an astonishing 16,500 conductance states within a molecular film. It represents a huge step forward over traditional digital computers in which data storage and processing are limited to just two states. Such a platform could potentially bring complex AI tasks, like training Large Language Models, to personal devices like laptops and smartphones, thus taking us closer to democratising the development of AI tools. The researchers believe that this breakthrough could be one of India's biggest leaps in AI hardware, putting the country on the map of global technology innovation.

Reference:

Sharma D, Rath SP, Kundu B, Korkmaz A, Harivignesh S, Thompson D, Bhat N, Goswami S, Williams SR, Goswami S, Linear symmetric self-selecting 14-bit kinetic molecular memristors, Nature (2024).

Research **Snapshots**
2024-25

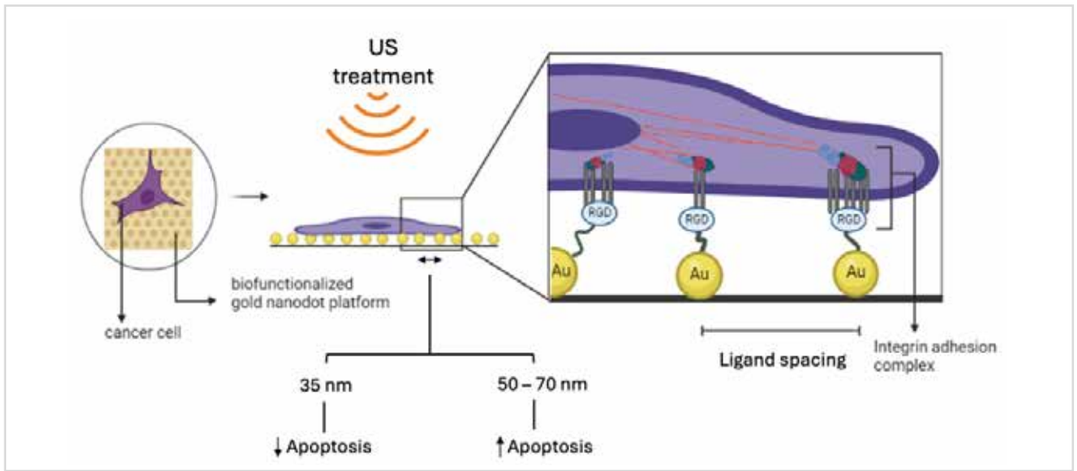


Self-shocks turn crystal to glass at ultralow power density

In a breakthrough, researchers at the Centre for Nano Science and Engineering and collaborators show that a material called indium selenide can "shock" itself to transform from a crystalline to glassy phase using very low power. The team discovered that when electric current was passed through wires made of indium selenide, a 2D ferroelectric material, long stretches of the material suddenly amorphised into glass. This transformation lies at the heart of memory storage in devices like CDs and computer RAMs. It consumes a billion times less power than the traditional melt-quench process used to convert crystal to glass. Such an advancement could unlock a wider range of PCM applications that could transform data storage in devices, from cell phones to computers.

Reference:

Modi G, Parate SK, Kwon C, Meng AC, Khandelwal U, Tullibulli A, Horwath J, Davies PK, Stach EA, Li J, Nukala P, Agarwal R, Electrically-driven long-range solid-state amorphization in ferroic In2Se3, Nature (2024).



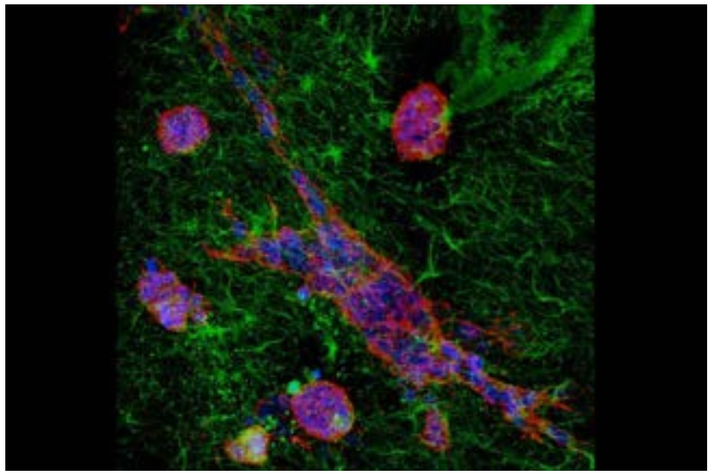
Tweaking cancer cell response to ultrasound treatment

Cancer cells bind to the extracellular matrix (ECM) using surface receptors called integrins. Researchers from the Department of Bioengineering show that tweaking this binding can boost ultrasound treatment. In tumours, excessive ECM secretion narrows the binding site spacing to under 35 nm, reducing treatment effectiveness. The team showed that a spacing of 50–70 nm causes cancer cell membranes to stretch due to forces exerted by a filament protein called myosin. More extracellular calcium is then pumped into the cytoplasm, which damages mitochondria and promotes cell death when exposed to low-frequency ultrasound. They also found that combining this with a low dose of Cilengitide – a drug that blocks integrin binding – can trick cells into sensing wider spacing.

Reference:

Veena SM, Chen D, Kumar A, Pratap R, Young JL, Tijore A, Nanoscale ligand spacing regulates mechanical force-induced cancer cell killing, Nano Letters (2025).

Research **Snapshots**
2024-25

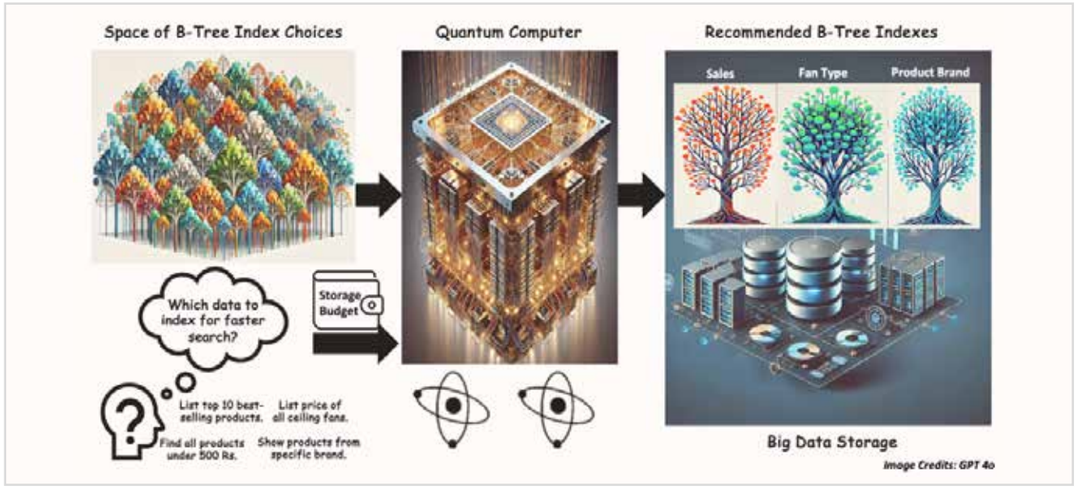


How cancer cells adapt while moving across tissues

The spread of tumour from the primary cancer site to distant organs, called metastasis, has puzzled scientists for many years – they are only now beginning to pinpoint triggers and mechanisms that drive this process. A new study from the Department of Bioengineering shows how inherent variations in a cancer cell and its interactions with its surroundings mould its migration. By placing ovarian cancer cells on soft and stiff surfaces that mimic healthy and diseased tissues, the researchers observed how each type adapted its movement on different surfaces. The findings reveal that cancer cells seem to adapt their migratory pattern depending on the physical and biochemical characteristics of their surroundings, called the microenvironment.

Reference:

Suresh M, Bhat R, Ovarian cancer cells exhibit diverse migration strategies on stiff collagenous substrata, Biophysical Journal (2024).



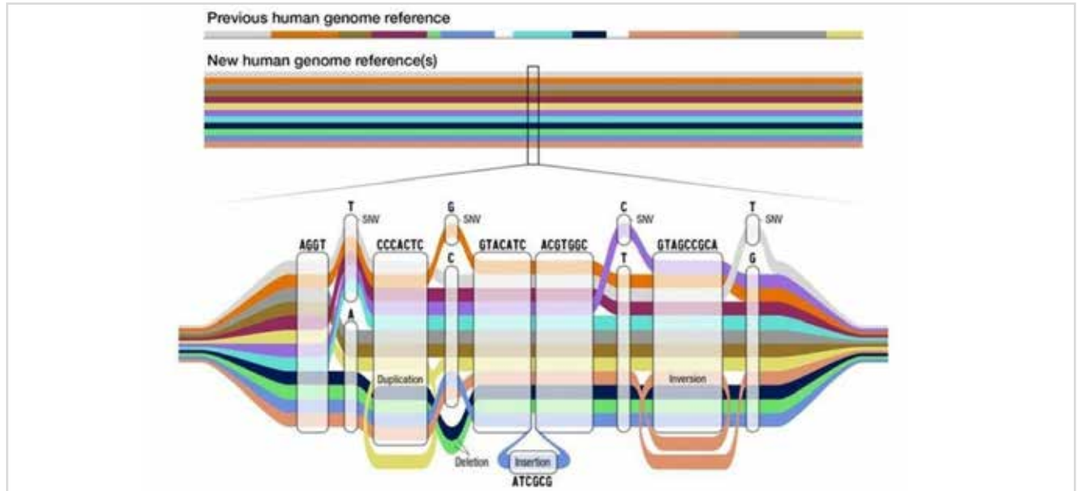
Turbo-charging data retrieval efficiency

In a new study, researchers at the Department of Computational and Data Sciences report a radical quantum gate-based circuit design for solving the computationally hard problem of database index selection. The new solution promises substantive improvement, approaching optimality, in data retrieval efficiency, as compared to contemporary heuristic approaches, which may result in poor outcomes. A highlight of the investigation is its validation on real quantum hardware, through access to IBM's quantum hardware, over the cloud. Going forward, the team plans to infuse quantum computing within other functional modules, the ultimate goal being a fully quantum-powered database engine.

Reference:

Kesarwani M, Haritsa JR, Index Advisors on Quantum Platforms, 50th International Conference on Very Large Databases (2024).

Research **Snapshots**
2024-25



New algorithms advance genomic equity and personalised medicine

Anyone who downloads the original older reference human genome sequence would see a document containing strings of A, C, G and T characters. This representation works fine for saving the genome sequence of a single person. However, the same string-based representation cannot be used for a pangenome reference because it needs to also reflect the genomic differences across multiple individuals.

A new collaborative study by researchers at the Department of Computational and Data Sciences and the University of Texas, Dallas provides novel ways for mathematically formulating the sequence-to-graph alignment problem and solving them using fast computer algorithms. This enables scientists access to superior algorithms for genome resequencing in basic and clinical biomedical applications.

Reference:

Chandra G, Gibney D, Jain C, Haplotype-aware sequence alignment to pangenome graphs, Genome Research (2024).

3.4.1 *Department of Bioengineering*

The Department of Bioengineering (BE) at the Indian Institute of Science was founded on June 4th, 2015. BE undertakes research and training in the broad multi-disciplinary area of biological systems with equal emphasis on science and engineering by bringing together biologists, engineers, and those who are trained as bioengineers.

FACT FILE

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Chair:
KAUSHIK CHATTERJEE

Current **Research**

Systems Biology of Cancer
Metastasis and therapy resistance remain two unsolved clinical challenges. A key property enabling cancer cell fitness during metastasis and therapy resistance is phenotypic plasticity and heterogeneity: the ability of cancer cells to reversibly switch to another cell-state during stress and consequent co-existence of many phenotypes in genetically identical population. Our work has decoded the design principles of cellular networks underlying phenotypic heterogeneity in multiple cancers, including in the highly aggressive small cell lung cancer which has an abysmal five-year survival rate of 7% and no molecular targeted therapy yet. Similarly, our analysis for melanoma has demonstrated how underlying regulatory networks can enable multiple cell-states and how cells can switch among them when exposed to drug, i.e., drug-induced state-switching. Finally, in ER+ breast cancer, we have unravelled how 'reversible' drug resistance can emerge and have developed population dynamics models that show that phenotypic heterogeneity and drug-induced switching can facilitate the long-term survival of cancer cell population, even in the absence of any genetic mutations.

Drug Delivery
Polymeric systems, particularly micro- and nano-carriers, have emerged as a promising solution for the targeted delivery of active drugs. Use of particles for delivery offers several advantages. Biologics are protected from the harsh external environment present (immune clearance and enzymatic degradation) during their voyage and increases their bioavailability at the target site. Particles can be designed to target specific sites including organ, cells and intra-cellular targets. For this part of the research, we are interested in applying biomaterial and nano- and microcarrier-based techniques to bridge the gap between basic biology and clinical therapies by designing polymeric particle-based vehicles

Core **Research**

The primary research areas of BE include Computational Systems Biology, Mathematical Biology, Drug Delivery, Biomaterials, Quantitative Cell Biology, Biophysics, Molecular Imaging, Cancer and stem cell mechanobiology and Immunoengineering.

to effectively deliver cargo to their target sites. The major focus is to utilise particle technologies to develop engineering platforms for targeted and efficient delivery of therapeutics for treatment of chronic inflammatory diseases such as osteoarthritis and persistent antibiotic resistant bacterial infections such as in case of tuberculosis.

Molecular Imaging
Study of cellular or molecular events outside the body, through in vitro or ex vivo experiments often oversimplifies the complex biological scenario in living subjects. The field of molecular imaging can potentially help to resolve this caveat as it aims to study these molecular or cellular processes within intact living body, in a longitudinal non-invasive manner. Our research focuses on the development of molecular imaging tracers (MRI, photoacoustic and PET) and molecular imaging methods to monitor various molecular targets/biomarkers that could potentially relate to early diagnosis of cancer or early assessment of treatment responses. The ability to image/monitor processes such as gene/protein/enzyme function, protein-protein interactions, changes in tumour microenvironment (TME), metabolic pathways, immune cell function or profiling of signal transduction pathways within an in vivo disease model, in a non-invasive longitudinal manner in real-time can eventually improve medical management of subjects and provide breakthroughs in current diagnostic or theranostic practices in the clinic.

Immunoengineering
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 goal of treating specific diseases. Our current focus is on developing strategies to treat complications that arise from type-2 diabetes and characterising the immune micro-environment associated with tumours.

Cancer and stem cell mechanobiology
The research in cancer mechanobiology focuses on studying and recapitulating the submicron-scale architecture of cancerous tissues using custom-made microfluidic/biomaterial platforms. Recently the field has learned that cancer cells are vulnerable to mechanical forces and undergo apoptosis when subjected to physiologically relevant mechanical stresses. Thus, our next goal is to investigate the effect of mechanical forces on cancer cells grown on the platforms mimicking in vivo microenvironment. The insight gained will be used to optimise mechanical forces to maximise cancer cell killing and the development of therapeutic strategies for clinical treatment. In particular, our lab is interested in oral cancer, the second most common cancer in India. The research in stem cell mechanobiology focuses on studying the effect of mechanical forces on stem cell differentiation. Such studies will guide the systematic optimisation of mechanical forces to maximise the yield of differentiated cells towards a desired tissue lineage and to develop stem cell-based therapies for clinical treatment.

Epithelial mechanobiology
Our research focuses on developing innovative, animal-free disease models that can be used to study disease mechanisms and support drug discovery. Recently, we have created organotypic models from lung and mammary epithelial cells, replicating complex tissue architecture to better understand how cancer originates in these tissues. In addition, we are investigating the spatio-temporal dynamics of epithelial tissues to identify biophysical signatures that are disrupted during disease progression. Through this work, we aim to address a fundamental question in epithelial biology: how do changes in tissue mechanics contribute to the onset of disease? To this end, we are specifically focussed on cancer initiation, and wound healing, and use 2D and 3D organotypic model systems to identify fundamental mechanisms of cellular competition and cooperation driving diseased states in epithelium.

Faculty & Staff

SIDDHARTH JHUNJHUNWALA | PhD (Pittsburgh), Associate Professor

RACHIT AGARWAL | PhD (Texas), Associate Professor

MOHIT KUMAR JOLLY | PhD (Rice), Associate Professor

SANHITA SINHARAY | PhD (Arizona), Assistant Professor

MEDHAVI VISHWAKARMA | PhD (EPFL), Assistant Professor

AJAY TIJORE | PhD (NTU, Singapore), Assistant Professor

Associate Faculty

BHUSHAN TOLEY | (Massachusetts Amherst), Associate Professor

RAHUL ROY | PhD (Illinois), Associate Professor

NARENDRA DIXIT | PhD (Illinois), Professor

RAMRAY BHAT | PhD (New York Medical College), Associate professor

SP ARUN | PhD (Johns Hopkins), Professor

PRERNA SHARMA | (TIFR), Associate Professor

NAGASUMA CHANDRA | PhD (Bristol), Professor

KAUSHIK CHATTERJEE | PhD (Penn State), Professor

VISHWESHA GUTTAL | (Ohio State), Associate Professor

PROSENJIT SEN | (California), Associate Professor

DEEPAK KUMAR SAINI | PhD (AIIMS), Professor

3.4.2
Centre for Society and Policy

The Centre for Society and Policy is a policy research centre, established in November 2018. As an interdisciplinary centre for science and technology policy, the centre explores interactions between science, technology, society, and development. The research and discussions at the centre aim to expand the social compact, that is, honour the implicit agreement between science and society to work together for sustainability, and mutual benefit. The centre organises seminars, lectures, and outreach through workshops and training programmes. It has a vibrant visiting faculty programme to attract leading scientists and researchers in the field of science and technology policy.

FACT FILE

Established: November, 2018
Phone: 080-2293-2486
Email: office.csp@iisc.ac.in
URL: https://csp.iisc.ac.in/

IN NUMBERS

2 Postdoctoral Scholars/ Research Associates
1 Project Associate
1 Project Assistant

Chair: ANJULA GURTOO

Current **Research**

Some of the research conducted during the year 2023-2024 includes policy agendas including sustainable futures, food security and health policy, and data economics. Specifically, the research includes developing a regulatory and monitoring ecosystem for the data platform, a market-based framework for data economics, and investigate regulatory guidelines and privacy options for data security. Further, standards, protocol, cyber safety and readiness are explored for power organisations. CSP has collaborated with the Keio University, Japan, to provide a dynamic platform for fostering collaboration and exchanging knowledge in the domains of science, technology, and innovation.

Core **Research**

The aim of the centre is to forge meaningful interactions between science, technology, society and policy through research and dialogue in diverse areas like information technology, infrastructure, health and genomics, S&T for development, sustainable futures, biotechnology, and natural resource and biodiversity.

Associate Faculty

ANJULA GURTOO | PhD (IIM Ahmedabad), Professor

INDER S GOPAL | PhD (Columbia University, NY),
Research Professor

ABINANDANAN T A | PhD (Carnegie Mellon), Professor

MOHIT KUMAR JOLLY | PhD (Houston, Texas),
Assistant Professor

SHASHI JAIN | PhD (CWI, Amsterdam), Associate Professor

SARASIJ DAS | PhD (University of Western Ontario, Canada),
Assistant Professor

3.4.3 *Computational and Data Sciences*

The department focuses on interdisciplinary programmes driven by computation and data- intensive methods, systems and applications. The research is aligned along

FACT FILE

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Degree Programmes offered: MTech and PhD

IN NUMBERS

18 Faculty Members
00 Visiting/Adjunct Faculty Members
1 Administrative Staff
01 Technical Assistance
02 Postdoctoral Students
61 PhD students
18 MTech Research students
78 MTech students
27 Students graduated in 2024 from DSBA (Online MTech)
75 Current students (MTech Online DSBA program; joined in 2025)
30 Project Associates

Conferments: 09 PhD, 07 MTech Research; 25 MTech CDS

Chair:
R VENKATESH BABU

Current **Research**

In the domain of Computer and Data Systems, several advancements were achieved this year.

Database Systems Lab:
We have published a monograph on Robust Query Processing, published in the international Foundations and Trends in Databases series of NOW Publishers.

We have studied how B-tree indexes, which are common in CPU implementations for fast column access in relational databases, can be leveraged at the GPU. We have implemented three approaches – a native B-tree on GPU with CUDA, a B-tree implemented in GPU using ray tracing primitives, and a CPU-resident B-tree visible through Nvidia's unified memory feature. A performance analysis is currently underway. A second project within this umbrella is to integrate the GPU-based operator implementations into the remainder of the database engine. In particular, the query optimiser, where a cost model must be constructed that accurately quantifies the runtimes of the GPU option and is incorporated within the plan selection process. This evaluation is currently ongoing using the popular open-source DuckDB platform as the base. Finally, we are also working on combining the Join and GroupBy operators into a super-operator called GroupJoin, and implementing this new operator within the DuckDB platform.

When complex SQL queries suffer slow executions despite query optimisation, DBAs typically invoke automated query rewriting tools to recommend "lean" equivalents that are conducive to faster execution. The rewritings are usually achieved via transformation rules, but these rules are limited in scope and difficult to update in a production system. We have investigated how the cognitive capabilities of LLMs can be leveraged for performant query rewriting while incorporating safeguards and optimisations to ensure correctness and efficiency. Our study shows that these goals can be progressively achieved through incorporation of (a) an ensemble suite of basic prompts, (b) database-sensitive prompts via redundancy removal and selectivity-based rewriting rules, and (c) LLM token probability-guided rewrite paths. Further, a suite of logic-based and statistical tools is used to check semantic violations in the rewrites prior to DBA consideration. We have implemented the above LLM-infused techniques and evaluated complex analytic queries from standard benchmarks on contemporary database platforms. The results show significant performance improvements for slow queries, with regard to both abstract costing and actual execution, over both SOTA techniques and the native query optimiser.

Core **Research**

Computational science research deals with mathematical modelling, numerical analysis, computational aspects of numerical methods to solve complex problems and implementation of efficient & robust parallel algorithms on massively parallel heterogeneous architectures relevant in today's exascale era. The research finds applications in Climate modelling, Electromagnetics, Fluid mechanics, Internet of Things, Materials-physics, Optics, Knowledge Harvesting, Medical imaging, Photonics, Structural biology, Systems Biology, etc.

Computer & Data Systems research aims to design architectures and platforms for Big Data, Cloud and Edge computing, Quantum Computing, Internet of Things, Databases, Accelerators, Reconfigurable Architectures, Scalable Methods for AI/ML Applications, as well as scalable methods and algorithms for Graph Analytics, Computer Vision, Machine Learning, Natural Language Processing, Fault tolerance for HPC Applications, Bioinformatics, Acceleration strategies for ocean modelling application.

Vision and AI Lab (VAL):
In 2024, the Vision and AI Lab at the Indian Institute of Science made impactful contributions to the fields of computer vision, generative modelling, and fairness in AI, with publications in top-tier venues including NeurIPS, CVPR, ECCV, ICLR, and WACV.

The lab addressed fairness and bias in machine learning models through two key works. One study proposed methods to mitigate biases in black box feature extractors for image classification (NeurIPS 2024). Another introduced a novel Distribution-Guided Debiasing strategy within diffusion models to promote equitable image generation across demographic attributes (CVPR 2024).

In the area of text-to-image synthesis, the lab proposed PreciseControl (ECCV 2024), a method for fine-grained control over image attributes in diffusion models, and Text2Place (ECCV 2024), a framework for affordance-aware human placement in generated scenes using text guidance.

To improve model generalisation, researchers leveraged large-scale vision-language models to enhance cross-domain classification performance (CVPR 2024).

For imbalanced learning scenarios, the lab developed DeiT-LT, a distilled vision transformer architecture that performs robustly on long-tailed datasets (CVPR 2024).

A spotlight paper at ICLR 2024 introduced Selective Mixup Fine-Tuning, designed specifically to optimise non-decomposable metrics in classification tasks, and was recognised among the top 5% of submissions.

The lab also addressed the problem of source-free domain adaptation through a transformer-based model that aligns non-causal factors to enhance target domain performance (WACV 2024).

These contributions collectively reflect the lab's continued leadership in responsible, generalisable, and controllable generative AI, while pushing the boundaries of foundational vision and learning research.

Visual Computing Lab:
This year, VCL members continued their research in data-efficient deep learning methods, especially in the context of adversarial robustness of computer vision models, compute-efficient training of large vision models as well as multi-modal and privacy-preserving machine learning (e.g., federated learning). Many of these works resulted in publications in prestigious ML journals and core A*/A conferences. Some key research contributions from the lab this year include:

1. A novel dynamic data selection method for self-supervised learning (SSL) that reduces compute cost by gradually shrinking the training subset based on model training dynamics [ECCV 2024],
2. An adaptive self-distillation strategy for minimising the adverse effect of client drift in federated learning under large client-data heterogeneity [TMLR 2024],
3. An effective test-time defence framework that enhances robustness of pre-trained vision models against adversarial attacks without requiring training data, enabling reliable deployment in data-restricted and safety-critical scenarios [Neurocomputing, 2025],
4. A method for enhancing 3D referential grounding results by learning coarse spatial relationships among objects in the scene,
5. A new conditional generation task of sketch-guided image inpainting and its solution using a novel partial discrete diffusion process [CVPR Workshop 2024] etc.

This year, the **NLP group** conducted research in the broad area of responsible language technologies. Specifically, the research aims to (1) deepen our understanding of large language models; and (2) ensure that language and vision models are geographically inclusive; and (3) reliably watermark large language models. The research led to multiple A* and A publications at ICCV, EMNLP, ACL, EACL and TMLR. The work has received attention from international media and has been recognised with the AI2050 Early Career Fellowship from Schmidt Sciences (conferred to 19 fellows worldwide).

The **DREAM Lab** works on distributed systems research, exploring platforms and algorithms efficient and effective use of cloud, edge and quantum computing. This year, the lab's research examined energy and time-optimised DNN training on edge accelerators, federated learning for DNN and graph neural networks, joint scheduling of drone analytics and routing, as well as programming abstractions to ease the composition of hybrid cloud and quantum computing applications. We also actively engaged with NPCI on scalable fintech, IBM Research on hybrid clouds, and Bangalore Traffic Police on easing urban mobility. Our research was published at top venues such as IEEE/ACM Transactions on Networking (TON), Future Generation Computer Systems (FGCS), International Symposium on Cluster, Cloud and Internet Computing (CCGRID), and International Conference on Quantum Computing and Engineering (QCE). Our lab's students and alumni were recognised with a MLCommons rising star award, CDS's MTech Research Gold Medal (2023), and best poster awards at IEEE HiPC conference and IISc EECS Symposium.

Middleware and Runtime Systems Lab:
The MARS lab conducted research in the following areas in the academic year 2024-25. Scalable methods for AI/ML applications: We have developed a novel divide-and-conquer method of parallelism for training large CNNs on the GPUs. The large model is divided into small models based on variational dropout values, the small models are asynchronously trained on multiple GPUs, the parameters are then unioned into the large model, and the process is repeated. On VGG-19 model with CIFAR dataset, our method achieves higher accuracy at about 30 minutes when compared to 3.5 hours taken by the widely used Distributed Data Parallel Method (DDP). Our also developed a parallel algorithm for hybrid CPU-GPU computations of large language models. While the forward and backward phases are performed on the GPUs, the parameter updates were carried out on the CPU. We skip certain layers of parameter updates such that the skipped layers will be processed during the next iteration. The objective is to minimise the idling and stalling on the resources. We submitted our work to CASTANET workshop.

Fault Tolerance for HPC Applications:
We have developed a fault tolerant library, FTHP-MPI, based on replication for MPI parallel application. The novelty of our library is that it combines fault tolerance with the high-performance communications provided by the native MPI library. This involved intricate use of operating system concepts, careful replication of process images from one process to another process, integration of checkpointing with replication dealing with various challenges including different number of processes involved in checkpoint writing and reading, logging of communication messages, efficient recovery mechanisms, and design of the entire workflow architecture. This is also the first work that seamlessly brings together checkpointing and replication, the first of its kind. We performed comprehensive set of experiments and in a novel result, has shown that replication-only approach (without checkpointing) can give better efficiency than checkpoint-only approaches. The novelty of this work is that this is the first time that the benefits of replication is demonstrated with real experiments involving real application executions. We submitted a paper on the above novel work to TPDS, a highly reputed journal in this field.
We then proceeded to develop adaptive replication-based fault tolerance. We developed a novel formulation of optimal checkpointing interval based on failure prediction accuracy and replication. With many experiments, we showed a very interesting result that adaptive replication based on failure predictions give better efficiency even with a small replication degree and failure predictors with low accuracy when compared to the other approaches. We submitted this work to SC, a highly reputed conference.

Acceleration of Time-Consuming Routines in Ocean Modelling:
We conducted detailed profiling studies for identifying performance bottlenecks in the ROMS model. We did partial work on developing flexible configurations with nested grids in the ROMS ocean model. This

will allow accurate simulations in regions of interest. We also developed techniques for overlapping communications with I/O to minimise I/O bottlenecks.

In the area of computational sciences, very important research successes were observed this year.

Medical Imaging Group (MIG) made significant contributions in the broad area of medical imaging in the past one year, this includes development of advanced model based deep learning methods for quantitative susceptibility mapping (QSM), improving the estimation of susceptibility maps by reducing streaking artifacts and enhancing edge preservation. Another research work focused on the information geometric based test-time adaptation (TTA) of deep learning-based semantic segmentation models, specific to individual patient data. This is a significant step towards generalisation of deep learning models and providing patient optimality. A hybrid algorithm (named as 'Greybox'), using both model- as well as deep learning-based, was developed for solving a multi-parametric nonlinear inverse problem of directly estimating TK parameters from undersampled DCE-MRI data, which is useful in breast cancer characterisation.

Scientific Computation Lab (SCL) advanced the Stochastic Logarithmic Norm for capturing transient instability. An Ito representation-based diffusion network for learning from unstructured data, a stochastic model of the constrained dynamics approach to data assimilation, some results on stochastic constrained dynamics and a sparsification of complex reaction-diffusion network were developed. A data-driven network dynamics modelling technique for physiological systems was developed. A simulation showing how a more infectious strain replaces others in a pandemic network in the Summer of 2021 seemed validated from post-January 2022 ongoing pandemic data. The diffusion/stochastic network model has been also applied to study orbit determination problems in tracking of low earth orbital objects, memristor devices and for prediction from time series data. The lab has been active in realising this approach on a coarse-grained reconfigurable system-on-chip toward accelerating data science applications and related chip tape-out activities. Hyper-spectral approach to AI driven medical imaging analysis and foundational data science problems such as graph sparsification are other areas of work.

In the Computational & Statistical Physics lab (CSPL), new algorithms were proposed for approximate matrix multiplication, randomized solving of high condition linear systems etc. Methods for biological inferences in high-D data, and applications of the earlier proposed NSMC algorithm to toy problems of reliability estimation are also nearing completion. A method for accelerating solution of N-body physics, and image compression using circulant decomposition are also topics of research being taken up recently.

AI for Research and Engineering eXcellence (AiREX) lab is dedicated to advancing artificial intelligence, scientific machine learning (SciML), and computational science. We focus on developing AI-driven predictive models and frameworks to solve complex challenges, integrating AI with traditional methods like finite element analysis. Our goal is to innovate at the intersection of AI and science, driving technological advancement.

Work being Done:

- **Scientific Machine Learning (SciML):** Utilising high-performance computing and Physics-Informed Neural Networks (PINNs) for advanced scientific computing.
- **Finite Element Methods (FEM):** Improving techniques for complex issues in multiphase flows, fluid-structure interactions, and turbulence.
- **Computational Sciences:** Combining numerical methods with parallel computing for enhanced simulations in various fields.
- **Generative AI:** Developing models for realistic data synthesis, aiding content creation, design automation, and predictive modelling.
- **MLOps:** Building scalable MLOps frameworks for efficient model deployment and management.

The **QUEST Lab** made significant contributions to the following fields (i) Scientific ML with a new Physics-Informed Neural Network model for turbulence modelling around a wind turbine including the release of trained checkpoints for transfer learning in novel applications (Physics of Fluids 2025), theoretical analysis of PINN architectures (ICCS 2024); (ii) Ecological Digital Twins with a new agent based model for modelling elephant movement in the Periyar-Agasthyamalai complex in the western ghats (Ecological Modelling 2024, DDDAS 2024), and (iii) AI for Education with a new Automated Educational Question Generation framework in data science (AIED 2024) and K-12 Social Science (BEA 2024). We also made preliminary contributions to developing machine learning models for precipitation forecasting (IGARSS 2024).

In the area of **computational flow modelling (FLAME lab),** research areas focused on the acceleration of reacting flow solvers and investigation of hydrogen-fuelled combustion phenomena for clean energy. A novel scalable asynchronous discontinuous-Galerkin method for partial differential equations arising in flow modelling was developed. The method was implemented into a widely used open-source finite element library and was demonstrated to provide excellent scalability at extreme scales on IISc's Param Pravega supercomputer. The performance of hydrogen fuel was studied for different load conditions in a longitudinally staged combustion system often used in power generation. In addition, a new machine learning-based reduced-order model has been developed to accelerate chemical kinetics computations in massively parallel reacting flow simulations. Findings from the above research were published in prestigious journals such as the Journal of Computational Physics and the Combustion and Flame.

MATRIX Lab's research contributions have focused on the following themes: (i) development of first real-space computational methodology and a scalable implementation amenable for finite-element discretization to conduct large-scale projector-augmented wave (PAW) based density functional theory (DFT) calculations on both multi-node CPUs and GPUs at an order of magnitude lower computational

cost than the state-of-the-art methods. One journal article reporting the methodology and the relevant accuracy and performance benchmarking recently got published in Physical Review B and another manuscript is under review reporting the GPU accelerated computational algorithms with focus on HPC centric aspects for solving underlying large-scale finite-element discretized DFT generalised eigenproblem, (ii) development of finite-element based methods and implementation strategies for non-collinear magnetism and spin-orbit coupling effects in pseudopotential DFT calculations. This work also involved development of a generalized force approach for computing atomic forces and periodic unit-cell stresses within a unified framework. This work got published recently in Physical Review B, (iii) our group was also instrumental in developing a residual based Chebyshev filtered based subspace iteration eigensolver that is tolerant to matrix-vector multiplications. This work is currently under review, (iv) development of multiscale methodology (atomistic to continuum) for chemical kinetic modelling with applications to combustion.

Algorithmic Techniques for Computational Genomics (ATCG) group published novel algorithms on pattern matching of biological sequences on genome graphs (published in Genome Research 2024, Algorithms for Mol. Biol. 2024). The group also published information theoretic results for the genome assembly problem (ISIT'24). This was the first work that characterised the information-theoretic conditions in terms of the amount of sequencing data needed to reconstruct real diploid genomes. In a related project, our open-source genome assembly software got tested and adopted by industry R&D labs (Oxford Nanopore Technology, Keygene) for computing high-quality human and plant genome sequences. The paper describing the software and underlying theory is currently under revision at Genome Research. Lastly, the group has started an ambitious 5-year IndiaAlliance DBT/Wellcome-funded project (2024-29) in collaboration with Strand Life Sciences. The project is expected to result in novel methods which will increase disease diagnosis yield for patients with genetic disorders.

Numerical Algorithms and Tensor Learning (NATL) Lab: Our research encompasses a comprehensive suite of advanced computational methodologies spanning scientific computing and machine learning domains. We have developed efficient wavelet-based physics-informed neural networks specifically designed to address multiscale problems alongside hybrid numerical methods for solving time-delayed fractional sub-diffusion equations characterised by multi-singularities. Our work extends to enhancing computational accuracy through adaptive discretization techniques for non-local integro-partial differential equations that exhibit initial time singularities. In computational dynamics, we have investigated neural dynamics for computing approximate bisimulations for weighted finite automata over real number fields. Additionally, our research portfolio includes the development of two-step parameterized tensor-based iterative methods for solving the matrix equation AXB=C, complemented by comprehensive studies on M-QR decomposition and hyperpower iterative methods for computing outer inverses of tensors. We have further advanced the field through our investigations into the computation of M-QDR decomposition of tensors and their applications and theoretical characterisations of weighted generalized inverses, collectively contributing significant methodological advances to computational mathematics and applied scientific computing.

Biomedical Image Analysis (BioMedIA) Lab: We develop AI-based methods for computational analysis of biomedical images for clinical applications, specifically scalable and translatable tools for big data applications in neuroimaging. We also work on tackling key challenges of medical image analysis including label scarcity and data diversity, model generalisability and interpretability. In the past year, we have been working on proposing methods for identification of MR imaging biomarkers for vascular cognitive impairment which could lead to various

neurological diseases such as dementia, semi-supervised techniques for analysis of various imaging modalities and data harmonisation/domain adaptation for clinical deployment of AI tools. Recently, we also started working on developing federated learning frameworks for training robust models in privacy-protected manner for multi-modal applications. Our work has led to publications in prestigious journals such as Medical Physics, European Radiology Experimental, Image and Vision computing and Pattern Recognition Letters. We have also recently published works including an early acceptance in top conferences in medical imaging including MICCAI 2025.

Biomolecular Computation Lab: This year, the Biomolecular Computation Lab released two advanced computational tools—DREAMWeb and KiPhyNet—based on novel algorithms developed in-house. 1. DREAMWeb is a graph-based modelling software that computes protein structures using distance-geometry data from NMR spectra. Unlike conventional dynamics and force-field-based methods, DREAMWeb avoids structural artifacts, offering more accurate protein modelling. 2. KiPhyNet simulates physiological networks using kinetic parameter data. It utilises a graph-based framework to model the transport of chemical species across cells via the vasculature. The lab also plays a pivotal role in the ICMR-IISc Centre for Health Data, driving the development of MIDAS (Medical Imaging and Information DataSets), a national platform for AI-enabled healthcare in India. This effort is in collaboration with ICMR and ArtPark, focusing on federated data collection and archival across server and mobile platforms. A major digital health initiative from the lab includes contribution to the development and deployment of the Aarogya Aarohan mobile app for pan-India public health data collection on oral cancer. It is participating in the AI Centre of Excellence in Oral Cancer - Phase 2 initiative that envisages to further develop and deploy digital health tools to downstage oral cancer across India. Extending this initiative, the lab has identified Bcl-2 inhibitors as potential oral cancer therapeutics from known anti-neoplastic agents through computational studies.

A joint IBM IISc Hybrid Cloud Lab on hybrid clouds was initiated with IBM Research was extended for another 3 years, with a focus on cloud computing, AI information management for and sustainability ML/AI. A new Center of Excellence on Intelligent Data Center NPCI-IISc Center of Excellence on Scalable FinTech Blockchain and Analytics was established with the support of Accenture, and a newly renovated lab-space was inaugurated. As a result of the world-class research environment available, the department was recognised as the 'Top Artificial Intelligence Lab in India in 2021' by Analytics India magazine.

Faculty & Staff

KONDURI ADITYA | PhD (Texas A&M University), Assistant Professor

ANIRBAN CHAKRABORTY | PhD (University of California-Riverside), Associate Professor

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

JAYANT R HARITSA | PhD (University of Wisconsin-Madison), Professor

CHIRAG JAIN | PhD (Georgia Institute of Technology-Atlanta), Assistant Professor

SEKAR K | PhD (University of Madras), Professor

PHANI MOTAMARRI | PhD (University of Michigan-Ann Arbor), Assistant Professor

DEBNATH PAL | PhD (Jadavpur University), Professor

DANISH PRUTHI | PhD (Carnegie Mellon University), Assistant Professor

VENKATESH BABU R | PhD (IISc), Professor and Chair CDS

RATIKANTA BEHERA | PhD (IIT Delhi), Assistant Professor

SOUMYENDU RAHA | PhD (University of Minnesota-Twin Cities), Professor

YOGESH SIMMHAN | PhD (Indiana University-Bloomington), Associate Professor

DEEPAK N SUBRAMANI | PhD (MIT-Cambridge), Assistant Professor

VAANATHI SUNDARESAN | DPhil (University of Oxford), Assistant Professor

SATHISH S VADHIYAR | PhD (University of Tennessee), Professor

MURUGESAN VENKATAPATHI | PhD (Purdue University), Professor

PHANEENDRA YALAVARTHY | PhD (Dartmouth College), Professor

3·4·4
Centre for Nano Science and Engineering

The Centre for Nano Science and Engineering (CeNSE) at the Indian Institute of Science (IISc) is dedicated to exploring and engineering at the nanoscale—lengths close to a billionth of a metre. Founded in 2010, CeNSE brings together a multidisciplinary team of scientists and engineers working at the intersection of materials, electronics, photonics, MEMS, biology, medicine, and quantum technologies. What began with a focus on devices and systems has now expanded to cutting-edge fields like neuromorphic and quantum computation.

CeNSE's research is supported by world-class infrastructure, including India's largest 24/7 micro and nano fabrication and characterisation facility. The centre hosts three major central facilities: NNfC (National Nano Fabrication Centre), MNCF (Micro and Nano Characterisation Facility), and the emerging Systems and Packaging Facility—all serving academia, industry, and government, with the first two already ISO certified.

CeNSE plays a critical role in training the next generation of researchers and technologists through advanced courses and hands-on experience. With national priorities aligned towards semiconductors and quantum technologies—reflected in government initiatives like the India Semiconductor and National Quantum Missions—CeNSE is uniquely equipped to lead innovation from "Science to Systems to Society."

FACT FILE

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IN NUMBERS

140	Central Staff
128	Project Staff
137	PhD students
31	M Tech Students
2	Joint MTech Students
15	MEngg Students
157	PhD Alumni
83	MTech Alumni
70	Journal Publications (2024)

Chair:
AMBARISH GHOSH

Current **Research**

Electronics:
Electronic devices drive modern technology, from sensors and displays to energy harvesters. At CeNSE, we develop next-generation energy-efficient and high-performance electronics.

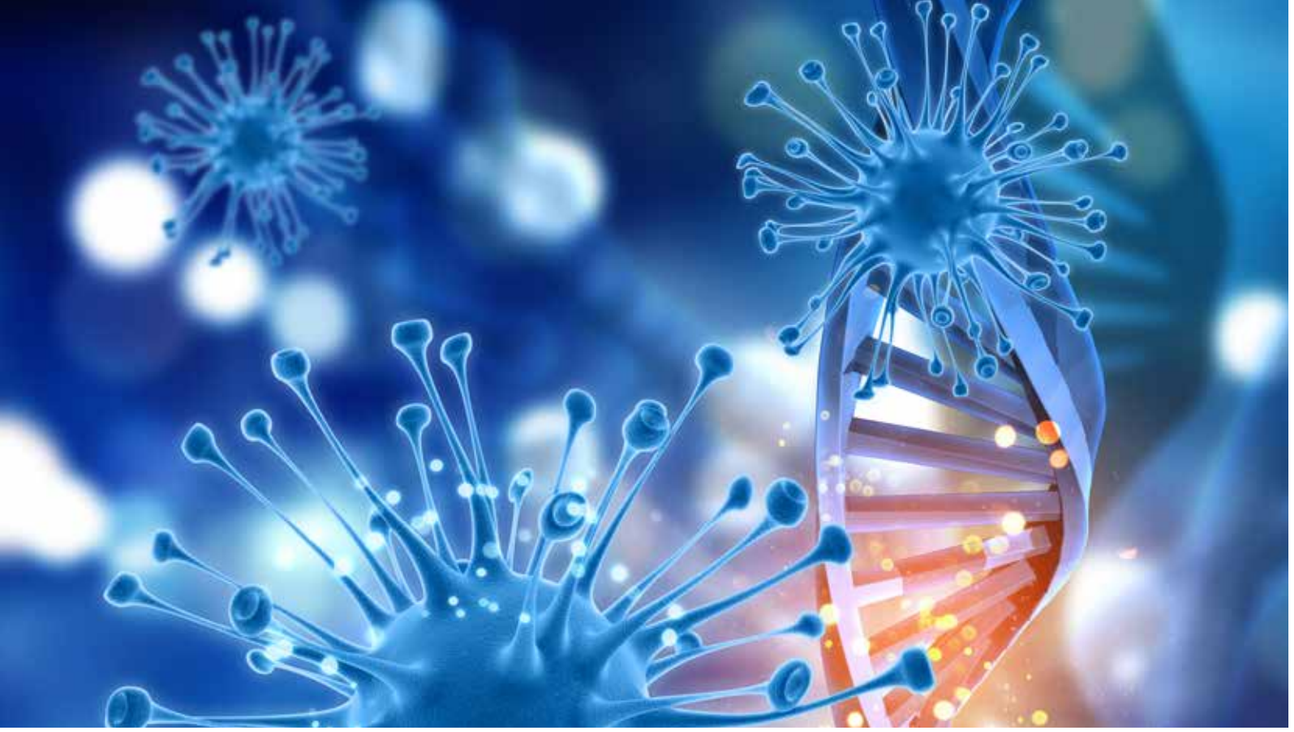
- **Sustainable Energy & Optoelectronics** - scalable perovskite solar cells, printing A4-sized sheets and addressing efficiency, stability, and lead toxicity; and nanopatterned back-contact architecture for high-efficiency perovskite solar cells and light-emitting diodes.
- **Power Electronics & RF Devices:** GaN and GaO devices are revolutionizing power conversion and RF electronics. Design and fabrication of GaN power transistors, enabling ultra-compact chargers and next gen 5G/6G amplifiers operating above 200 GHz.
- **Beyond Moore's Law Computing:** Emerging AI, ML, and IoT demand new materials and architectures. Exploration of 2D materials like graphene and TMDCs, and integration of ferroelectrics with silicon for novel memory devices.
- **Sensors & Photonics:** Gas, bio, and pressure sensors for applications from healthcare to aerospace; infrared detectors promise affordable night-vision and surveillance technology; and photonic circuits enhance optical sensing, enabling high-sensitivity Raman spectroscopy and trace-gas detection.

Materials:
Materials drive technological advancements in electronics, photonics, and quantum systems. At CeNSE, interdisciplinary collaboration between material scientists and engineers fosters innovation, blending expertise in synthesis, characterisation, and device fabrication.

- **For Semiconductors & Power Electronics:** GaN is revolutionising LEDs, power electronics, and RF applications. GaN thin film studies and transistor fabrication links material properties to device performance. This work spans wafer development to system integration for power converters and RF MMICs.
- **For MEMS & Photonics:** Researchers develop AlN and oxide-based materials like PZT and BaTiO3 for piezoelectric MEMS, focusing on high-performance, eco-friendly alternatives. Integrated photonic applications leverage functional oxide thin films, enabling electro-optic modulators on silicon.
- **Perovskites & Optoelectronics:** Lead-halide perovskites offer defect-tolerant, efficient solar cells and LEDs. CeNSE faculty are enhancing stability, exploring

Core **Research**

Electronics – power electronics, memory devices, gas, bio and pressure sensors; **Optoelectronics,** thin-film solar cells, spectroscopy; **Quantum science and technology –** topological insulators, superconductors, van der waal heterostructures, quantum sensing, quantum fluids, electron hydrodynamics; **Bio-medical interface –** nanopore sensing and sequencing, lab-on-chip, electrochemical biosensors, neural interfaces, neural tissue engineering; **MEMS, NEMS, Systems, Packaging and Microfluidics** – nonlinear dynamics, nanorobotics, piezoelectricity, droplets, wafer scale packaging ; Photonics and Lasers – silicon photonic integrated circuits, fibre lasers, ultrafast lasers, signal processing; **Materials and electronics devices** – thin films, bulk crystals, wide band-gap devices, ferroic oxides, heterojunctions; **Brain-inspired computing –** artificial intelligence, neuromorphic computing, chaos



lead-free alternatives, and developing large-bandgap perovskites for next-gen optoelectronics.

- **Quantum & Neuromorphic Materials:** oxide-based quantum materials, investigating Mott insulators, skyrmion-based memory, and phase-change materials. CeNSE also develops materials for neuromorphic computing, using vanadium oxide and nickelates to emulate brain-like processing. Twistronics materials – these materials provide precise control over the electronic properties by manipulating twist angle between 2D layers. Group tries to understand various correlated and topological phenomena like Superconductivity, Mott Insulating phases, Ferromagnetism, Anomalous Quantum Hall Effect.

CeNSE integrates material synthesis, advanced characterisation, and device fabrication, pushing the boundaries of modern electronics, sensing, and quantum technologies.

Photonics:
Photonics including all branches of study involved in the generation, processing and applications of light, is a major research focus at CeNSE.

- **High-Power & Nonlinear Optics:** fiber lasers for high-power applications, exploring Raman-based wavelength conversion and laser power combining for directed energy systems; and research on frequency comb sources for optical communication and microwave photonics.
- **Photonic Integrated Circuits:** silicon and hybrid photonic circuits for computing, communication, and sensing; also work on low-loss waveguides, wavelength-selective devices, and integrated photodetectors using CMOS technology, enabling high-speed connectivity for next-gen applications.
- **Plasmonics & Single-Photon Sources:** Integration of plasmonic materials with 2D materials and quantum emitters (e.g. NV-centres in diamond) for photodetection, single-photon generation, and microfluidic control.
- **Efficient LEDs:** highly emissive materials for efficient LEDs and optical quantum technologies.

CeNSE actively partners with ISRO, DRDO, BEL, and private industry to develop high-power lasers, medical laser systems, and optofluidic technologies. From integrated circuits to quantum photonics, CeNSE's photonics research drives cutting-edge innovation across multiple domains.

Nano-bio research:
CeNSE, IISc, leads pioneering research at the intersection of nanotechnology and biology, integrating engineering, physics, chemistry, and biotechnology to develop innovative healthcare solutions.

- **Nanorobotics for Theranostics:** Intelligent nano-robots for targeted diagnosis and therapy, creating smart, sensor-enabled nanorobots for collective diagnostics and therapeutic delivery in biological environments.
- **Single-Molecule Sensing:** solid-state nanopores for detecting and sequencing biomolecules like DNA and proteins.
- **Electrochemical Sensors:** sensors for health monitoring, including diabetic care solutions.
- **Microfluidics & Bio-Printing:** microfluidic devices to study single-cell properties and developing advanced bio-printing techniques for organ-on-a-chip applications.
- **Neuroscience & Nerve Repair:** nano-structured devices for neural regeneration and brain activity sensing.
- **Viscosity / rheological sensor:** use MEMS resonators and magnetic nanorobots to track health conditions by investigating rheological properties of biological fluids, living cells and tissues.

CeNSE fosters interdisciplinary collaboration with academia, industry, and clinicians to drive real-world impact. Startups like PathShodh (diabetes monitoring) and Theranautilus (medical nanorobots) are direct outcomes of this research.

MEMS/ NEMS/ Microfluidics:
CeNSE, IISc is a leader in MEMS (Micro-Electro-Mechanical Systems), NEMS (Nano-Electro-Mechanical Systems), and Microfluidics research, covering fundamental studies and cutting-edge device development.

Fundamental Research:

- **Materials & Resonators –** Material research spans silicon, silicon nitride, piezoelectrics, and 2D materials to enhance MEMS/NEMS sensors, actuators, and computing applications. Nanomechanical resonators are used to explore nonlinear dynamics, energy dissipation, and noise in miniaturized systems.
- **Opto-Mechanics & Acoustics –** Integration of mechanical elements with optical systems enables precise sensing and signal processing. Researchers are also developing hybrid acoustic wave processors for next-gen communication and computing.
- **Fluid & Interface Dynamics** – Investigating how fluids behave at micro and nanoscale, crucial for designing high-performance microfluidic devices. Studies include fluid-structure interactions and novel measurement techniques embedded within micro-resonators.
- **Non-equilibrium Physics and Active Matter –** Exploring self-propelled, motile systems to study collective intelligence and understand fundamental non-equilibrium phenomena.
- **Quantum Fluids –** Exploring quantum fluids such as liquid He4 and H3, to understand quantum turbulence and other macroscopic quantum phenomena.

Technology & Applications

- **Advanced Sensors & Signal Processing –** Development of high-performance pressure sensors, gyroscopes, and reconfigurable MEMS/NEMS chips for AI applications.
- **Medical Nanotechnology –** Magnetic nanobots capable

of targeted drug delivery, intracellular manipulation, and navigating live tissues. Microfluidic devices for cytometry, measuring cell properties, and bio-printing tissues.

- **Droplet & Body-on-Chip Systems –** Research in controlled droplet manipulation for applications in biotechnology, printing, and microreactors. Development of organ-on-chip systems for personalized medicine and drug testing.
- **Wafer-Scale Technologies–** wafer-scale MEMS/NEMS packaging to enable scalable commercial applications.

CeNSE is driving innovation at the intersection of nanotechnology, biology, and computing, fostering industry collaboration and advancing India's leadership in MEMS, NEMS, and microfluidics research.

Quantum Technologies:
CeNSE, IISc, is actively engaged in cutting-edge quantum technology research, spanning quantum sensing, computing, and materials.

- **Quantum Information & Mechanics -** on-chip optical cavities to study quantum information transfer between mechanical modes. These resonators, cooled to their quantum ground state, offer new avenues for quantum applications.
- **Quantum Fluids -** superfluid helium and single/few electron bubbles toward new qubit platforms, quantum phase transitions and quantum turbulence.
- **Quantum Materials & Devices –** van der Waals heterostructures, investigating emergent quantum phenomena at cryogenic temperature and ultra-high magnetic field in stacked 2D materials heterostructures of Superconductor, Semiconductors, ferromagnet and ferroelectric materials; synthesise materials via MBE and sputtering, engineer unique interfaces, fabricate nano/micro devices, and study their electronic, structural, and magnetic properties; and oxide-based quantum materials for memory and phase-change applications.
- **Quantum Photonics:** Quantum photonic circuits enable scalable quantum computing by leveraging telecommunication wavelengths for photon generation, manipulation, quantum gates, and detection, advancing real-world quantum technologies.
- **Quantum Sensors & Clocks-** ultra-small atomic clocks, NV-centres in diamond for nanoscale thermometry and magnetometry, Integrating NV-diamond with magnetic nanorobots to develop motile quantum sensing platforms, addressing challenges in quantum sensor fabrication through novel microfabrication and heterogeneous integration techniques.
- **Quantum Microscope & Sensors:** 2D material-based Quantum Twisting Microscope for momentum resolved scanning and charge sensing.

Computing Platforms:
Modern computing faces challenges due to fundamental constraints in nano and microelectronics. To power AI, ML, and IoT efficiently, CeNSE, IISc, is pioneering next-gen computing inspired by the brain's cognitive functions. Our goal is to develop energy-efficient neuromorphic chips that drastically outperform traditional processors.

We are designing brain-like computing systems using cutting-edge materials and device architectures. Our interdisciplinary research spans:

- **Molecular Neuromorphic Chips –** Organic materials for AI-driven computing.
- **Photonic Neuromorphic Chips** – Light-based computing for ultra-fast processing.
- **Inorganic Neuromorphic Materials –** Materials enabling brain-like decision-making.

CeNSE combines world-class infrastructure with deep expertise in materials, nanofabrication, and computing. We develop indigenous platforms for applications in AI, cybersecurity, and bioinformatics.

- **Analog Computing & Deep Neural Networks –** Energy-efficient AI hardware.
- **Spiking Neural Networks –** Edge-of-chaos computing for complex problem-solving.
- **Reconfigurable Computing–** Parallel, fault-tolerant systems for large-scale AI.

Associate Faculty

ADITYA SADHANALA | PhD (Cambridge), Assistant Professor

AKSHAY NAIK | PhD (Maryland), Associate Professor

AMBARISH GHOSH | PhD (Brown), Professor

CHANDAN KUMAR | PhD (IISc), Assistant Professor

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

DHAVALA SURI | PhD (BITS-Pilani, Goa), Assistant Professor

GAYATHRI PILLAI | PhD (National Tsing Hua), Assistant Professor

MANOJ VARMA | PhD (Purdue), Professor

NAVAKANTA BHAT | PhD (Stanford), Professor

PAVAN NUKALA | PhD (U Penn), Associate Professor

PROSENJIT SEN | PhD (UCLA), Associate Professor

RUDRA PRATAP | PhD (Cornell), Professor

SAURABH CHANDORKAR | PhD (Stanford), Associate Professor

SHANKAR KUMAR SELVARAJA | PhD (Ghent), Associate Professor

SREETOSH GOSWAMI | PhD (NUS), Assistant Professor

SRINIVASAN RAGHAVAN | PhD (Penn State), Professor

SUPRADEEPA V R | PhD (Purdue), Associate Professor

SUSHOBHAN AVASTHI | PhD (Princeton), Associate Professor

VINI GAUTAM | PhD (JNCASR), Assistant Professor

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 des ing, planning, and operation of transportation syster

FACT FILE

Established: 2009
Phone: +91-80-22932521/ 2043/ 3251/ 3252 +91-80-2346 8207
Fax: +91-80-2346 8207
Email: office.cistup@iisc.ac.in
URL: http://cistup.iisc.ac.in/
Degrees Offered: Nil

IN NUMBERS

The current strength of CiSTUP is 76, consisting of:

- 3 faculty + 1 research faculty + 1 visiting chair professor +1 International Visiting Professor (Total 6)
- 8 postdoctoral researchers
- 20 full-time researchers
- 25 students (along with the primary department)
- 15 interns
- 2 Admin staff

Chair: ABDUL RAWOOF PINJARI

Current **Research**

- Research under the theme of "City-Scale Modelling", such as multiscale mobility sensing, modelling, inference and simulation tools for multimodal transport planning and traffic control for Bengaluru.
- Emerging mobility systems – on-demand last mile connectivity for public transit systems, shared mobility as a service (e.g., bike sharing systems; vehicle allocation and routing problems), electric vehicles, etc.
- Understanding and modelling traveller choices in complex travel environments. For example, analytical and learning models for driving behaviour in heterogeneous and disorderly traffic streams.
- Decision-support tools for public transit agencies, including ridership forecasting models and bus-bunching avoidance solutions.
- Development of integrated driving and traffic simulators.
- Optimising the potentials of drive-by sensing for city-scale monitoring, context-aware, data-driven driver behaviour analysis for public transportation in India, learning from multi-sensory, unlabelled, streaming data in autonomous systems, multi-vehicle trajectory prediction for collision detection.
- Investigation of whether there is a uniform understanding of road rules among various road users (motorised, non-motorised drivers, and pedestrians) and identification of gaps in driver education that may compromise road safety.
- Autonomously collecting crash data using drones applying multi-drone energy-aware scheduling, path planning, crash analysis algorithms, autonomous flying, and autonomous data collection.
- Proof of concept for urban mobility forecasting using Artificial Intelligence (AI) techniques and methods.

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), Spatio-temporal Data Analytics, Urban Sensing.

Faculty & Staff

ABDUL RAWOOF PINJARI | PhD (Univ. of Texas), Professor

TARUN RAMBHA | PhD (Univ. of Texas), Associate Professor

PUNIT RATHORE | PhD (Univ. of Melbourne), Assistant Professor

VIJAY GOPAL KOVVALI | PhD (Texas A&M Univ.),
Research Professor

CHANDRA BHAT | PhD (Northwestern Univ.), Satish Dhawan
Visiting Chair Professor

VINAYAK DIXIT | PhD (University of Central Florida, USA)
International Visiting Professor

3.4.6 *Interdisciplinary Centre for Energy Research*

The Interdisciplinary Centre for Energy Research (ICER) was launched in 2012 with a focus on renewables and energy conversion and storage technologies. The department now has 6 core faculty, and several affiliate faculty leading efforts in three verticals: Materials & Chemical, Thermal & Mechanical, and Power & Electrical systems.

FACT FILE

Established: 2012
Phone: +91 80 2293 3521
Email: office.icer@iisc.ac.in
URL: http://icer.iisc.ac.in
Degree Programmes offered: The Centre offers PhD and MTech Research programmes in the area of Energy.

IN NUMBERS

34 PhD
5 MTech Research

Chair: PRAMOD KUMAR

Current **Research**

- Design and Development of Super Critical CO2 (sCO2) power packs & Trans Critical CO2 (tCO2) Heat Pumps
- Turbomachine design for sCO2 systems
- Natural refrigerant-based cooling and heating for reduced environmental impact
- Development of compact heat exchangers for supercritical carbon dioxide Brayton power plant for CSP applications
- Feasibility study to evaluate the use of Bamboo for power generation through gasification
- Fundamental and preliminary investigation on MSW-RDF for thermochemical conversion gasification process
- Advanced bio-fuels generation from thermochemical conversion of biomass - Research, Demonstration and Analysis
- Polymer-hybrid solid electrolytes for next-generation high-performance Na-based batteries (Na-ion, Na-metal)
- High-energy density sulphur batteries for EV and space applications
- Multivalent aqueous batteries for India-specific stationary energy storage solutions
- Electrochemical carbon capture and electrosynthesis of high-value chemicals
- Hybrid evaporative cooling systems
- Solar PV waste heat-driven water purification
- Fuel cell systems optimal design
- Design and optimisation of thermochemical energy storage systems
- Design and demonstration of a silica-gel + water adsorption cooling system

Research Highlights

Supercritical CO2 Power Systems: Developed India's first closed-loop supercritical CO2 Brayton cycle power block, offering higher efficiency and compactness for nuclear, solar, and waste heat applications. Designed gearbox-driven sCO2 turbomachinery with thrust collar to manage high axial loads (8kN, 60,000 rpm), and conducted experimental/computational studies on turbulent sCO2 flows in microchannels to optimise heat exchanger design.

Sustainable Hydrogen and Biofuels: Pioneered thermochemical processes for generating 99.97% pure hydrogen and advanced biofuels (methanol, ethanol) from biomass. Developed a two-stage gasification process for hydrogen-rich syngas with minimal tar, scalable to 350 kW for power and chemical production. Studied oxy-coal combustion of high-ash coal in O2/N2 and O2/CO2 environments, reducing alkali metal emissions

Advanced Photovoltaics: Created a large-area PV testbed for Indian conditions and developed encapsulated organic PV on flexible glass for enhanced stability. Achieved over 50,000 hours of stability using graphene-embedded polymer packaging and reduced optical losses in silicon solar cells by 35% with biomimetic hierarchical nanostructured coatings (HNC), improving efficiency by ~25%.

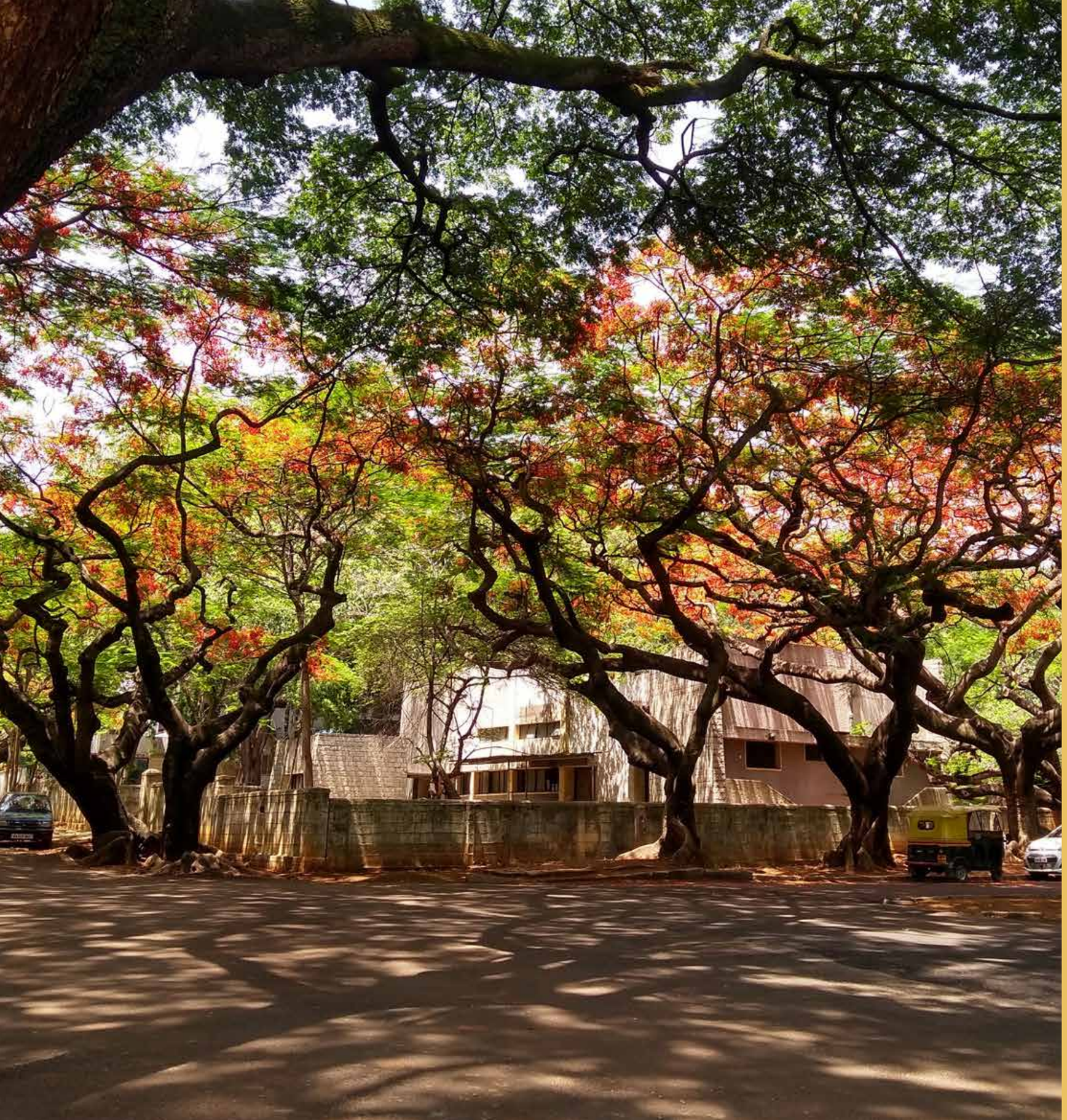
Core **Research**

Supercritical-CO2 Power and Cooling Cycles, Printed Circuit Heat Exchangers, Turbomachinery, Biomass Conversion, Green Hydrogen Production and Storage, Data Centre Thermal Management, Solar Thermal Energy, Solar PV, Biomass Conversion, Energy Efficient Brine Concentration and Resource Recovery, Fuel Cells and Electrolysers, Battery Technologies, Electrochemical Carbon Capture, Passive Radiative Cooling Coatings, Polymer Electrolytes, and Energy Harvesting and Sensing.

Solar Thermal and Cooling Technologies: Developed coatings for high-temperature solar reflectors and a two-stage silica gel + water adsorption system for solar-driven cooling and desalination. Developing novel spray coatings with tuned spectral emissivity and absorptivity to achieve passive daytime cooling.

Advanced Battery Technologies: Developed flexible Li-S batteries with Li2S-carbon cathodes and gel electrolytes for satellite applications, aqueous rechargeable batteries (Na, Zn, Mg, Ca, Al) for grid storage, and Li-CO2 batteries with high energy density (1876 Wh/kg) using advanced electrocatalysts to enhance CO2 redox kinetics.

Energy-Water Nexus: Developed a multi-effect membrane distillation module with integrated internal feed preheating channels for improved energy efficiency.



Core Faculty

DASAPPA S | PhD (IISc), Professor

PRADIP DUTTA | PhD (Columbia), Professor

ANINDA JIBAN BHATTACHARYYA | PhD (Jadavpur), Professor

PRAMOD KUMAR | PhD (IISc), Professor

JAICHANDER SWAMINATHAN | PhD (Massachusetts Institute of Technology), Assistant Professor

FARSA RAM | PhD (Academy of Scientific and Innovative Research), Assistant Professor

3.4.7 *Interdisciplinary Centre for Water Research*

Reaching across traditional disciplinary boundaries, ICWaR aims to provide a comprehensive understanding of the impact of complex environmental factors on areas related to water science and technology and subsequently offers efficient and effective engineering solutions to environmental problems. Students in ICWaR receive education in diverse areas and carry out interdisciplinary research addressing some of the major water-related science and engineering challenges of modern society.

FACT FILE

Established: 2015
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Fax: +91 80 2360 0404
Email: office.cds@iisc.ac.in
URL: icwar.iisc.ac.in

IN NUMBERS

21 PhD students
88+Journal Publications
15 Conference publications

Chair: PRAVEEN C RAMAMURTHY

Current **Research**

During 2024–2025, the Interdisciplinary Centre for Water Research (ICWaR) at the Indian Institute of Science (IISc), Bengaluru, continued to advance its mission of addressing critical challenges in water science through cutting-edge interdisciplinary research. The Centre's efforts have spanned climate variability, hydrological extremes, environmental pollution, groundwater systems, and sustainable water management.

A key development this year is the establishment of the Centre for Cauvery River Basin Management and Studies (cCauvery), hosted at ICWaR. This collaborative initiative with NIT Tiruchirappalli, guided by cGanga at IIT Kanpur and supported by the National River Conservation Directorate (NRCD), aims to restore and sustainably manage the Cauvery River Basin. Through a multidisciplinary framework encompassing scientific research, data dissemination, policy engagement, stakeholder collaboration, and education, cCauvery is positioning itself as a national model for integrated river basin management.

Research at ICWaR has also focused on understanding the environmental impacts of chemical pollutants in water systems, particularly pesticides and heavy metals. Innovative materials such as green-synthesised nanoparticles and biogenic adsorbents have been developed for efficient contaminant removal. These efforts are coupled with advances in biodegradation using microbial agents and the development of point-of-care electrochemical sensors for real-time pollutant detection, offering scalable and sustainable solutions for water purification and monitoring.

In the domain of climate and hydrologic extremes, the Centre has investigated the role of monsoon low pressure systems (LPS) in driving extreme rainfall across India. Newly developed LPS tracking algorithms and simulations using Earth system models have helped uncover the links between regional orography and LPS behaviour, with implications for monsoon predictability and flood risk management. The influence of flash droughts and compound extremes – such as sea level rise combined with storm surges and rainfall – has also been examined, revealing strong interannual modulation by global climate drivers like ENSO and the Indian Ocean Dipole.

Groundwater research at ICWaR has focused on understanding flow connectivity in hard rock aquifers under intensive abstraction. Integrated field investigations and numerical modelling have revealed evolving flow patterns in sheared crystalline terrains. These findings are being incorporated into large-scale hydrological models to better simulate

Core **Research**

Urban water systems; Urban hydrology/hydrogeology; Watershed and river basin hydrology; Floods and droughts; Water management; Agrohydrology; Satellite hydrology; Hydro-Geodesy; Water budget; Extreme rainfall events; Wetland science; Land-atmosphere interactions; Lake ecosystems; Aquatic geochemistry; Application of Stable isotope technique in groundwater studies, Geothermal reservoir modelling; Global water cycle and impacts of climate change; Isotope hydrology; Applications of sensor and satellite technologies; Domestic and industrial wastewater treatment; Climate change impact on hydrology of Indian rivers; Urban Floods and lake ecosystem; Coastal Floods; Hydrologic fluxes; Glacier Hydrology; Nanotechnology based solutions for water purification, Biometeorological impacts.

groundwater-soil interactions and inform sustainable groundwater management strategies. Efforts in isotope geochemistry have led to new insights into past climate variability and hydrological processes. Snow accumulation rates during glacial cycles in Antarctica have been analysed using ice core records, while novel isotopic proxies derived from phytoliths are being developed for reconstructing past humidity. Concurrently, solute exchange between surface water and groundwater in coastal deltas has been investigated to assess water quality risks in regions experiencing sea level rise and salinity intrusion.

Urban water quality and wastewater research has assessed the role of trace metals in aquatic systems and their linkages to antimicrobial resistance. Long-term time-series monitoring in rivers and lakes has been undertaken to track reactive transport processes, especially in urbanised landscapes. Complementing these efforts are hydrological modelling and statistical analyses that incorporate compound drivers of floods, evaluate climate model skill in streamflow prediction, and assess the impact of climate trends on seasonal forecast accuracy. Geodetic tools are also being employed to quantify glacier mass balance, sea level rise, and water storage anomalies at multiple scales. Together, these research themes underscore ICWaR's commitment to advancing science-based solutions for water resilience in a changing climate.

Ongoing Research Activities

Centre for Cauvery River Basin Management and Studies (cCauvery)

The Centre for Cauvery River Basin Management and Studies (cCauvery), established in 2024, is hosted at the Interdisciplinary Centre for Water Research (ICWaR), Indian Institute of Science (IISc), Bengaluru. It is a collaborative initiative between IISc Bengaluru and NIT Tiruchirappalli, guided by cGanga at IIT Kanpur, and functions as the knowledge partner of the National River Conservation Directorate (NRCD), Ministry of Jal Shakti. cCauvery is dedicated to the restoration, conservation, and sustainable management of the Cauvery River Basin—one of India's most vital and contested water systems. The river sustains millions across southern India and plays a critical role in agriculture, ecology, and regional heritage.

The Centre adopts a multidisciplinary framework involving:

- **Data Collection & Dissemination –** Building knowledge on river health and basin dynamics
- **Scientific Research –** Advancing studies in hydrology, water quality, climate resilience, and ecosystem restoration
- **Strategic Planning & Policy Support –** Enabling evidence-based water governance
- **Monitoring & Assessment –** Tracking water quality, flows, and ecological health
- **Education & Capacity Building** – Training stakeholders through academic programmes and outreach
- **Stakeholder Engagement** – Bridging government, academia, industry, and communities

By combining science, policy, and collaboration, cCauvery aims to be a national model for integrated river basin management, ensuring the sustainable future of the Cauvery River and its people.

Praveen C Ramamurthy

My research focuses on the intersection of environmental nanotechnology, sustainable materials, and water quality monitoring—particularly addressing the pressing challenge of chemical pollutants such as pesticides and heavy metals in water systems. These contaminants pose severe risks to both environmental and human health, often leaching into groundwater used for human consumption and irrigation. With industrialisation, urbanisation, and modern agricultural practices accelerating pollutant flux into ecosystems, we are witnessing a transition from localised contamination to a broad-scale epidemiological crisis. Heavy metals, known for their persistence, bioaccumulation, and non-biodegradability, remain one of the most intractable threats. Their toxic effects—ranging from immune and neurological impairment to carcinogenesis—are well documented. Likewise, pesticide residues such as the herbicide atrazine persist in agroecosystems and are increasingly detected in potable water sources. My lab explores innovative, sustainable pathways to mitigate these threats through two interlinked research thrusts:

Development of Biogenic Adsorbents

We engineer advanced materials such as green-synthesised nanoparticles, biogenic adsorbents, and nanocomposites to enhance contaminant removal efficiency. These materials exhibit high adsorption capacities, are regenerable, and produce non-toxic by-products—offering a marked improvement over traditional methods like ion exchange or chemical precipitation, which are often cost-intensive and ineffective at trace levels.

Biodegradation and Sensing of Pesticides

We aim to degrade persistent herbicides like atrazine using microbial agents with specific biodegradation capabilities. Concurrently, we are developing point-of-care electrochemical sensors based on novel materials and enzyme systems to detect pesticides in real time. These sensors offer a practical alternative to bulky and expensive laboratory instrumentation like HPLC-MS and GC, enabling decentralised monitoring of water quality.

This integrated framework—merging green materials science with microbial biotechnology and sensor engineering—seeks to deliver scalable, affordable, and sustainable solutions for water purification and environmental monitoring.

Govindasamy Bala & VV Srinivas

Prof Bala and Prof Srinivas are investigating the characteristics of Monsoon Low Pressure Systems. The South Asian summer monsoon brings copious rain to agriculture-dependent country India and bulk of the precipitation in central India is attributed to monsoon low

pressure systems (LPS). Large uncertainty exists in the statistics of LPS (frequency, intensity and tracks) during the historical period and in future projections. For an in-depth investigation of the climatology of LPS, we have recently developed an LPS tracking algorithm which is validated by comparing characteristics of LPS from our tracking scheme with previous studies. Our analysis indicates the formation of around 14 LPS per year (over 68 LPS-days). 60-70% of monsoon rainfall in north, east and central India is found to be associated with LPS (location is within 1000 km radii of LPS). Over the central Indian region, around 82% of extreme precipitation events occur during LPS days. Our analysis of extreme precipitation related to LPS has the potential to provide valuable information for flood risk assessment during monsoon season in central India.

Subsequently, we have used the NCAR Community Earth System Model (CESM1.2.2) to simulate the LPS characteristics over India and the Bay of Bengal. Our preliminary analysis indicates that CESM could reproduce most of the observed LPS characteristics. Using the CESM model simulations, we are investigating the influence of southeast Asian mountains (SAMs), Western Ghats and the Himalayan mountains and Tibet on LPS characteristics.

VV Srinivas

Flash droughts (FDs) have attracted widespread attention in recent years due to their sudden onset and rapid intensification with significant impacts on ecosystems, water resources, and agriculture. A novel approach is proposed to quantitatively define FD based on the aridity index, and it was utilised to examine spatiotemporal characteristics (including trends) and triggers of FDs over 25 river basins across India between 1981 and 2021 (Poonia et al., 2024). Spatiotemporal variability and risk of compound sea level-rainfall extremes and compound skew surge-rainfall extremes was analysed along the Indian coastline. The effect of El Nino Southern Oscillation (ENSO) and Indian Occean Dipole (IOD) on the interannual variability of these extremes was also investigated. Results revealed a disparity in spatiotemporal variability and risk of compound coastal extremes between India's East-West coasts (Dutta et al., 2025).

M Sekhar

Connectivity of groundwater flow within crystalline-rock aquifers controls the sustainability of abstraction and baseflow to rivers yet is often poorly constrained at a catchment scale. The groundwater connectivity in a sheared gneiss aquifer is investigated under the UPSCAPE project of MoES-NERC, by studying the intensively abstracted Berambadi catchment (84 km2) part of the Kabini CZO, using field studies and numerical model simulations. The study indicated a well-connected system, both laterally and vertically, that has evolved with high abstraction from a laterally to a vertically dominated

flow system. Also, as a result of shearing, a high degree of lateral connectivity remains at lower groundwater levels. Better representations of groundwater processes are needed in large-scale hydrological models to improve simulations of regional-to-global-scale hydrology and climate. As part of the UPSCAPE project, we incorporated a 2D groundwater flow model into the variable infiltration capacity (VIC) hydrological model code to address its lack of a lateral groundwater flow component and allowing bi-directional exchange of water between the aquifer and the soil. Numerical simulations showed that the distribution of water table depths and water budget components varied significantly as grid resolution increased from 1° to 0.05° for the medium and high transmissivity systems.

Prosenjit Ghosh

The stable isotope research group addressed some of the crucial scientific curiosities on the snow accumulation rate over the Antarctic region during glacial cycles and demonstrated deviation from the prediction. The study conducted in collaboration with the IIT Mumbai and ISI Kolkata, Mathematical Science researcher showed a strong linkage between temperature and the apparent rate of accumulation of ice at three sites in East Antarctica over the past 800 kiloyears. The conclusions emerge from statistical analysis of an empirical model based on ice core data on snow accumulation.

A new proxy of triple oxygen is introduced for relative humidity reconstruction using the rice grain amorphous silica phytoliths, usually found preserved in Archaeological sites. This is collaborative research with Oregon state University, USA. The work is partly funded by the DST, Government of India.

Ramananda Chakrabarti
Large seasonal variability in the composition of the Godavari River draining basalts has been documented which has important implications for understanding silicate weathering and climate change. A seasonal variability study for the Mahanadi River water and surrounding groundwater has also been initiated. Solute exchange between surface water and groundwater from varying depths in the Sundarbans delta has been investigated. The results revealed that regionally, the Cl- concentration of Sundarbans shows an increasing trend (average 329–351 mg/L) with declining groundwater levels (3 m). There is a predominant exchange of Sr2+ between shallow depth [D1: 14–25 and D2: 30–50 m below ground level (m bgl)] with seawater (Sr2+: 30–85 µM), which is possibly absent at greater depths (D3:115 and D4: 333 m bgl). The ERT data also show progressively increasing resistivity with increasing depth. The above data are consistent with high salinity and enriched δ18O at shallow depths. The lateral and vertical transportation of solutes in variable hydraulic head conditions has implications for drinking water quality and availability in this heavily populated coastal area.

LN Rao
Vaidya et al (2024) present a comprehensive assessment of wastewater management challenges in developing countries, with a focus on India as a case study. The study examines the current status of wastewater generation, treatment, and reuse across urban and rural settings, highlighting that over 70% of the wastewater generated in India remains untreated, leading to significant environmental and public health risks. The authors critically analyse the gaps in existing wastewater infrastructure, governance, and enforcement of environmental regulations. Particular emphasis is placed on the fragmented institutional frameworks and limited integration between water supply and sanitation agencies, which hinder effective management. The paper further explores socio-economic constraints, such as inadequate funding, lack of public awareness, and technological barriers, that prevent the implementation of decentralised and sustainable wastewater treatment solutions. Drawing on global best practices, the authors recommend the adoption of nature-based solutions, improved financial mechanisms (including PPP models), and community engagement strategies. The study underscores the urgency of aligning wastewater management with circular economy principles and Sustainable Development Goals (SDGs), especially SDG 6. It concludes with a forward-looking roadmap for enhancing wastewater treatment capacity, integrating reuse strategies, and fostering innovation through policy reforms and research investments in the Indian context.

Rajarshi Das Bhowmik
Recent studies by Rajarshi's group have advanced current understanding of climate extremes, hydrologic variability, and their drivers across India. Kumar et al. (2025) proposed a revised method for estimating flood return periods by accounting for the co-occurrence of floods with their potential drivers (e.g., rainfall, soil moisture, ENSO), demonstrating that traditional univariate methods can significantly underestimate flood risk. Budamala et al. (2025) conducted a skill assessment of decadal hindcast experiments using CMIP6 models to evaluate their ability to reproduce streamflow regimes in Indian rivers, identifying robust patterns and limitations for long-term hydrologic planning. Rasool et al. (2024) developed a stochastic rainfall generator capable of simulating unprecedented rainfall events, validated under changing climate conditions using extreme value statistics. Posa et al. (2024) linked global climate modes such as ENSO and IOD to long-term shifts in flood seasonality across peninsular India, highlighting spatial heterogeneity in teleconnection impacts. Bhowmik et al. (2024) demonstrated that long-term hydroclimatic trends significantly degrade the performance of seasonal forecasts, suggesting the need for trend-aware prediction systems. Dhanurkar et al. (2024) investigated correlations between global fire products and hydrometeorological anomalies, offering new insights into the hydroclimatic impact of forest fires and feedback under climate variability.

Bramha Dutt Vishwakarma
Bramha has a background in Geodesy and uses geodetic sensors for studying the impact of climate change and human intervention on large scale water availability and the Earth system. Bramha is currently working on downscaling coarse GRACE satellite data for hydrological application, on in-situ glacier mass balance measurements in Ladhak, deciphering drivers of water storage change, understanding coastal sea level change, modelling water availability and separating the influence of climate change and human intervention. Bramha has received funding from SERB, ISRO, and MOES.

Thejna Tharammal
Thejna Tharammal's research focuses on the hydrologic cycle and the effects of climate change on monsoons in the past and future scenarios. Dr Tharammal conducts numerical experiments using Earth system models to explore the changes in the hydrologic cycle and water vapor sources across different time periods. This research seeks to advance the fundamental understanding of the monsoon to better anticipate its future evolution. Dr Tharammal's work also involves other critical areas such as the

effects of aerosols on the Indian monsoon and understanding potential tipping points within the Earth system under climate change. Dr Tharammal is a contributing member of the "Earth Commission" of Future Earth dedicated to defining evidence-based boundaries for Earth system safety and resilience. Recently, she was awarded the ANRF-Prime Minister Early Career Research Grant for research related to monsoon changes.

Soumita Boral
Current research investigates the dissolved chemistry of large rivers and urban lakes to assess the sources and reactive transport processes of fey metals in aquatic systems. Conducted a study on Bangalores lakes, sampling lakes with different degrees of anthropogenic stress and modifications for e.g., Hesarghatta Lake – supplying drinking water, Jakkur Lake – receiving treated wastewater, Varthur Lake - receiving direct wastewater. The role of sources (both anthropogenic and natural) and reactive processes, especially redox driven was investigated along with metal speciation and bioavailability for ecological risk assessments. This study demonstrates the importance of monitoring often overlooked metals that could often act as sentinels of the ongoing processes that control the chemistry and thereby the quality and threats for aquatic life. Also, conducting time-series sampling of Kaveri River to understand the short-term spatio-temporal variations, the source-sinks of metals in large rivers and the reactive transport processes that modulate river chemistry at different hydro-climatic zones. Also, as a co-PI received funding from DST-WTC call in a project that assess the role of metals in enhancing antimicrobial resistance in the surface environment in urbanscapes such as Bangalore.

Faculty & Staff

Chair: PRAVEEN C RAMAMURTHY | PhD (University of Clemson), Professor

Core Faculty

RAJARSHI DAS BHOWMIK | PhD (North Carolina State University, USA), Assistant Professor

BRAMHA DUTT VISHWAKARMA | PhD (University of Stuttgart, Germany), Assistant Professor

Associate Faculty

GOVINDASAMY BALA | PhD (McGill University), Professor

SEKHAR M | PhD (IISc), Professor

SRINIVAS VV | PhD (Indian Institute of Technology Madras), Professor

PROSENJIT GHOSH | PhD (Physical Research Laboratory), Professor

RAMANANDA CHAKRABARTI | PhD (University of Rochester), Associate Professor

SANJIV SAMBANDAN | PhD (University of Waterloo), Professor

LAKSHMINARAYANA RAO | PhD (McGill University), Associate Professor

DST Inspire Faculty

THEJNA THARAMMAL | PhD (University of Bremen)

SOUMITA BORAL | PhD (IIT Kanpur)

3.4.8 *Management Studies*

The oldest management education department in India, established in 1947, the Department of Management Studies at IISc offers master's and doctoral programmes. It conducts cutting-edge research across diverse areas of management, setting national benchmarks in research and education through interdisciplinary approach and engagement with complex real-world problems.

FACT FILE

Established: 1947
Phone: +91 80 2293 2378
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URL: office.mgmt@iisc.ac.in

IN NUMBERS

8	Academic Staff
30	PhD
25	MMgt
34	Publications
9	PhD Conferments
18	MMgt Conferments

CHAIR: SHASHI JAIN

Current **Research**

Our research spans several interdisciplinary domains reflecting core strengths in Innovation & Enterprise, Energy & Policy, Sustainability & Policy, Health & Society, Finance & Risk, and Operations & Systems.

Entrepreneurship and Innovation Ecosystems
We investigate the dynamic trajectories of returnee and domestic entrepreneurs within emerging startup hubs like Bangalore. Focusing on opportunity recognition, innovation capacity, and venture growth cycles, our work provides actionable insights for policy frameworks and interventions aimed at strengthening entrepreneurial ecosystems and driving economic growth in emerging markets.

Energy Systems and Sustainability Transitions: Our projects address India's critical transition towards low-carbon energy systems, emphasising renewable integration and rural energy access. We develop analytical models and planning tools to support demand-side management, variable renewable energy integration, and energy infrastructure resilience. This research underpins sustainable energy policies vital for India's clean energy transition.

Sustainability and Public Policy: Research here explores the nexus between sustainability and policy in urban and industrial contexts. Key topics include lean production systems, sustainability enablers for SMEs, and incentive-driven behavioural change. These studies aim to guide sustainable urban transformation and industrial practices through evidence-based policy recommendations.
Health, Public Policy, and Socio-technical Innovation
Our work in health focuses on leveraging AI and socio-technical interventions to enhance public health outcomes. Notable projects include AI-powered oral cancer screening, behavioural strategies for sickle cell anaemia elimination under CSR initiatives, and economic evaluations of emerging medical technologies. These efforts align with national health priorities to improve equity, access, and efficiency in healthcare delivery.

Technology, Intellectual Property, and Informal Systems: We study the impact of intellectual property management, cybersecurity frameworks, and informal urban systems on technology adoption and innovation. Research includes patent lifecycle valuation, IP's role in sustainability, and leadership and incentive mechanisms that enhance technology readiness and societal resilience.

Financial Engineering and Risk Analytics: In collaboration with banking partners, we apply data envelopment analysis and machine learning for technical efficiency evaluation of rural banks and credit risk modelling. Our work focuses on estimating default probabilities, loss given default, and calibrating rating models to support regulatory compliance and robust risk management frameworks.

Operations Research and Smart Logistics: This research stream develops optimisation models and heuristic algorithms to solve practical logistics challenges, including scheduling for manufacturing, drone-truck integrated last-mile delivery, and urban bus allocation. We also focus on lean production optimisation for SMEs to improve operational efficiency and competitiveness.

Quantitative Finance and Risk Management: We employ advanced mathematical and statistical models for portfolio optimisation, hedging strategies, and pricing derivatives. Research highlights include model-free hedging via martingale optimal transport, non-parametric modelling of multidimensional Hawkes processes, and hybrid statistical factor models combining PCA and MLE techniques. These models aim to enhance asset management and risk mitigation in complex financial environments.

Core **Research**

Innovation & Enterprise: Entrepreneurship, innovation, start-ups, industrial economics
Energy & Policy: Energy access, energy systems, renewable transitions, energy policy
Sustainability & Policy: Sustainability transitions, environmental systems, urban and informal systems, public policy
Health & Society: Public health, socio-technical interventions, AI for social good
Finance & Risk: Financial engineering, risk analytics, quantitative finance
Operations & Systems: Supply chain, lean systems, optimisation, operations research

Faculty

MH BALA SUBRAHMANYA | PhD (ISEC), Professor

M MATHIRAJAN | PhD (IISc) | Chief Research Scientist

P BALACHANDRA | PhD (IISc), Chief Research Scientist

CHIRANJIT MUKHOPADHYAY | PhD (Missouri), Professor

ANJULA GURTOO | Fellow (IIM Ahmedabad), Professor

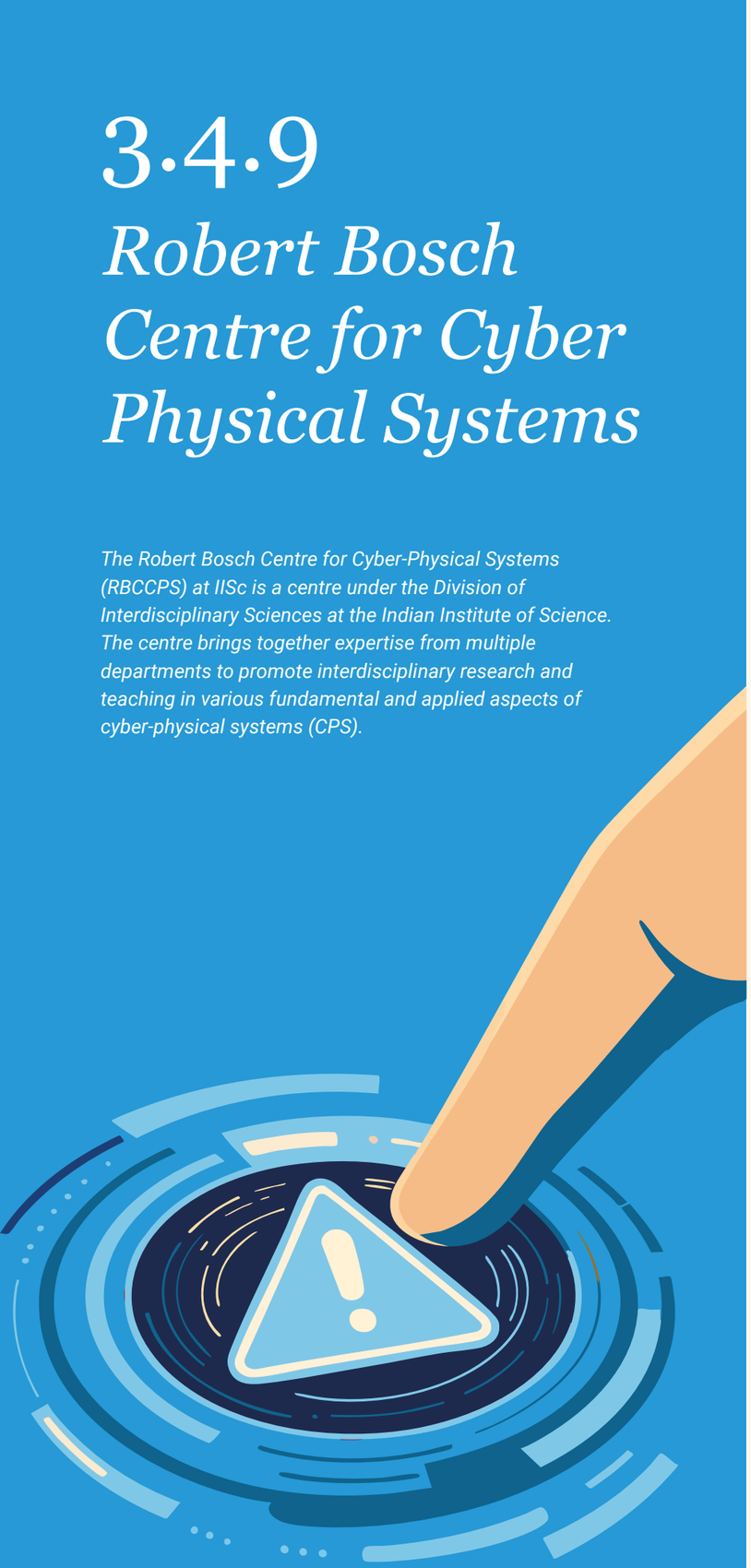
PARTHASARATHY RAMACHANDRAN | PhD (Oklahoma State), Professor

SHASHI JAIN | PhD (TU Delft), Associate Professor

SUMIRTHA GANDHI | PhD (IIT Madras), Assistant Professor

3.4.9 *Robert Bosch Centre for Cyber Physical Systems*

The Robert Bosch Centre for Cyber-Physical Systems (RBCCPS) at IISc is a centre under the Division of Interdisciplinary Sciences at the Indian Institute of Science. The centre brings together expertise from multiple departments to promote interdisciplinary research and teaching in various fundamental and applied aspects of cyber-physical systems (CPS).



FACT FILE

Established: 2011
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Fax: +91-80-2293 2046
Email: office.cps@iisc.ac.in
URL: https://cps.iisc.ac.in/
Degree Awarded:
MTech (Res) - 4
PhD - 7
MTech - 35

IN NUMBERS

7 Journals & Publications
Students:
80 MTech (55 MTech RAS + 25 MTech AI)
7 MTech Res - 7
50 PhD

Chair: SURESH SUNDARAM

Current **Research**

The centre focuses on foundational and applied research to solve cutting edge problems in **Robotics** involving advanced machine learning techniques, **Connected Autonomous Systems** like drones and 5G-enabled autonomous vehicles, and Socio-**Technical Systems** like urban transportation systems and Smart Cities. Specific topics include formal techniques for data driven control systems, legged motion, multi-modal learning, CPS security, data science for smart-X systems, multi-agent robotic systems, advanced drone technologies, social robotics, human-robot interfaces, stochastic control for robotic systems etc.

The centre has core faculty as well as joint faculty and associate faculty drawn from various departments in the divisions of EECS and Mechanical Sciences. In addition, it has a strong visiting faculty program, who complement the teaching and research. The centre also hosts post-doctoral researchers as well as visiting scientists and professors from academia and industry.

The centre created a new section-8 company, I-Hub for Robotics and Autonomous systems Innovation Foundation (ARTPARK) to focus on translational R&D leading to creation of new ventures.

RBCCPS has also established strong collaborations with many major technology companies and engages with many start-ups. It also works closely with government bodies and participates in specific standardisation activities.

Core **Research**

Robotics; AI and Machine Learning, Control and Optimisation; Security and Privacy in CPS; Connected Autonomous Systems like drones and 5G-enabled autonomous vehicles; and Socio-Technical Systems like urban transportation systems and Smart Cities.

Core & Joint Faculty

BHARADWAJ AMRUTUR | PhD (Stanford), FNAE, Professor
DEBASISH GHOSE | PhD (IISc), FNAE, Professor
SHISHIR N Y KOLATHAYA | PhD (Georgia Institute of Technology), Assistant Professor
VAIBHAV KATEWA | PhD (University of Notre Dame), Assistant Professor
PUNIT RATHORE | PhD (University of Melbourne), Assistant Professor
PUSHPAK JAGTAP | PhD (Technical University of Munich), Assistant Professor
ARJUNAN PANDARASAMY |PhD (IIT Delhi), Assistant Professor
PAVAN TALLAPRAGADA | PhD (Maryland), Associate Professor
ABDUL RAWOOF PINJARI | PhD (Texas), Associate Professor
TARUN RAMBHA | PhD (Texas), Associate Professor
RAVI PRAKASH | PhD (IIT Kanpur), Assistant Professor

Associate Faculty

SHALABH BHATNAGAR | PhD (IISc), FNAE, Professor
CHIRANJIB BHATTACHARYYA | PhD (IISc), FNAE, Professor
DEEPAK D'SOUZA | PhD (CMI), Professor
VINOD GANAPATHY | PhD (Wisconsin), Associate Professor
ASHITAVA GHOSAL | PhD (Stanford), Professor
ADITYA GOPALAN | PhD (Texas), Associate Professor
GURUNATH GURRALA | PhD (IISc), Associate Professor
RADHAKANT PADHI | PhD (Missouri), Professor
TV PRABHAKAR | PhD (TU Delft), Principal Research Scientist
YOGESH SIMMHAN | PhD (Indiana), Associate Professor
SURESH SUNDARAM | PhD (IISc), FNAE, Professor
HIMANSHU TYAGI | PhD (Maryland), Associate Professor
PRADIPTA BISWAS | PhD (University of Cambridge), Associate Professor
ASHWINI RATNOO | PhD (IISc), Associate Professor
ANDY RUINA | PhD (Brown), Satish Dhawan Chair Professor
KIRAN KUMARI | PhD (IIT Bombay), Assistant Professor
GR JAYANTH | PhD (Ohio State University), Associate Professor
RISHITA DAS | PhD (Texas A&M), Assistant Professor

Visiting Faculty

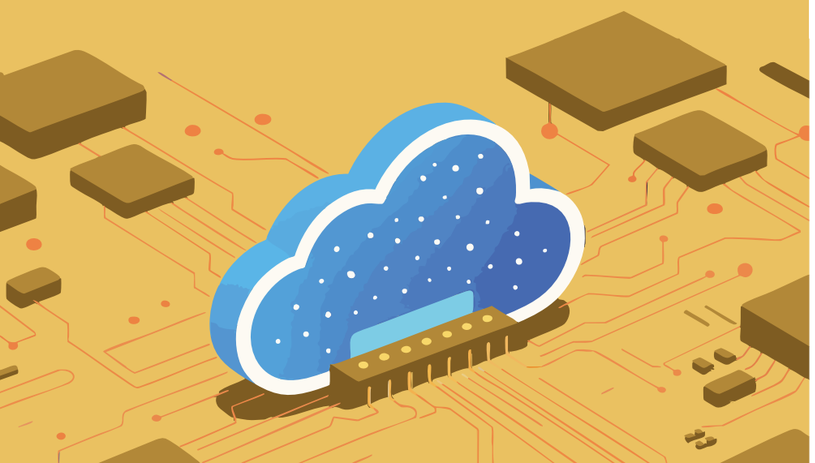
NARENDRA KARMARKAR | PhD (UC Berkeley), Visiting Professor
DARSHAK VASAVADA | MS (IISc), Guest Faculty
PRASANT MISRA |PhD (University of New South Wales, Sydney, Australia)
PRATHYUSH MENON | PhD (University of Leicester, UK)
PR KUMAR | DSc (Washington University)

3.4.10 *Supercomputer Education and Research Centre*

The Supercomputing Education and Research Centre (SERC), at IISc provides the state-of-the-art computing environment catering to the ever-increasing demands of high-performance computing for scientific and engineering research. The Centre hosts 24/7 supercomputing facilities and services including supercomputers of Petaflop capacities for traditional HPC (High performance computing), deep learning and AI based applications, HPC software and about 2 Petabytes of storage.

Our supercomputer systems have served about 25 departments, 100 research groups and 375 users of the Institute in various fields including aerospace, brain research, chemistry, climate modelling, computational and data sciences, computer science, earth sciences, electronics system engineering, inorganic and physical chemistry, materials research, mechanical engineering, microbiology and cell biology, molecular biophysics, physics etc. SERC resources are also being used by researchers from academic organisations, government-funded R&D laboratories and industry.

National Supercomputing Mission (NSM) and SERC:
SERC continues to play active role in NSM. SERC had created a vision document for R&D for and with extreme-scale computing. SERC has also initiated projects related to indigenous supercomputing hardware development.



FACT FILE

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IN NUMBERS

HPC services to 23 departments, 100 research groups and 375 students at the Institute

80 publications, including about 65 publications across the Institute based on supercomputing usage

95 K jobs and 205 million CPU core hours of usage

Chair: SATHISH VADHIYAR

Current **Research**

Faculty conducted research on cloud systems with research students from Computational and Data Sciences in the "Cloud Systems Lab." This year the lab worked in the following areas.

Research Areas:
Serverless Platform Architecture, Distributed Application Service Resilience, Isolates for FaaS, Agentic Frameworks for Fault Management

Current Research:
Current research is on evaluating the use of Generative AI tools for responsive system fault management.

Computational Electromagnetics group research involves the development of fast, scalable, and accurate 3D electromagnetic solvers. These solvers scale to O(N) and O(NlogN) memory and solve time complexity. They can also be applied to complex inhomogeneous geometries to solve electromagnetic radiation and scattering problems. The solution to very large problems is limited by the serial nature of the code, which can be overcome by effectively parallelising the code. The solvers are parallelised for heterogeneous High-Performance Computing (HPC) architecture and ported to SERC supercomputers. Solving significant size problems leads to high solution times due to the ill-conditioning of the system matrix. The group also works on developing efficient and fast preconditioners to reduce the solver's overall solution time. The group is developing a fast direct solver to solve electromagnetic radiation and scattering problems. The solver retains the (*NlosN*) matrix factorisation time complexity and (N) solution time complexity. The group is also working on parallelising the developed numerical solver for homogeneous and heterogeneous HPC clusters.

Core **Research**

Supercomputing systems, applications and statistics, cloud systems, system virtualisation, cloud middleware, operating systems, networking, digital library, information retrieval, Machine Learning, information security, computational electromagnetics, parallel programming.

Digital Library group continued to study the technological development in the areas of Digital Libraries (DL) for better organise and retrieve data from Digital Library. The group hosts Digital Repository of Theses and Dissertations of Indian Institute of Science on cloud platform and carried study about usage studies about user job and usage accounting data analytics for Supercomputers to aid in user policies and capacity planning.

Faculty & Staff

FILBERT MINJ | MTech (JNU), Principal Research Scientist

J LAKSHMI | PhD (IISc), Principal Research Scientist

SATHISH VADHIYAR | PhD (Univ. of Tennessee),
Associate Faculty and Chair

YOGENDRA KUMAR NEGI | MTech (Delhi),
Senior Scientific Officer

Associate Faculty

R GOVINDARAJAN | PhD (IISc), Professor

ABHIK CHAUDHURY | PhD (Univ. of Karlsruhe, Germany),
Associate Professor

MANISH JAIN | PhD (Univ. of Minnesota), Associate Professor

Honorary Professors

N BALAKRISHNAN | PhD (IISc), Honorary Professor

3·5

Division of *Mechanical Sciences*

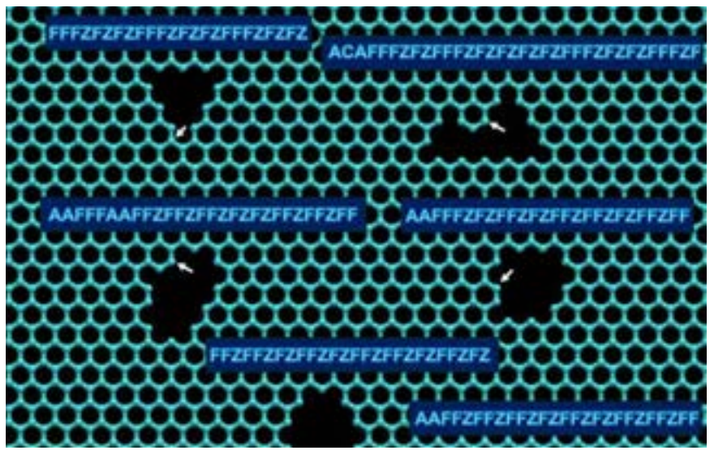
Research in the Division spans diverse areas including Geotechnical Engineering, Civil & Aerospace Structures, Transportation, Water Resources, Environmental Engineering and Sustainable Habitat, Climate, Structural and Functional Materials, Manufacturing, Design Theory and Methodology, Geochemistry, 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

Among the focus areas include seismology and climate change – modelling as well as paleo studies – 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.

DEPARTMENTS | CENTRES | UNITS

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



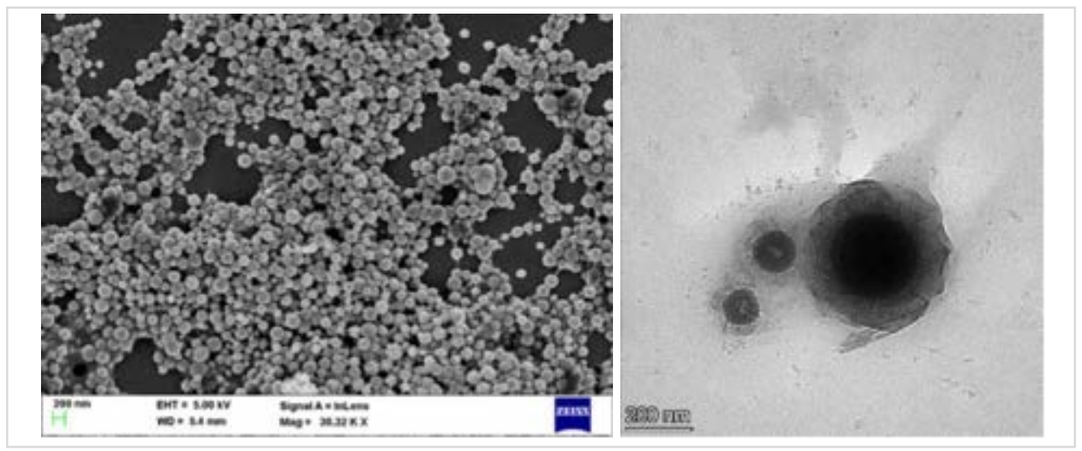
A language for ML models to predict nanopore properties

Researchers at the Department of Chemical Engineering have devised a new language which encodes the shape and structure of nanopores in the form of a sequence of characters. This language can be used to train any machine learning model to predict the properties of nanopores in a wide variety of materials. Called STRONG – STring Representation Of Nanopore Geometry – the language assigns different letters to different atom configurations and creates a sequence of all the atoms on the edge of a nanopore to specify its shape. Using STRONGs drastically cuts down on the amount of data that needs to be analysed for predicting nanopore properties.

Reference:

Sharma P, Thomas S, Nair M, Govind Rajan A, Machine learnable language for the chemical space of nanopores enables structure–property relationships in nanoporous 2D materials, Journal of the American Chemical Society (2024).

Research **Snapshots**
2024-25

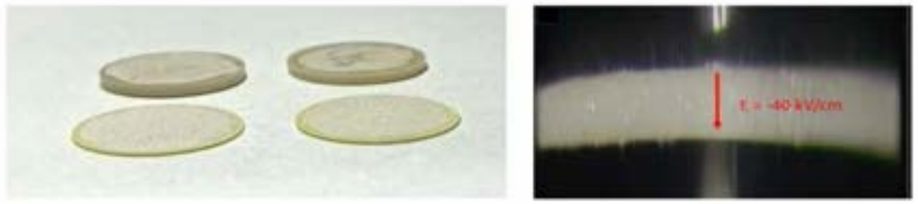


Nanoparticle-based remediation of chromium-contaminated water

Groundwater is an essential source of drinking water across the country. However, heavy metal contamination in groundwater presents a significant health hazard. Researchers at the Centre for Sustainable Technologies (CST), Department of Civil Engineering (CiE), and Department of Instrumentation and Applied Physics (IAP) have developed a nanomaterial-based solution that can effectively reduce the presence of heavy metals like chromium in groundwater. The authors suggest that the material they developed, S-CMC-nZVI, is promising for on-site remediation of chromium-contaminated groundwater. The technique developed can also prove quite useful in remediating contaminants such as cadmium, nickel, and chromium in contaminated sediments of Bellandur lake.

Reference:

Prathima B, Raghvan VS, Soni S, Gorthi SS, Babu GLS, Sulfide-enhanced carboxymethyl cellulose stabilised nano zero-valent iron for chromium (VI) mitigation in water: Evidence from batch and column studies, Journal of Water Process Engineering (2024).



Small changes can dramatically boost efficacy of piezoceramics

Piezoelectric materials deform (stretch or contract) when an electric field is applied, making them suitable for wide-ranging applications, from ultrasound imaging in hospitals to actuators in guided missiles. Researchers at the Department of Materials Engineering and collaborators show that the efficacy of a commonly-used piezoceramic can be dramatically increased just by reducing its thickness and by preventing atomic defects inadvertently formed during manufacturing. The team discovered that when the thickness of a circular piezoceramic disc was reduced from 0.7 mm to 0.2 mm, its electrostrain jumped from 0.3% to 1%. The findings emphasise the need to revisit how piezoceramics are made and tested and point to how little is known about what drives electrostrain below a certain thickness.

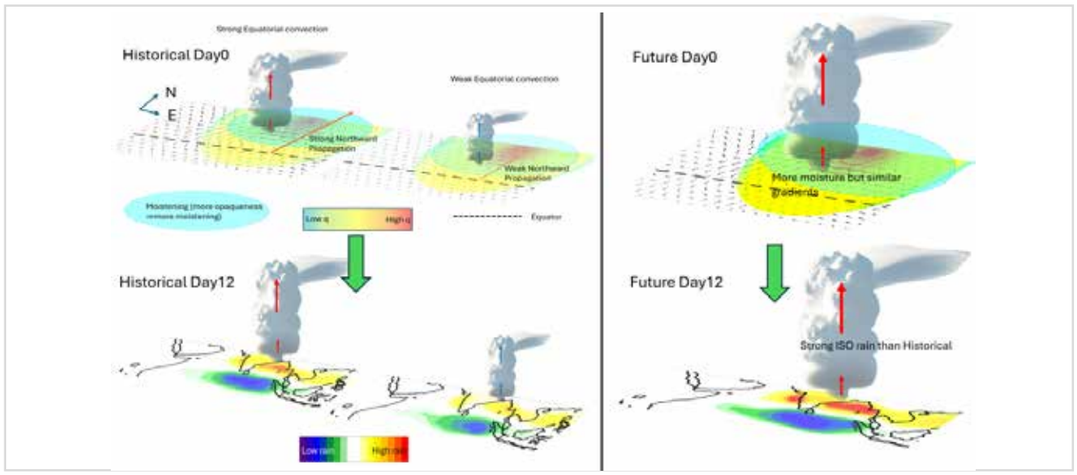
Reference:
Adhikary GD, Adukkadan A, Muleta GJ, Monika, Singh R, Singh DN, Luo H, Tina GA, Giles L, Checchla S, Daniels J, Ranjan R, Longitudinal strain enhancement and bending deformations in piezoceramics, Nature (2025).

Research **Snapshots**
2024-25

Fixing cracks in space bricks with bacteria

Researchers at the Department of Mechanical Engineering have developed a bacteria-based technique to repair bricks that can be used to build lunar habitats, if they get damaged in the moon's harsh environment. They created artificial defects in sintered bricks and poured in a slurry made from Sporosarcina pasteurii, guar gum, and lunar soil simulant. As the slurry penetrated the defects, the bacterium produced calcium carbonate to fill the cracks. It also produced adhesive biopolymers that strongly bound the soil particles together with the residual brick structure, recovering much of the brick's lost strength. This process can help avoid replacing damaged bricks with new ones, extending the lifespan of built structures.

Reference:
Gupta N, Kulkarni R, Naik AR, Viswanathan K, Kumar A, Bacterial bio-cementation can repair space bricks, Frontiers in Space Technologies (2025).



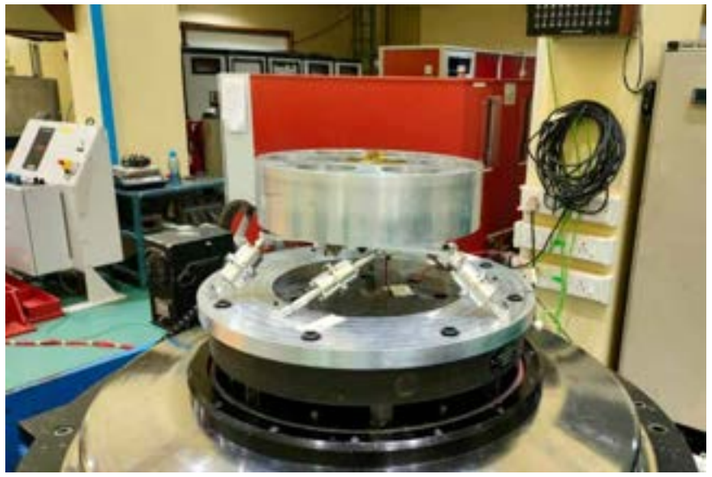
Cloud band movement influences wet spells during Indian monsoon

The monsoon rains have long remained the lifeblood of India, providing the lion's share of the water used for drinking and irrigation. The yearly arrival of the rains, which quenches the thirst of the harsh summers, is caused by the movement of cloud bands from the equator towards the north. Researchers at the Centre for Atmospheric and Oceanic Sciences have shown that contrary to previous understanding, the strength of the cloud band plays a key role in its movement as well as the density of rains that the Indian subcontinent receives during the wet spells of the monsoon. They believe that these findings will help improve the efficiency of current climate models used to forecast seasonal and sub-seasonal rainfall.

Reference:

Kottapalli A, Vinayachandran PN, Equatorial convection controls boreal summer intraseasonal oscillations in the present and future climates, npj climate and atmospheric science (2025).

Research **Snapshots**
2024-25



From shakes to stillness: Protecting space cameras from micro-vibrations

Micro-vibrations are low amplitude disturbances generated by moving equipment onboard a spacecraft that can really shake up and degrade the functionality of sensitive optical devices, like cameras attached to the spacecraft bus. Consequently, images captured from the spacecraft can get distorted and blurred. Researchers from the Department of Mechanical Engineering and Indian Space Research Organisation (ISRO) have developed a two-radii Gough-Stewart platform (GSP)-based multi-axis vibration isolation system for spacecraft applications. They adopted a novel geometry-based approach to derive the dynamically isotropic configuration of the two-radii GSP. This work underscores the efficacy of the design approach and the suitability of an MGSP for isolating micro-vibrations in spacecraft.

Reference:

Singh YP, Ahmad N, Ghosal A, Dynamically isotropic Gough-Stewart platform for micro-vibration isolation in spacecrafts, Mechanism and Machine Theory (2024).

3.5.1 *Aerospace Engineering*

Founded in 1942 as the Department of Aeronautical Engineering, it was renamed as the Department of Aerospace Engineering in 1982 to reflect the growing activities in space research and education. The department offers PhD, MTech and MTech (Research) programmes, and currently has 31 faculty and about 150 students. The academic and research activities are in four major areas, namely: Aerodynamics, Structures, Propulsion, and Guidance and Control.

FACT FILE

Established: 1942
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Degree Programmes offered: PhD, MTech (Res), MTech

IN NUMBERS

23 Academic Staff
8 Scientific Staff
89 PhD Students
12 MTech (Res)
47 MTech
20 MTech
2 MTech (Res)
11 PhD Conferments

Chair:
JOSEPH MATHEW

Current **Research**

Aerodynamics
A strong experimental programme spanning low-speed to hypersonic flows has been pursued in several wind tunnels and shock tunnels, fitted with instrumentation for classical measurements, modern diagnostics, and flow visualisation. Computational studies cover external aerodynamics of wings and full aircraft, DNS and LES of turbulent and transitional flows, aeroacoustics and new algorithms. New directions include a search for precursors of extreme events in turbulent regions, and information theory application to turbulence intermittency. Continuing studies are on phenomenology and origin of unstart in hypersonic intakes, unstart modes and shock dynamics in supersonic ejectors.

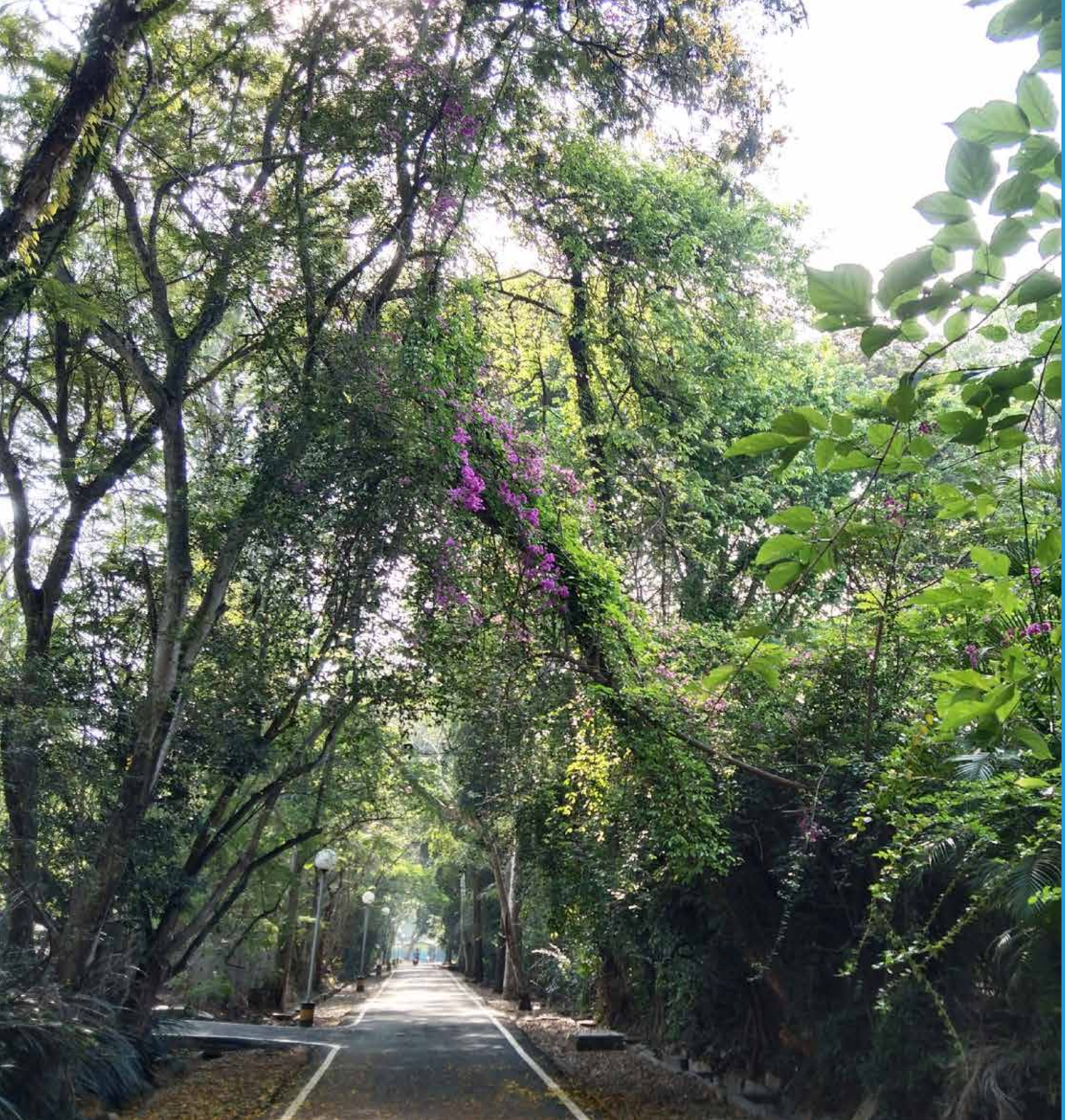
Structures
Wave propagation, novel materials, structural vibrations, aeroelasticity, non-destructive evaluation are the major topics of study, incorporating emerging methods like deep learning. Wave propagation work including bio-Inspired suture materials for efficient energy absorption, high wave attenuation and reduction in group speeds, peri-dynamics, and modelling blast mitigation and design for protection. Application of Lead Zirconate Titanate (PZT) for vibration, noise control, actuation, de-icing, sensing and condition structural health monitoring of composite embedded systems; AI/ML for bearing defect identification; nonlinearity and disorder in energy transfer properties of topological materials; magnetoelastic lattices with multiple stable configurations for novel, reconfigurable materials.

Propulsion
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 atomisation. Current focus is on non-circular orifices, a major finding that means droplet size is always higher. Droplet impact on flexible surfaces - wings of drones, insect, and leaves. Studies for gas turbines include soot formation, quenching, turbulent air/fuel mixing, and effect of hydrogen enrichment on soot and Nox; for combustion in high-speed flows, cavity flame holding.

Guidance and Control
The guidance and control group work on algorithms for various vehicles and verify them with experiments using several types of drones and ground vehicles. Problems have been formulated for guidance and control of Multi-UAV Systems, aerial manipulation, ML-based collision prediction and avoidance with applications to multi-agent biological entities for autonomous/precision agriculture, and station-keeping for satellites. New results include a novel guidance method using vector field-based commanded heading input, rogue drone interception, multi-UAV coordination – intersection planning, swarm guidance for narrow passages. Other applications are of UAV and AI for precision agriculture and zero gravity bio-mechanics.

Core **Research**

Aerodynamics: Low speed flows – transition and turbulence, supersonic and hypersonic flows – mixing, drag, heat transfer, computational fluid dynamics, LES, aeroacoustics, stability, aeroelasticity, information theory and machine learning.
Aerospace Structures: Composite structures, nanocomposites, functionally-graded materials, vibrations, wave propagation, structural health monitoring, finite element analysis, non-destructive evaluation, metamaterials, and shape memory alloys.
Propulsion: Atomisation and sprays, combustion instability, flame structure and interactions, soot formation measurement and modelling.
Guidance and Control: Optimal control, path planning, image processing, obstacle avoidance, multi-agent systems, robotics and artificial intelligence.



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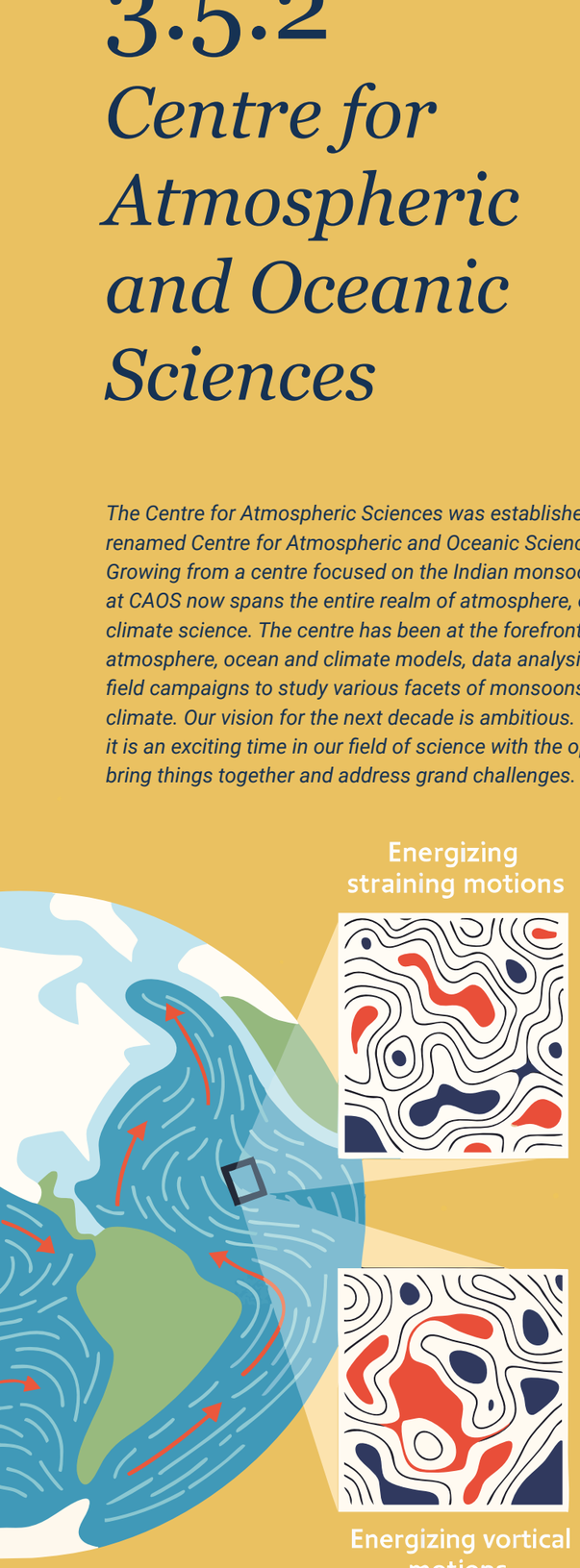
3.5.2 *Centre for Atmospheric and Oceanic Sciences*

The Centre for Atmospheric Sciences was established in 1982 and renamed Centre for Atmospheric and Oceanic Sciences in 1996. Growing from a centre focused on the Indian monsoon, research at CAOS now spans the entire realm of atmosphere, ocean, and climate science. The centre has been at the forefront of using atmosphere, ocean and climate models, data analysis, and focused field campaigns to study various facets of monsoons, oceans, and climate. Our vision for the next decade is ambitious. We believe that it is an exciting time in our field of science with the opportunity to bring things together and address grand challenges.



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Programmes offered: PhD, MTech (Res), and MTech in Earth and Climate Science
Office Staff: NIL

IN NUMBERS

9	Academic Staff
28	PhD Students
1	MTech(R) Students
22	MTech Students
13	PhD and MTech conferments

Chair: PN VINAYACHANDRAN

Current **Research**

Boreal summer intraseasonal oscillations

The boreal summer intraseasonal oscillation (BSISO) is the major mode of tropical intraseasonal variability during the Indian summer monsoon (ISM). It partly controls the dry and wet spells of the ISM and thus is crucial for agricultural yield in the country. Understanding the future of BSISO is essential as it has been established recently that the large-scale BSISO environment enhances the probability of extreme rainfall events enormously. In this study, the ability of Coupled Model Inter Comparison Project Phase 6 (CMIP6) models to capture the northward propagation of boreal summer intraseasonal oscillation (BSISO) is examined using a counting algorithm. A composite moisture budget reveals the difference in moisture dynamics between the above-average-performing (AAPM) and below-average-performing (BAPM) models. The AAPM composite has a stronger horizontal moisture advection ahead of the convection centre than the BAPM composite. The weaker wind and moisture perturbations in the BAPM mainly cause this difference in the horizontal moisture advection between AAPM and BAPM. The BAPM composite shows a weaker equatorial convection signal compared to the AAPM composite, resulting in weaker wind and moisture perturbations and a lesser number of northward propagations. Finally, we understand the future of BSISO by examining the projections of Shared Socioeconomic Pathways 370 (SSP370) from the available AAPMs. The background moisture will be enhanced uniformly in the future, leading to no substantial change in gradients. The equatorial convection amplifies and broadens in the future projections, leading to very little change in the wind perturbations. This results in the enhancement of BSISO rainfall by 63% in the Bay of Bengal and 42% in the Arabian Sea. However, the proportion of northward propagations remains the same as moisture advection remains the same. The study implies that with a correct representation of BSISO's equatorial convection, the prediction of BSISO and extreme rainfall associated with BSISOs becomes more reliable.

Convection-circulation coupling in the tropics

The complexities of convection–circulation coupling challenge understanding of the tropical atmosphere. This coupling is manifested in the vertical component of vorticity, which both aids and is modulated by convection. This study, for the first time, investigates the structure, maintenance, and propagation of vorticity associated with precipitating convection at various intraseasonal timescales (low-frequency (LF), high-frequency (HF), and synoptic-scale events) for global tropical ocean basins during the boreal summer. It is shown that vorticity associated with precipitating convection intensifies progressively and becomes vertically uniform away from the Equator, owing to boundary-layer vortex stretching and convection-induced vertical advection of vorticity into the free troposphere. Despite quantitative differences, these findings hold across global ocean basins, and the dominance of vortex stretching and vertical advection persists across timescales. The study also delves into the mechanisms for the northward propagation of vorticity during intraseasonal events, showing precisely how the mechanisms are latitude dependent. This is the first systematic study of

Core **Research**

Monsoon dynamics and variability, oceanography, ocean modelling, and air-sea interaction, cloud physics and tropical convection, hydrological cycle, extreme events, nonlinear climate dynamics, planetary boundary layer, aerosol physics and chemistry, large-scale waves and geophysical turbulence, ocean convection and small-scale turbulence, climate science, ocean and atmospheric modelling, AI and ML for data analysis, and theoretical geophysical fluid dynamics.

the evolution of convection–circulation coupling through the vorticity budget, offering observational benchmarks for covariation of precipitation, vertical vorticity, and velocity in climate models.

Sensitivity of tropical monsoon rainfall to stratospheric sulphate aerosols

Previous modelling studies had shown that the efficacy of the cooling via stratospheric aerosol geoengineering SAG increases with altitude of the aerosol layer. It has been also shown that the stratospheric heating associated with SAG could stabilise the tropical atmosphere and weaken the tropical hydrological cycle. Using a global climate model, we performed a systematic study by prescribing volcanic sulphate aerosols at three different altitudes (22 km, 18 km and 16 km) and assessed the sensitivity of the global and tropical mean precipitation to the altitude. We found that even though the efficacy of cooling increases with altitude of the aerosol layer, the global and tropical mean precipitation changes are less sensitive to the height of the aerosol layer. This is because the magnitude of both the global and tropical mean precipitation reduction increases with aerosol altitude in response to increasing efficacy of aerosols, but this sensitivity related to the slow response (sea surface temperature change) is nearly offset by the sensitivity of fast precipitation adjustments to aerosol altitude. A perspective and analysis based on atmospheric energy budget was presented to explain the lack

of sensitivity of the hydrological cycle to the altitude of the stratospheric sulphate aerosol layer.

Seasonal cycle of rainfall over India

Observations indicate that rainfall during the onset phase of the monsoon (June) is not correlated with rainfall in the post-onset phase (July-September). For the first time, this study establishes a connection between inter-annual and monthly variations in rainfall without assuming any of the intra-seasonal features typically observed during the monsoon, such as onset, intra-seasonal oscillations, synoptic variabilities, and extremes. Inter-annual variations lead to perturbations to the mean seasonal cycle, which in turn results in monthly variations of rainfall on top of the mean seasonal cycle. This study aims to understand the governing mechanisms behind these monthly variations of rainfall every year. The analyses reveal that June rainfall, which is related to the rapid or slow progress of the monsoon onset, is primarily influenced by the normal or slow phase transition of the Madden-Julian Oscillation, along with prevailing background conditions of precipitable water. Conversely, the rainfall for the remainder of the season is mainly governed by the phase of the El Niño Southern Oscillation through anomalous moisture flux convergence.

Northward propagation of Boreal Summer Intraseasonal Oscillation

The Boreal Summer Intraseasonal Oscillation (BSISO) is a pronounced mode of tropical variability. We show that northward propagation of this mode over India occurs in multiple stages after convection is initiated over the equatorial Indian Ocean. First, the convection moves into the southern Arabian Sea (AS) due to moistening of the free troposphere via horizontal BSISO anomalous winds acting on the background moisture distribution and forms a northwest southeast (NW SE) oriented convection band. Subsequently, in the presence of an easterly vertical shear of monsoon winds and meridional gradient of anomalous vertical velocity, a NW SE oriented tilting term is generated that results in a tilted gyre north of the existing convective anomaly and south easterly BSISO winds over the South Asian landmass. In the second stage, these winds tap the ambient north westward moisture gradient and help move the convection further north over land. Moreover, the background winds advect anomalous moisture to initiate convection over the Bay of Bengal. Thus, the BSISO is a horizontal advection driven moisture mode within a vertically sheared background.

ISO rainfall over the Bay of Bengal

The northward propagating intraseasonal Oscillation (ISO) is one of the dominant modes of tropical variability during Boreal summers. Several mechanisms have been proposed to explain northward propagation. Yet the factors that decide the ISO rainfall over a particular region remain elusive. This study shows that the ISO rainfall anomalies weaken across the south Bay of Bengal (SBoB) before they re-strengthen over the north Bay of Bengal (NBoB). We use the moisture budget to understand the reason for these weakening-strengthening cycles. We find that the horizontal moisture flux convergence (MFC) predominantly controls the ISO rainfall anomalies over the two regions. The convergence of background moisture by the ISO wind perturbations decides the ISO rainfall structure. Since past literature suggests that the Planetary Boundary Layer (PBL) convergence is caused by barotropic vorticity, we further conduct the vorticity budget to understand the rainfall structure. We find that though vorticity tilting helps generate the positive tendency of the ISO vorticity, the vorticity stretching enhances it. Further splitting of the stretching term helps us conclude that the convergence due to wind perturbations is the predominant term, representing feedback between dynamics and thermodynamics. We hypothesise that the weaker rainfall anomalies in the SBoB result from the weaker background column relative humidity and moisture, which do not allow the initial dynamic perturbations to grow as fast as they do in an environment with stronger background relative humidity and moisture (NBoB). Our study helps us understand the factors that control the ISO rainfall over a particular region and could help improve the model simulations.

Submesoscale processes associated with the East India Coastal Current

Seasonal variations and generation mechanisms of the submesoscale features associated with the East India Coastal Current (EICC) are investigated using a high resolution (≈1 km) regional ocean model set up for the Bay of Bengal (BoB) during 2012–2013. Simulations show that EICC is extremely rich in submesoscale features manifested as fronts, filaments, and eddies and the associated submesoscale processes exhibit significant seasonal variations. Characteristics such as local Rossby number, normalised horizontal divergence, vertical velocity, and strain rate show marked increase during winter monsoon (November–January). Submesoscale features of EICC are least active during spring (March–April). EICC is much more active in the submesoscale regime than the open ocean. Frontogenesis is the strongest at the end of summer monsoon in the north bay and spreads throughout the EICC in winter monsoon. There is continuous conversion of available potential energy to kinetic energy throughout the year. In the summer monsoon, strong stratification caused by the increased freshwater influx from Ganga Brahmaputra rivers suppresses generation of mixed layer instabilities in the north bay. In the winter monsoon, freshwater advection by EICC enhances the generation of mixed layer instabilities. The Ertel potential vorticity is mostly negative for EICC region throughout the winter monsoon. Further investigations of the criteria for symmetric instability reveals that the conditions over EICC region remain highly susceptible to the symmetric instability throughout the winter monsoon. The seasonal variability and generation processes of submesoscale features of EICC are closely related to the seasonal variability of EICC and freshwater forcing of the bay.

Ocean mixing using large eddy simulations

Tropical cyclones rank among the most damaging weather phenomena. Yet, the limited availability of high-resolution observations and the assumptions made in operational ocean models hinder a complete

understanding of the ocean's response. By employing high-fidelity large-eddy simulations alongside moored observations located outside the storm track, we reveal the critical role of interacting shear and convective processes in shaping upper ocean dynamics (See Figure). A paper published in Geophysical Research Letters and led by a PhD student Devang Falor in CAOS. Our model outputs closely align with measurements of sea surface temperature and salinity. Wind-induced shear turbulence disrupts stratification, causing the mixed layer to deepen and drawing freshwater downward during rainfall events. Simultaneously, surface-driven buoyancy loss enhances vertical mixing through convective processes. The resulting mixing efficiency and eddy diffusivity exhibit significant variation across depth and time throughout the storm's progression. These findings highlight the importance of accurately capturing upper ocean mixing processes to refine parameterisations in models aimed at forecasting tropical cyclone intensity.

Advection-based tracking and analysis of salinity movement in the Indian Ocean

The Bay of Bengal (BoB) has maintained its salinity distribution over the years despite a continuous flow of fresh water entering it through rivers on the northern coast, which is capable of diluting the salinity. This can be attributed to the cyclic flow of high salinity water (≥ 35 psu), coming from Arabian sea and entering BoB from the south, which moves northward and mixes with this fresh water. The movement of this high salinity water has been studied and analysed in previous work (Singh et al., 2022). This paper extends the computational methods and analysis of salinity movement. Specifically, we introduce an advection-based feature definition that represents the movement of high salinity water and describe algorithms to track their evolution over time. This method allows us to trace the movement of high salinity water caused due to ocean currents. The method is validated via comparison with established observations on the flow of high salinity water in the BoB, including its entry from the Arabian Sea and its movement near Sri Lanka. Further, the visual analysis and tracking framework enables us to compare it with previous work and analyse the contribution of advection to salinity transport.

Microstructures along the Indian west-coast continental shelf

During the month of October, the West Indian Coastal Current (WICC) is in a stage of transition from equatorward to poleward flow. The sea surface salinity near the Indian Coast is lower in the south compared to the north. Whereas the sea surface temperature is higher in the north than in the south. A salinity maximum (SM, Salinity ≥ 35.7 psu) exists in the sub-surface between depth ranges of 50–80 m. In situ vertical microstructure profiles collected along the continental shelf off the West Coast of India (WCI) for the first time, are used in this study to characterise vertical mixing under these complex thermodynamic regimes. Estimated sectional mean (median) values of the dissipation rates of turbulent kinetic energy ( ) and thermal variance ( ) are in the range 10^{-9} – 10^{-8} (10^{-9} – 10^{-8}) W kg^{-1} and 10^{-8} – 10^{-7} (10^{-9} – 10^{-8}) $^0C^2$ s^{-1} respectively. Sectional mean (median) values of the diapycnal diffusivity ( ) and eddy thermal diffusivity ( ) are in the range 10^{-6} –10^{-5} (10^{-6} –10^{-5}) m^2 s^{-1} and 10^{-4} –10^{-2} (10^{-6} –10^{-4}) m^2 s^{-1}, respectively. The barrier layer (BL) was observed at most of the measurement locations. The layering structures in the salinity profiles observed within BL indicate the phase of transition of halocline reformation. Experiments using a one-dimensional model suggest that this layering is caused by the mixing of surface freshwater (surface freshening caused by heavy rains) with mixed-layer water. Double diffusion with weak staircase structures in temperature and salinity is observed predominantly in the interior layer of the ocean in this region. The presence of SM at most stations, with its thickness decreasing from north to south, created conditions favourable for double-diffusive mixing. Signatures of salt fingering (SF) and diffusive convection (DC) were observed in 40% and 8% of the water column, respectively. Turbulent mixing in the column below the mixed layer (ML) is weak (≤ 10−6 m2 s−1) to moderate (10−4 m2 s−1), with some highly turbulent intermittent regions (10−2 m2 s−1) conducive to DC. The data presented here show the prevalence of two mixing regimes in the vertical: (1) vertical mixing of freshwater (due to rain) with the ambient mixed layer water, and (2) small-scale double-diffusive mixing due to contrasting temperature–salinity gradients predominantly in the ocean's interior layer (below the isothermal layer).

A scalable system for visual analysis of ocean data

Oceanographers rely on visual analysis to interpret model simulations, identify events and phenomena, and track dynamic ocean processes. The ever-increasing resolution and complexity of ocean data due to its dynamic nature and multivariate relationships demands a scalable and adaptable visualisation tool for interactive exploration. We introduce pyParaOcean, a scalable and interactive visualisation system designed specifically for ocean data analysis. pyParaOcean offers specialised modules for common oceanographic analysis tasks, including eddy identification and salinity movement tracking. These modules seamlessly integrate with ParaView as filters, ensuring a user-friendly and easy-to-use system while leveraging the parallelisation capabilities of ParaView and a plethora of inbuilt general-purpose visualisation functionalities. The creation of an auxiliary dataset stored as a Cinema database helps address I/O and network bandwidth bottlenecks while supporting the generation of quick overview visualisations. We present a case study on the Bay of Bengal to demonstrate the utility of the system and scaling studies to evaluate the efficiency of the system.

Bay of Bengal river plume response to a tropical cyclone

The response of a river plume to a tropical cyclone (TC) is a lesser-known aspect of tropical oceanography. We have investigated the interaction between a river plume and a category 5 TC, Phailin (8-14 October 2013), in the Bay of Bengal using high-resolution simulations of ROMS (Regional Ocean Modelling System). Two distinct experiments were performed: one including the river runoff into the ocean (Riv) and the other excluding it (NoRiv). From the east coast of India, a river plume advected offshore along the southern arm of a cyclonic eddy. The cyclone destroyed the river plume and scattered the low salinity water over a large region. The presence of a river plume made the pre-storm north bay a fresh, warm, and stably stratified basin, with a shallow mixed layer (ML) and thick barrier layer (BL). Upon the passage of Phailin, the stratification weakened, ML deepened, and BL thickness decreased. Maximum temperature drop and salinity rise were seen along the southern flank of the cyclonic eddy. The terms of salinity and temperature equations show that vertical mixing and advection caused these responses, aided by the cumulative effect of upwelling induced by the cyclonic eddy and storm, and the advection of redistributing river water.

Arabian Sea high salinity core supplies oxygen to the Bay of Bengal

The oxygen minimum zone (OMZ) in the Bay of Bengal (BoB) is unique owing to its curious capability to maintain steady dissolved oxygen (DO) levels. In this study, we identify a process by which the oxygen is supplied to the BoB, using DO and microstructure profiles in the southern BoB and Argo profiles over the entire basin. A high salinity core (HSC) rich in DO is advected by the Summer Monsoon Current (SMC) into BoB. Vertical mixing driven by turbulent processes recharge DO concentration in thermocline above OMZ. Salt-fingering processes were active below the HSC and were observed to enhance the vertical mixing. HSC identified in the Argo data, also rich in oxygen, can be traced up to 19 N, confirming that HSC is a source of DO and potentially prevents OMZ from moving to the denitrification regime. This might be a potential oxygen source for the BoB OMZ in changing climate conditions.

Sensitivity of global warming to the latitudinal distribution of radiative forcing

Previous studies have shown that radiative forcing imposed in high latitudes causes larger global warming than similar forcing in low latitudes. CAOS studied the causes for this using a linear forcing-feedback framework. For this we conducted different experiments by increasing

the solar insolation in various latitude bands using the NCAR CAM4 model and compared the magnitudes of five major climate feedbacks (Planck, albedo, lapse rate, water vapour, and clouds). Compared to the simulation where forcing is imposed in low latitudes, we found that the climate sensitivity is nearly twice (thrice) in the simulation where the forcing is imposed in northern (southern) hemisphere high latitudes. We showed that these sensitivity differences between low and high latitude radiative forcing simulations primarily arise due to differences in all four classically defined feedbacks including albedo, lapse rate, water vapour, and cloud feedbacks, with the largest differences attributed to differences in lapse rate, water vapor, and cloud feedbacks. Albedo feedback and the Planck response also contribute to the overall differences. Overall, our study at CAOS highlighted the strong dependence of climate feedbacks and sensitivity on the meridional structure of radiative forcing.

Sensitivity of global mean warming to the hemispheric differences in radiative forcing

While previous studies have shown that climate sensitivity to solar insolation changes imposed in the Northern (NH) versus the Southern Hemisphere (SH) is different, the underlying mechanisms remain unclear. In this work at CAOS, we investigated the climate response to three different radiative forcing scenarios: globally uniform radiative forcing, radiative forcing imposed only in the NH, and radiative forcing confined only to the SH. We found that the global mean warming is larger when forcing is imposed only in the SH. To explain the mechanisms for this, we estimated climate feedbacks using the radiative kernel approach. We found that albedo and Planck feedbacks are insensitive to hemisphere of forcing, and the larger climate sensitivity to the southern hemispheric radiative forcing is primarily due to differences in shortwave cloud feedbacks. We also examined the impacts of interhemispheric differences in radiative forcing on tropical circulation, planetary albedo, and land/sea warming contrast. Our results clearly demonstrated how the intertropical convergence zone moves into the hemisphere where the radiative forcing is larger without maintaining a symmetric planetary albedo. Overall, our work at CAOS provided clear insights into climate system responses to interhemispheric differences in radiative forcing caused by forcing agents such as aerosols from volcanic eruptions and human activities, and land cover changes, in addition to solar geoengineering.

Multidecadal climate mode of the Southern Hemisphere and El Niño Southern Oscillation Seasonal transitions

El Niño Southern Oscillation (ENSO) is the dominant interannual mode of quasi-periodic climate variability in the tropical Pacific Ocean. However, in recent decades, winter-to-summer ENSO transitions have become eclectic, primarily due to the tropical-extratropical interactions at interannual timescales. These interactions influence the prevailing trade winds, which blow generally west across the equatorial Pacific Ocean, thus impacting the lifecycle of ENSO.

In our study, we report the existence of a climatic mode that drives multidecadal sea-level pressure (SLP) variations in the extratropical South Pacific Ocean during boreal spring (see Figure 1a). This pattern, characterised by a zonal SLP dipole, impacts the seasonal transitions of ENSO from boreal winter to summer by influencing equatorial zonal winds in the Pacific Ocean. Therefore, we refer to this pattern as the ENSO transition mode (ETM). In its positive phase, ETM features anomalous westerly winds in the central-eastern equatorial Pacific Ocean that amplify boreal winter-to-summer Nino3.4 sea-surface temperature anomalies (N34SST), a metric used to quantify ENSO variability.

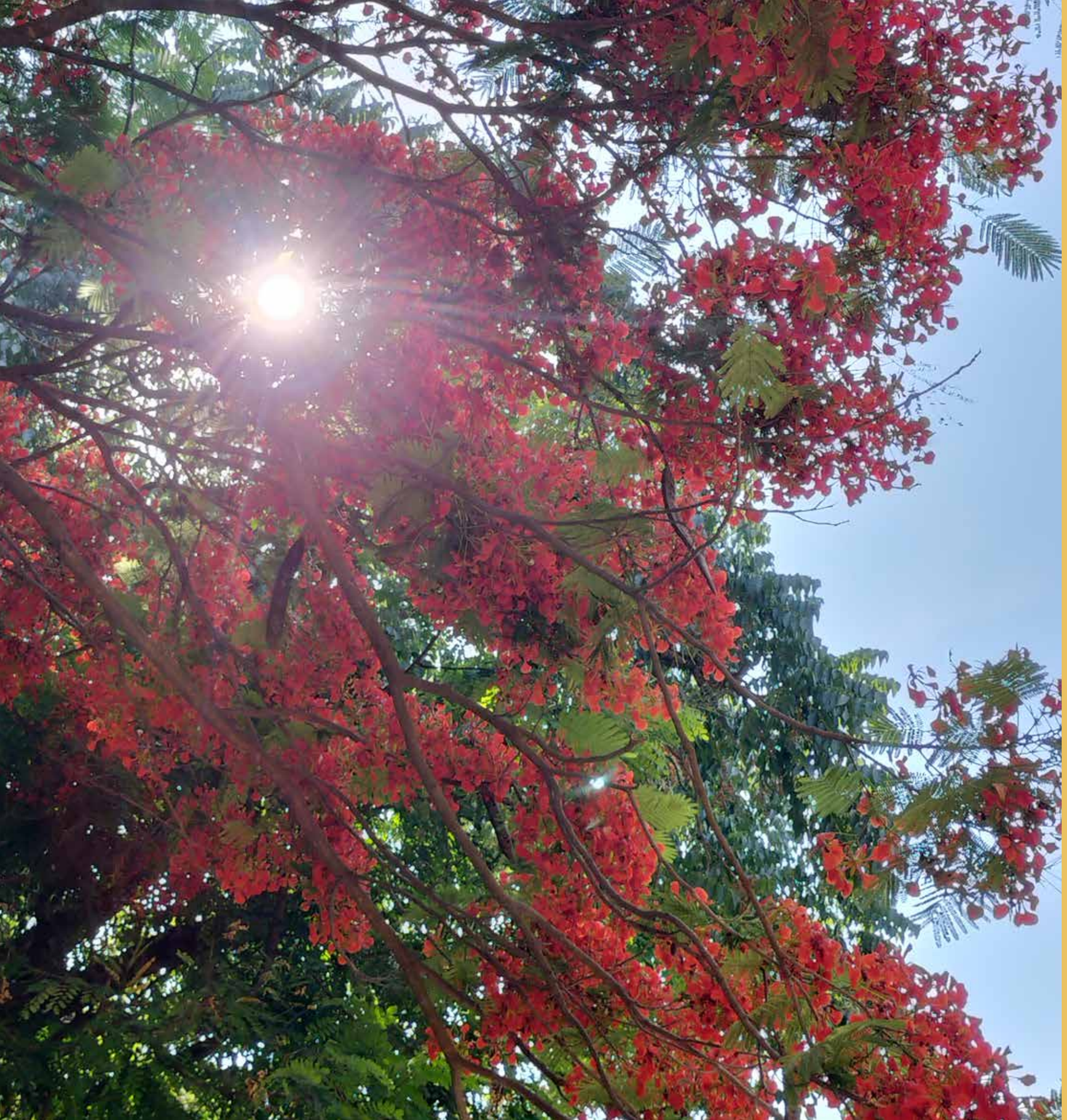
Sensitivity of tropical monsoon rainfall to the latitudinal distribution of stratospheric sulphate aerosols.

Stratospheric aerosol geoengineering (SAG) is one of the several solar geoengineering options that have been proposed to counteract climate change. In the case of SAG, reflective aerosols injected into the stratosphere would reflect more sunlight and cool the planet. When assessing the potential efficacy and risks of SAG, the sensitivity of tropical monsoon precipitation changes should

be also considered. Using a climate model, we performed several stylised simulations with different meridional distributions in the stratosphere. Because tropical monsoon precipitation responds to global mean and interhemispheric difference in radiative forcing or temperature, we quantified the sensitivity of tropical monsoon precipitation to SAG in terms of two parameters: global mean aerosol optical depth (GMAOD) and interhemispheric AOD difference (IHAODD). For instance, we find that the simulated northern hemisphere monsoon precipitation has a sensitivity of −1.33 ± 0.95% per 0.1 increase in GMAOD and −7.62 ± 0.27% per 0.1 increase in IHAODD. We also estimated precipitation changes in terms of the two sensitivity parameters for the global mean precipitation and for the indices of tropical, northern hemisphere, southern hemisphere and Indian summer monsoon precipitation changes. Similar sensitivity estimates are also made for unit changes in global mean and interhemispheric differences in effective radiative forcing and surface temperature. Our CAOS study based on planetary energetics provides a simpler framework for understanding the tropical monsoon precipitation response to external forcing agents.

Climate and carbon cycle response in net zero emission pathways

The climate system response to a set of nine scenarios where emissions are followed by the removal of all carbon emitted into the atmosphere were examined. The nine stylised simulations were driven by cumulative emissions of 1,000 GtC, 2,000 GtC, and 5,000 GtC over 150, 250, and 500 years, followed by the removal of all carbon over the same period. It was found that the climate system returns to preindustrial state on millennial timescales independent of emission and removal pathways. However, larger changes in the climate system at the end of removals (on centennial timescales) were simulated for a larger magnitude and longer duration of the emission and removal pulses. Since a delay in emission reduction implies a larger magnitude and longer duration for the emissions and consequently larger magnitude and longer duration for the removals to bring the climate state to preindustrial conditions, an earlier emission reduction would help to avoid large climate and carbon cycle impacts on centennial timescales.



Faculty

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JAI SUKHATME | PhD (Chicago), Professor

VENUGOPAL VURUPUTUR | PhD (Minnesota),
Associate Professor

ASHWIN K SESHADRI | PhD (CMU), Associate Professor

BISHAKHDATTA GAYEN | PhD (University of California),
Associate Professor

3·5·3 *Centre for Earth Sciences*

Faculty 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 work on diverse problems in earthquake geology, global tectonics, core dynamics and magnetism, ocean-atmosphere interaction, climate change and paleoclimate studies, petrology and rock geochemistry, and chemical weathering of continents.

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IN NUMBERS

8	Academic Staff
33	PhD
1	MTech (Research)
22	MTech (Earth and Climate Science Programme)
4	PhD Conferments

Chair: BINOD SREENIVASAN

Core **Research**

Planetary magnetism, dynamo theory, climate change (past and present), isotope hydrology, climate-tectonics interaction, 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, chemical weathering and planetary thermostat, chemical oceanography, seismology, machine learning applications in geophysics, geodesy.

Current **Research**

Planetary dynamics and magnetism (Binod Sreenivasan)
The dipole-multipole transition in planetary dynamos was investigated through the analysis of magnetic waves in an unstably stratified fluid. In addition, the role of the mantle in the transition was investigated analytically. It is thought that this study will eventually lead to a "Whole Earth" dynamic model.

A laboratory experiment of core convection, the first of its kind, showed the likely role of the lower mantle in the observed east-west heterogeneity of the Earth's inner core.

Earth evolution (Sajeev Krishnan)
The petrology group focused on the crustal growth processes on the Earth during the late Archaean period (~2.5Ga). The Archean-Proterozoic boundary represents a significant transitional period in Earth's evolution, marking a sudden rise in atmospheric oxygen and the beginning of present-day plate tectonics. The Late Archaean crust consists of several fragments of the Gondwana Supercontinent, such as India, Africa, Sri Lanka, and East Antarctica. Among these, the southern part of India is crucial as it contains several ~2.5 Ga crustal units metamorphosed at ~2.4 Ga, hence becoming the primary focus of research.

Deep Earth dynamics and surface observations (Attreyee Ghosh)
Modelling the geometry and slip-decay pattern of the mid-crustal ramp in the Kumaon-Garhwal region using geodetic data that has implications for seismic hazard assessment. Role of slabs, lateral viscosity variations and small-scale heterogeneity in generating the peculiar anisotropy pattern in western North America using instantaneous models of mantle convection. Investigating the sudden acceleration of the Indian plate during the Cretaceous period using forward convection models.

Geophysical inversion (Pawan Bharadwaj)
Geophysical inversion group continued its efforts to investigate the use of generative AI in seismology. Near-surface geophysics: Used autoencoders to improve depth investigation by extracting subsurface responses from vehicle noise, enhancing the detection of deeper voids with less data and resources than traditional methods. Enhanced crustal imaging: Trained variational autoencoders to extract crustal scattering effects from the seismic wavefield, enabling better analysis of anisotropy and the 3D nature of the Earth's crustal structure. Earthquake imaging: Showed that deep neural networks can better isolate earthquake information from seismic waves, allowing clustering analysis of earthquake sources, and generating virtual seismograms that facilitate precise examination of earthquake directivity effects.

Isotope geochemistry (Prosenjit Ghosh)
The stable isotope research group developed a new method for clumped isotope analysis using small carbonate samples. Showed lighter water composition during early earth, responsible for life diversifying from the evidence preserved in Cuddapah carbonates of 1.8 billion years old. Designed a new proxy for past wildfire reconstruction using isotopes of nitrogen in structural ammonium of clay to understand the drawdown of atmospheric CO_2 during the Pleo-Pleistocene time interval. Seasonality during Miocene, established from the west coast of India using growth bands in marine gastropods.

Chemical Oceanography (Sambuddha Misra)
The history of lead pollution (1993 – 2013) in the Indian ocean was reconstructed utilising coral samples from Lakshadweep to reveal a doubling of lead pollution within this period. In addition, the sources of lead were traced through isotope fingerprinting.

Hydroclimatic extremes, remote sensing (Bramha Dutt Vishwakarma)
The group uses satellite geodesy with large scale geophysical models, in-situ observations, and other remote sensing products to study earth system and its response to climate and anthropogenic forcings. They also collect in-situ glacier mass balance and velocity data from Ladakh.

Faculty & Staff

BINOD SREENIVASAN | PhD (Cambridge), Professor & Chair

PROSENJIT GHOSH | PhD (DAV, Indore), Professor

SAJEEV KRISHNAN | PhD (Okayama), Professor

RAMANANDA CHAKRABARTI | PhD (Rochester), Associate Professor

ATTREYEE GHOSH | PhD (Stony Brook), Associate Professor

SAMBUDDHA MISRA | PhD (Florida State), Assistant Professor

PAWAN BHARADWAJ | PhD (Delft University of Tech.), Assistant Professor

BRAMHA DUTT VISHWAKARMA | PhD (Stuttgart), Assistant Professor (jointly with Interdisciplinary Centre for Water Research)

Associate Faculty

D NAGESH KUMAR | PhD (IISc), Professor

3·5·4 *Chemical Engineering*

The Department of Chemical Engineering is a centre of excellence in research and education. It comprises thirteen full-time faculty, one adjunct faculty, and one DST-INSPIRE faculty fellow. The department currently has 55 students carrying out research in fundamental and applied areas, and 24 MTech students

FACT FILE

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Degree Programmes offered: PhD, MTech (Res) and MTech

IN NUMBERS

13 Academic Staff
50 PhD Students
2 MTech (Res)
39 Publications
28 MTech
9 PhD Conferment

Chair:

Current **Research**

Dynamics of a turbulent particle-gas suspension plays a key role in fluidised bed reactors. The newly developed Fluctuating Force Fluctuating Torque (F3T) is shown to accurately model the dynamics. The effect of the magnetisation model on a spheroidal magnetic particle in a rotating magnetic field was studied. It was found that the problem could be mapped on to the dynamics of a spherical dipolar particle subjected to a steady magnetic field in a shear flow. Due to this mapping, there was found to be a one-to-one correspondence between previous results for a particle in a shear flow and a steady field and the present results for a particle in a rotating magnetic field.

A machine-learnable framework to map nanopore chemical spaces, enabling predictions of 2D material properties, is developed. A 100-year-old debate in the field of statistical mechanics of constant energy systems is resolved. In catalysis, we revealed a facet-dependent activity for oxygen evolution on iron-doped nickel oxyhydroxide. Additionally, we explored how surface and edge functionalisation modulate the mechanical properties of graphene oxide. Expanding into polymer research, we created the first model for inhibitor-modulated 2D polymer growth, offering insights into covalent organic frameworks. We introduced a pedagogical framework for microcanonical

Core **Research**

Biomolecular/Biological engineering, diagnostics and drug engineering, catalysis and reaction engineering, process intensification, membranes and water treatment, complex fluids and granular materials, transport processes, paper microfluidics, nanomaterials, energy science and engineering, statistical mechanics and molecular simulations, active matter systems, environmental engineering; synthesis, analysis, and modelling of soft materials.

statistical mechanics that aligns with thermodynamic laws for nonideal fluids. We have uncovered key pathways for MoS2 monolayer formation via organometallic chemical vapor deposition and proposed a charge assignment scheme for accurate water transport simulations in nanotubes.

Functional devices based on in situ formed percolating networks of palladium nanostructures for hydrogen leak detection are developed. Rigorous testing for sensitivity and resistance to interference as per ISO standards have shown that the fabricated sensor is responsive and selective. The novelty lies in developing the precursor solution, assembly method, and post-treatment step, collectively ensuring high-performance hydrogen sensing. We also collaborated with TCS research to additively fabricate meta-surface lens antennas suitable for mobile satellite communications. We collaborated with a team of physicians from Manipal to test inkjet-printed strips for detecting chloride ion concentration in saliva.

The new framework developed for understanding emulsion formation in large capacity devices is shown to extract from evolving experimental drop size distributions the proportion of two controlling breakup mechanisms, the distribution of daughter drops they each produce and drop size dependent breakup rate. Splitting of rising and falling drops by intercepting wedges is investigated with precision using multiple high-speed cameras. A number of hitherto unknown modes of drop deformation leading to their breakup are unravelled.

The mechanism of crystal nucleation from solutions is poorly understood. Our studies have revealed the crucial role played by hydration on the free energy landscape of crystal nucleation of NaCl from aqueous solutions. Mechanistic details of organiser mechanism in Turkevich protocol for gold nanoparticle is highly complex and non-classical. Previous studies have indicated that the reduction followed by nucleation is aided through organiser molecules. Using molecular simulations and DFT studies, we have uncovered the mechanistic details of the organiser mechanism during the formation of gold nanoparticles. Polymorph classification of gas hydrates occurs in many polymorphs.

Water treatment and catalysis research focused on developing novel catalysts for unconventional processes like photo-piezocatalysis. Efforts were also made to create mixed matrix adsorbents and membranes for selective contaminant separation, with a particular emphasis on using ion-exchange membranes for ion separation in multicomponent mixtures. New processing techniques for upscaling and recycling of polyolefins are under development. Design of drug molecules via targeted methylation is under investigation.

Together with colleagues from France, a computational framework to draw inferences of in vivo immune responses to HIV using ex-vivo data is developed. Applying it to data from macaques, we deduced that the early cumulative immune response was a good correlate of long-term natural control of HIV. In a second study, we identified a trade-off between the antiviral and immune-stimulatory effects of antibody therapies for HIV, which may be important in devising strategies to elicit lasting HIV remission.

Faculty

JAYANT M MODAK | PhD (Purdue), Professor

GANAPATHY AYAPPA | PhD (Minnesota), Professor

PRABHU R NOTT | PhD (Princeton), Professor

V KUMARAN | PhD (Cornell), Professor

SANJEEV KUMAR GUPTA | PhD (IISc), Professor, Chair

NARENDRA M DIXIT | PhD (Illinois), Professor

SUDEEP PUNNATHANAM | PhD (Purdue), Professor

S VENUGOPAL | PhD (Purdue), Associate Professor

RAHUL ROY | PhD (Illinois), Associate Professor

BHUSHAN J TOLEY | PhD (Massachusetts),
Associate Professor

ANANTH GOVIND RAJAN | PhD (MIT), Assistant Professor

DEBASHIS ROY | PhD (IIT Kharagpur), Assistant Professor

NIRMALYA BACHHAR | PhD (IIT Bombay), Assistant Professor

3·5·5 *Civil Engineering*

The department spans five major areas: (a) Dam, (b) Geotechnical, (c) Structural, (d) Transportation Systems and (e) Water Resources and Environmental Engineering. A wide spectrum of research activities – analytical, numerical, and experimental methods are pursued. In addition to the doctoral and master's research, a unique MTech programme is offered where a student can opt for a major and a minor.

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IN NUMBERS

22 Academic Staff
4 Scientific Staff
95 PhD students
3 MTech (Res) students
93 MTech students

Chair: ANANTH RAMASWAMY

Current **Research**

Primary focus has been on the development of hygro-chemo-thermo-mechanical model for concrete at meso-scale in a multi-physics framework. The model has been examined in a standalone mechanical loading framework and in a hygro-mechanical framework to assess shrinkage and creep estimation in concrete. Extension to a thermal setting has also been undertaken to account for the degradation under fire (very high temperature). Modelling of 3D printed concrete and carbon capture in concrete were also studied. Health monitoring of structures to address issues arising out of effects of environmental effects on measurements have been addressed to get a corrected status of the structural condition. Crack propagation in composite laminates through phase field methods formed another study direction. Experimental research to understand the microcracking evolution and crack propagation in large sized concrete specimens under monotonic and fatigue loadings is undertaken with the help of acoustic emission and digital imaging.

The Interfacial Solid Mechanics Group works on diverse problems involving contact and interaction between solids at the continuum and sub-continuum scales and also develops computational tools to enable first-in-class simulations. Recent areas of investigation include the micromechanics of deformation in honeycomb indentation, effect of subsurface voids on indentation hardness, large-strain plastic deformation in two-level metallic hierarchical solids, FE solvers for physically accurate adhesive interactions in elastic solids, and problems in applied contact mechanics (catenary-pantograph interaction dynamics in high-speed rail), among others.
The Infrastructure Materials Research Group works on developing low-carbon multi-blended cements, durability of structural concrete, multi-scale modelling of cementitious composites, thermodynamic and service life modelling, reactivity and activation of supplementary cementitious materials (SCMs), Microstructure and transport in concrete, and developing and optimising sustainable performance-engineered concrete. We also work on utilisation of alternative building materials in structural concrete, such as biomass ashes and biochar, steel slag, and construction and demolition waste.

Urban Floods: Impact of climate change and an increase in the urban population have resulted in increased urban flood vulnerabilities. To quantify the impact of climate change, the intensity, duration, frequency relationships the spatiotemporal variation in extreme rainfall distribution within an urban catchment is evaluated based on a dense network of telemetric rain gauge stations. An integrated urban flood model is developed to provide rainfall and flood forecasts over an urban city like Bengaluru, Karnataka. A Weather Research and Forecasting (WRF) model is set up to provide short-term rainfall forecasts. The WRF model is further integrated with a hydrological model to provide flood forecasts at different locations. Further, the impact of urbanisation on hydro-meteorologic variables across seven cities is investigated. A digital twin is currently being developed to provide a tool for evolving real time, rapid responses.

The Remote Sensing Ecohydrology Laboratory investigates the use of satellite-based solar-induced chlorophyll fluorescence (SIF) to monitor crop productivity in India. SIF, a direct indicator of photosynthetic activity, serves as a physiological proxy for gross primary productivity (GPP). The investigation provides the first analysis of how SIF tracks GPP across India's cropping systems, revealing that the GPP-SIF relationship is modulated by temperature, radiation, and soil moisture at different stages of the growing season. The lab also explores the potential of SIF yield

Core **Research**

Some major research thrust areas are predictive science, theoretical and applied mechanics, large scale testing, development of novel construction materials, multi-scale modelling, seismic resistant design, water resources, environmental, dam and transportation systems 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.

(SIF normalised by absorbed photosynthetically active radiation) as an early warning indicator for agricultural drought. Compared to conventional hydrometeorological and greenness-based indicators, SIFyield shows the strongest correlation with GPP reductions and leads other signals by 1–2 months, making it valuable for early crop stress detection. The lab also employs spaceborne LiDAR to assess canopy structure and biodiversity across India's forest ecosystems, contributing to broader vegetation monitoring efforts.

Hydrological model calibration plays a crucial role in estimating optimal parameters for accurate simulation. Estimation of parameters is inevitable in hydrological modelling due to the challenge of directly measuring them, as most parameters are conceptual descriptions of physical processes. Modelers commonly employ optimisation algorithms for calibrating hydrological models. However, these algorithms often pose computational challenges, especially when dealing with complex physics-based and distributed models. To address these challenges, our study introduces a novel approach called hydroCNN+DDS. By leveraging the strengths of Convolutional Neural Networks (CNN) and the Dynamically Dimensioned Search (DDS) algorithm, hydroCNN+DDS simplifies the model calibration process in complex physics-based models. This approach enables to capture the general patterns and relationships between discharge time series and parameters without compromising the underlying physics. We use hydroCNN+DDS to estimate parameters in the highly parameterized hydrological model, Structure for Unifying Multiple Modelling Alternatives (SUMMA) using hourly observed discharge. Notably, hydroCNN quickly generates sub-optimal parameters, serving as a good initial solution for DDS. This initialisation aids DDS in converging faster towards an optimal solution. One of the notable advantages of the hydroCNN+DDS approach is its potential for spatial and temporal transferability. This feature proves valuable in dynamic systems and regions with limited historical data, expanding the applicability of the methodology. Furthermore, our proposed methodology is versatile and can be applied to any simple or complex models, accommodating any variables of interest. The best practices of good model calibration are followed in our approach.

Streamflow elasticity and reservoir influence in data-scarce river basins is of great interest to understand hydrometeorological controls. This work provides new insights into the role of climate variability, storage, and land-use changes on long-term water availability. Another important research theme includes reconstructing historical streamflow and baseflow using a hybrid approach that combines conceptual hydrological models with machine learning, particularly in Himalayan basins prone to floods and landslides. We are exploring the integration of crowdsourced observations and remote sensing in validating environmental forecasts, especially for urban flood monitoring. Additionally, the group is initiating new research on the cascading impacts of forest fires on hydrology, sediment transport, and downstream flood risk in mountainous terrains.
In order to better represent groundwater processes for understanding feedback between the human and natural systems in hydrology models, a 2D groundwater flow model (AMBAHS-2D) was developed. This was coupled with the popular variable infiltration capacity (VIC) surface water hydrology model. The coupled model was applied to different catchments in India and in southeast Asia.

Spatio-temporal patterns of urban groundwater systems under the combined impacts of social, infrastructural and hydrological dimensions are challenging. Using the case of Bengaluru city in India, it was demonstrated how fine-resolution data can inform model-based estimates of groundwater budgets.

The Kabini Critical Zone Observatory is managed in southern India. The observatory is a super site for carrying out Cal/Val studies for SAR microwave satellite platforms (Sentinel-1 and NISAR) and for the upcoming thermal satellite TRISHNA. Several studies are underway in the Berambadi agricultural catchment of the Kabini CZO for evaluating water-food-energy nexus issues, impact of land treatment interventions on hydrological budgets, and sustainable crop practices considering water & carbon fluxes.

Research on reduced order modelling of dynamical system in the context of reliability estimation and mechanics of nanocomposites. On the first topic we developed a novel computational scheme. On the second topic, through detailed molecular dynamics simulation we found crack propagation mechanism in a polymer nanocomposite (with carbon nanotube reinforcement). Understanding the effects of particle morphology on the intergranular and interfacial shear response of granular materials, with a special attention towards geomechanical processes like liquefaction, interface slip and flow through soils. A new framework for accurately characterising the size and shape of grains using 3D micro-computed tomography, spherical harmonic based geometric reconstruction coupled with a new watershed algorithm is developed. Fundamental mechanisms of soil liquefaction are critically examined in the light of particle morphology and individual contributions of grain size and shape on these processes are quantified. Use of natural coir fibres for effectively mitigating the liquefaction in sands is demonstrated for the first time. A new idea of geocell anchor cage is proposed and applied to significantly enhance the load bearing capacity of soils. Through 3D printing, textured geogrids are manufactured for the first time.

Extensive work on using Xray computed tomography for understanding the structure cohesive granular ensembles. In situ uniaxial compression tests were conducted as a part of this research and this extensive data set is being analysed. We have also initiated work on the indentation of a granular ensemble. The evolution of the deformation field is mapped with the progress of indentation. Examining the structure of a potter wasp nest using x ray computed microtomography. The labyrinth of cells and chambers in the potter wasp nest is currently being analysed. Orthogonal cutting experiments on granular materials to study shear banding and fracture in cohesive granular materials. A photoelasticity set up for understanding force propagation in cohesive granular ensembles is functional. Using the set up to understand the influence of cohesive diads on the ensemble. The map of force propagation in the ensemble is analysed.

Modelling the rocking and sliding of free-standing objects using rigid body dynamics. The features of an open-source finite element software MASTODON, used for seismic analysis and risk assessment of critical infrastructure. Analysing the response of embedded structures such as tunnels and embedded nuclear power plants under near-fault earthquake loading conditions.

Experimental studies on homogenous earthen dams to observe dam breaching and analyse the erodibility of dam under controlled hydraulic and geotechnical conditions. Experimental results on breaching by overtopping erosion process in an earthen embankment in a laboratory flume and simulation of same model using Plaxis2D are reported in this report along with the details of the experimental set-up and procedures.

Parametric Study of Sand Behaviour with Experimental and Numerical Modelling using FLAC 3D. This study provides valuable insights into the nonlinear behaviour of sand under triaxial compression and emphasises the importance of considering confining pressure and relative density effects. The findings contribute to a better understanding of the mechanical response of sand, aiding in the design and analysis of geotechnical structures where accurate predictions of soil behaviour are crucial.

Stability of slopes subjected to rainfall are being studied and mitigations methods like microbially induced calcium precipitation is explored to increase the strength and reduce permeability under unsaturated conditions.

Hammer energy during soil testing of SPT of Indian testing was estimated, and understand variation and studied effect of hammer energy on empirical correlation in Geotechnical engineering. Cavity formation of Urban areas was investigated, and understand the reason for the same, was given methods to investigate and also treat the same before the collapse of the cavity.

The main areas of research of IISc Sustainable Transportation Lab (IST Lab) have been; sustainable transportation planning and policy, integrated public transport planning and management, transport and Quality of Life (QoL), transport and climate change, disaster resilient transport, modelling and optimisation of transportation systems, travel behaviour analysis and modelling, pedestrian and crowd flow modelling, driver behaviour and road safety, Intelligent transportation system (ITS), traffic control and management, and so on.

Faculty & Staff

ABDUL RAWOOF PINJARI | PhD (Texas, Austin), Professor

ANANTH RAMASWAMY | PhD (Louisiana), Professor

ANBAZHAGAN P | PhD (IISc), Professor

ASHISH VERMA | PhD (IIT Bombay), Professor

CHANDRA KISHEN JM | PhD (Colorado), Professor

DEBASISH ROY | PhD (IISc), Professor

DEBSUNDER DUTTA | PhD (UIUC), Assistant Professor

DEBRAJ GHOSH | PhD (Johns Hopkins), Professor

JYANT KUMAR | PhD (IISc), Professor

KESHAV BHARADWAJ RAVI | PhD (Oregon State University), Assistant Professor

MADHAVI LATHA GALI | PhD (IIT Madras), Professor

NAGESH KUMAR D | PhD (IISc), Professor

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

NARAYAN K SUNDARAM | PhD (Purdue), Associate Professor

RAJARSHI DAS BHOWMIK | PhD (North Carolina State University), Assistant Professor

RAGHUVEER RAO P | PhD (IISc), Principal Research Scientist

SATYAVATI KOMARAGIRI | PhD (University of Texas at Austin), Assistant Professor

SEKHAR M | PhD (IISc), Professor

SITHARAM G THALLAK | PhD (Waterloo), Professor (On lien)

SIVAKUMAR BABU GL | PhD (IISc), Professor

SRINIVAS VV | PhD (IIT Madras), Professor

SWETHA VEERARAGHAVAN | PhD (Caltech), Assistant Professor

TARUN RAMBHA | PhD (Texas, Austin), Assistant Professor

TEJAS GORUR MURTHY | PhD (Purdue), Professor

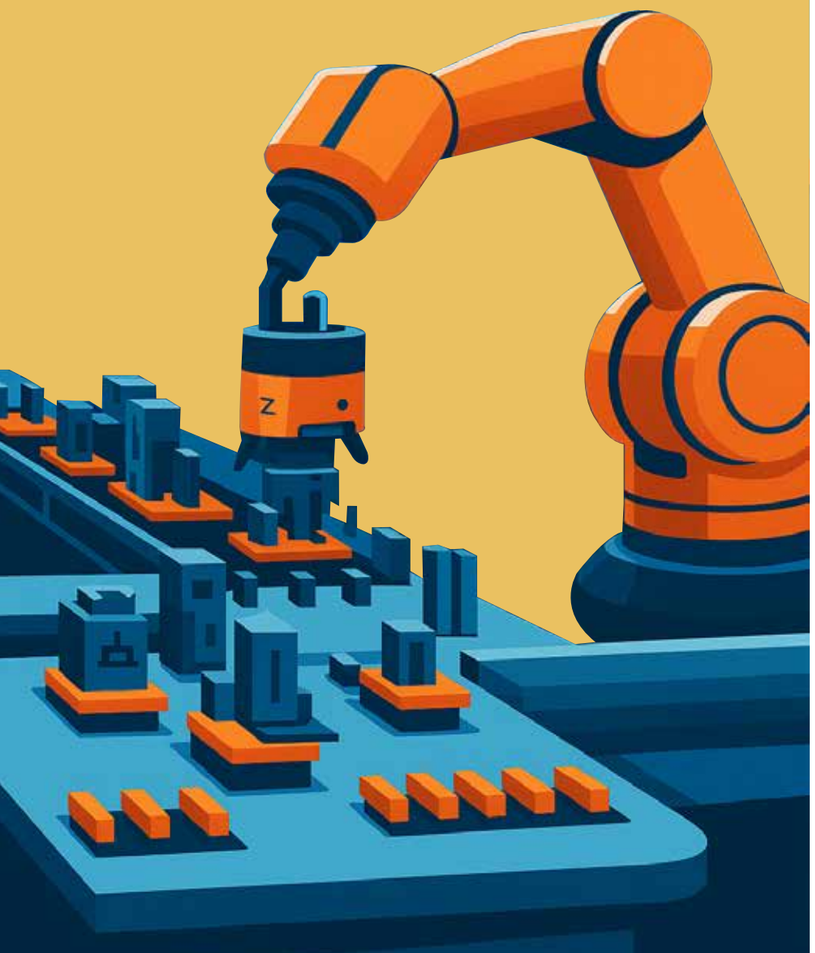
VENKATESHA S | MSc (Engg) (IISc), Senior Scientific Officer

VIDYA SAGAR R | PhD (IISc), Principal Research Scientist

3.5.6

Design and Manufacturing

Department of Design and Manufacturing (DM) is among the most research and technology intensive design and manufacturing schools in India, steeped in the ambience of Indian Institute of Science (IISc). DM is the design and manufacturing lead of IISc.



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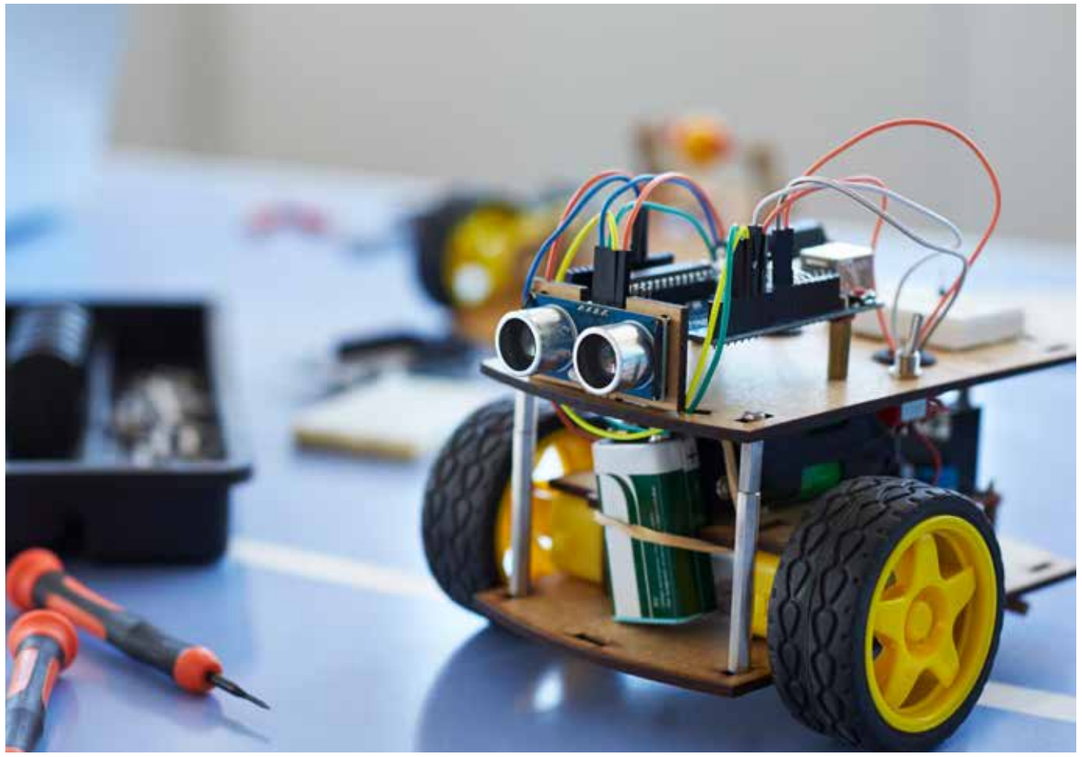
URL: https://dm.iisc.ac.in/dm/
Degree Programmes Offered: PhD, MTech (Res), MDes (Product Design, Development and Management), MTech (Smart Manufacturing)

IN NUMBERS

10 Academic Staff
1 Scientific Staff
65 PhD Students
2 MTech (Res)
42 MDes PD&E and 31 MTech SM
19 MDes PD&E Conferments
11 MTech SM Conferments
79 Publications
10 PhD conferments
1 MTech (Res) Conferment

Chair: AMARESH CHAKRABARTI

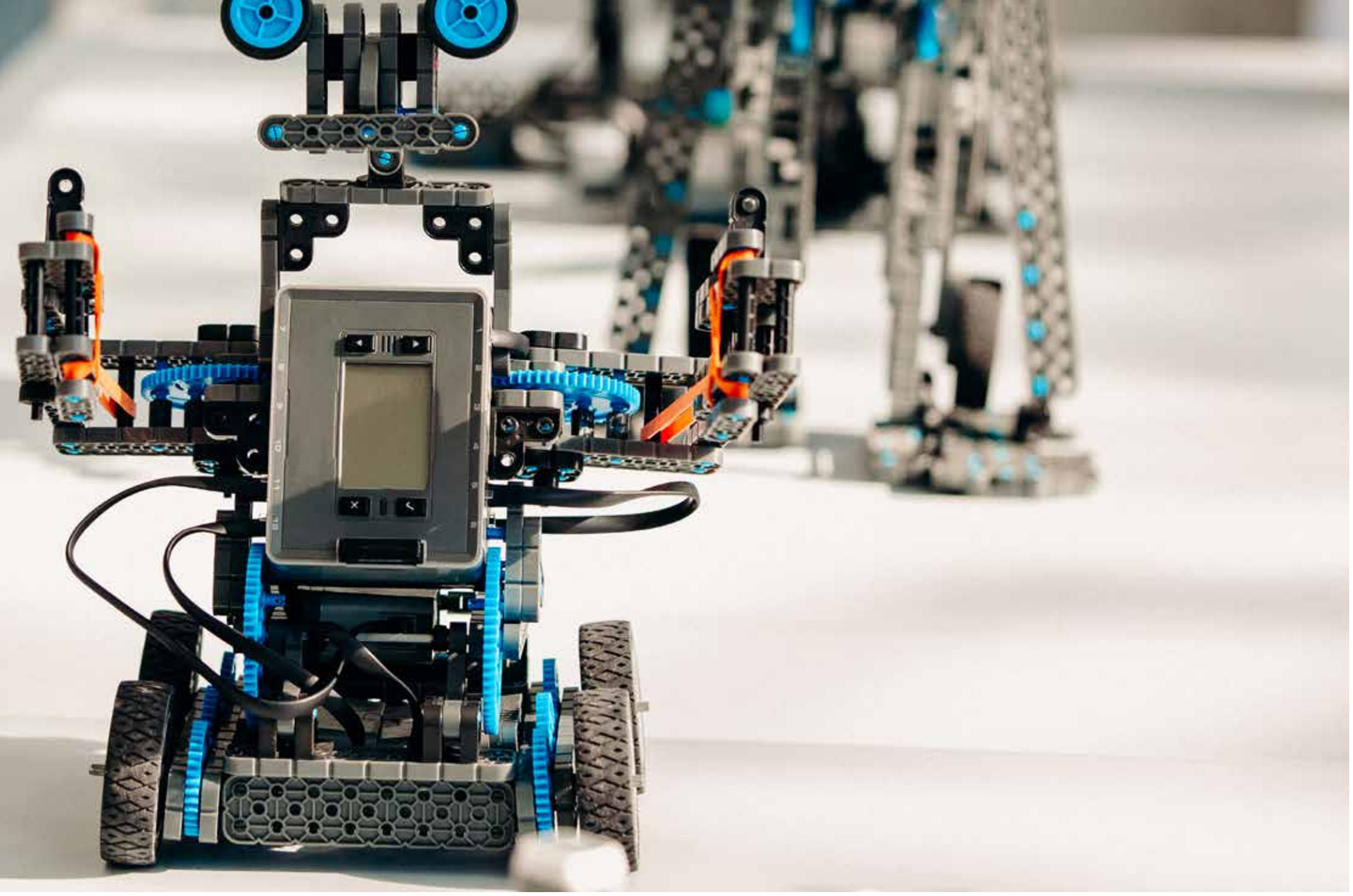


Current **Research**

Development process, informatics, AI:
A tool for supporting synthesis of multiple state mechanical devices developed. A gamified tool for training in design thinking tested with graduate engineers. A systematic process for reducing cross-subject variation in developing causal explanations of systems using SAPPhIRE model of causality developed. Algorithms for multilinear mechanical assembly, functional vision, and autonomous posturing of Digital Human Models developed. Work initiated in Built Environment (BE) and construction management, design and its management, and innovation management.

Human factors, aesthetics:
Work initiated for the development of Smart Prostheses under Abdul Kalam Technology Innovation National Fellowship. A project for measurement of Parkinson's tremor and assistive device design initiated. Further results obtained on truck dashboard and door modification; sweat evaporation simulation, muscle modelling, robust lane detection and object identification on road, eyeball detection and localisation. For ISRO Gaganyaan mission, a VR mock-up of crew cabin is developed to train astronaut-elects. Further results obtained development of a Digital Twin, on Privacy Respecting AR/VR, on Automotive UI and on Advanced HMI for 6th Gen Cockpit.

Mobility, robotics:
Work initiated for development of bioinspired visual sensors-based mobile robot locomotion. Nature inspired visual sensors in robotics hold vast and tremendous potential for revolutionising the field of autonomous navigation. The different types of visual sensory systems in living beings have been studied by our team. They are classified into various categories of eyes with the help of which the various inspirations are adopted in visual sensors. The eyes of arthropods (compound eyes) have a wide field of view and a three-dimensional



perception of the surroundings. These sensors, which draw inspiration from nature's elegant visual systems, such as the eyes of insects, and aerial, aquatic, and terrestrial species, may equip robots with superior imaging capabilities such as improved vision in cluttered environment and so on. State-of-the-art AI tools for automotive subsystem design and advanced finite element modelling procedures for assessing exhaust valve performance under dynamic pressure loads developed.

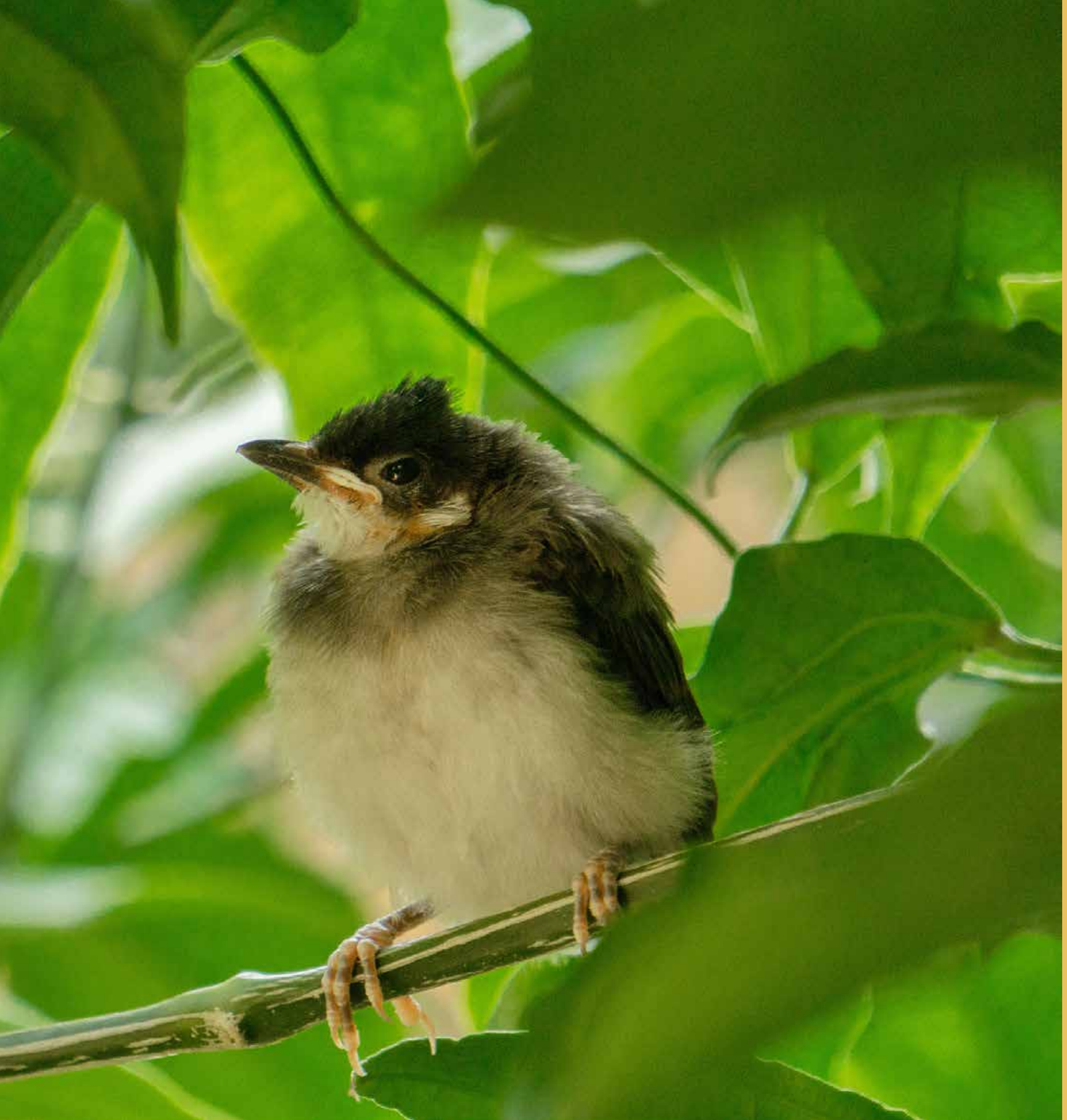
Smart, sustainable systems: Research into sustainable buildings using sensor-systems and drone technology for effective energy saving and situation awareness for efficient project management. Research into sustainability assessment in manufacturing developed and validated a novel framework to capture active impacts of products/manufacturing to identify effective interventions. Sustainable materials such as AL-foam and bio-composites developed and characterised, with significant promise for reduction of environmental footprint. Research initiated in developing lifecycle impact assessment framework for virtual systems.

MedTech, digital health: Work on Neonatal Hearing Screening System Development and Validation is ongoing work on the Development of an Indigenous imaging-based intraoperative probe for brain tumour delineation. Work progressed in developing a next generation tele-ultrasound system for foetal imaging. Development of functional prototype of an indigenous insulin pump progressed into a start-up. Technologies for clinical applications, including label-free diagnosis of cancer from breast and brain tissues, assessment of stenosed trachea, force sensing with haptic feedback for catheter ablation, rapid detection of SARS-CoV virus, and therapeutic neurological intervention, developed. Progress on knee joint contact biomechanics with TKR and Assistive device design towards Parkinson's Tremor compensation.

Materials and manufacturing: Natural based composites for packaging and clinical applications developed. Fracture, deformation, and wave propagation in lightweight materials like wood for sports applications tested. Ceramic based composites suitable for thermal power plants to reduce NOx emissions developed. Progress made in mechanical characterisation and simulation of jute-polyester/epoxy composites under impact loads, robust constitutive modelling of glass and carbon fibre composites, and a cost-effective approach for determining orthotropic lamina properties in a laminate, optimisation of cross-ply composite laminates using machine learning techniques proposed. For developing an in-process warpage mitigation technique in Additive Manufacturing, a Finite Element Model for accurate estimation of warpage developed. The model takes into consideration the geometry of the substrate or build plate in predicting the temperature evolution within the part, which plays a crucial role in realising an efficient in-process stress relieving technique.

Core **Research**

Development process, informatics, AI (creativity; informatics, AI, CAD, CAE, NPD, DFMA); **mobility, robotics** (robot manipulation/control, mechanisms, automotive systems/safety); **human factors, aesthetics** (ergonomics, HMI, DHM, XR/Haptics, UI/UX, Aesthetics); **smart, sustainable systems** (smart manufacturing, digital twin, sustainable materials/processes, construction 4.0); MedTech, digital health (medical device manufacturing/certification, medical ultrasound/implants, assistive devices); materials, manufacturing (materials design, AM, biomaterials, metrology).



Faculty & Staff

AMARESH CHAKRABARTI | PhD (Cambridge), Professor
ANINDYA DEB | PhD (SUNY), Professor
B GURUMOORTHY | PhD (Carnegie Mellon), Professor
DIBAKAR SEN | PhD (IISc), Professor
MANISH ARORA | PhD (Twente), Associate Professor
PRADIPTA BISWAS | PhD (Cambridge), Associate Professor
VISHAL SINGH | PhD (Sydney), Associate Professor
ABHIJIT BISWAS | PhD (IIT Madras), Assistant Professor
RINA MAITI | PhD (IIT Bombay), Assistant Professor
ABHRA ROY CHOWDHURY | PhD (NUS), Assistant Professor
ND SHIVAKUMAR | PhD (IISc), Principal Research Scientist

Associate Faculty

GK ANANTHASURESH | PhD (Michigan), Professor
SATISH VASU KAILAS | PhD (IISc), Professor
MONTO MANI | PhD (IIT Madras), Professor
SATYAM SUWAS | PhD (IIT BHU), Professor
HARDIK JEETENDRA PANDYA| PhD (IIT Delhi), Associate Professor

3·5·7
Centre for Sustainable Technologies

The Centre for Sustainable Technologies is the first truly interdisciplinary centre established at IISc in 1974 as ASTRA (Application of Science and Technology for Rural Areas). This centre pursues cross-cutting collaborative research in areas of renewable energy, sustainable buildings, water, and the environment. Current research addresses a host of global concerns while focusing on decentralised S&T based interventions: efficient use of primary energy and environmental resources, development of low energy buildings, integration of renewables (BIPV and End-of-Life PV) in buildings, climate-change adaptation and resilience, thermal comfort and wellness, wastewater and sanitation, grey water treatment and recycling, waste management including sanitary land filling, waste to energy, waste recycling and waste disposal, bio-mass for energy, plasma technology, plasma hydrocarbon reforming, clean coal technologies, biomass to liquid fuels and fuel cell applications, bio-methanation, turbomachinery research for energy and water pumping. The newest additions to the CST portfolio in the year 2022-25 are smart manufacturing using low-carbon materials, which can be applied for infrastructure construction, CO2 sequestration, and environmental remediation, and catalytic conversion of biomass into industrially useful fuels and chemicals.

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IN NUMBERS

7	Faculty Members (Core)
7	Faculty members (Associate)
1	Adjunct faculty member
0	Scientific Staff
30	PhD
10	MTech (Sustainable Technologies)
2	MTech (research)
32	Postdoc, research associate, & research assistant
57	Publications
11	Capacity Building Activities, Outreach Training
6	PhD Conferments

Chair: G MADHAVI LATHA

Current **Research**

Restorative climate-responsive architecture and wellness: Building and architectural sciences dealing with climate-responsiveness and thermal resilience of vernacular and conventional building typologies, sensitivity to diversity in local resources, biodiversity, and culture, and climate-change adaptation and mitigation. Examining novel restorative approaches in the built environment for societal and planetary wellness. Wellness studies dealing with indoor environment quality, role of moisture and thermal comfort, health and productivity, integrated with ecological restoration. Integration of renewables in buildings, with particular emphasis on the integrability of building-integrated photovoltaics (BIPV) and end-of-life PV as a building material in tropical conditions. Smart building and energy neutrality assessments.

Sustainability science: An interdisciplinary systems approach to sustainability, examining its theoretical basis and application in architecture (buildings) and design. Sustainability assessment and forecasting in design and technology, identification of effective design-based interventions. Design for the BoP addressing multi-stakeholder empowerment, livelihood security, and health. Examining geographically characterised

active impacts traceable to design and manufacturing.

Plasma technology, wastewater treatment, recycling and waste to energy:
Non-thermal plasma cleaning, enrichment and reforming of methane and tar compounds. Plasma-activated water characterisation and its application for wound healing, surface hygiene, and green fertiliser production. Plasma grey water treatment for recycling purposes. Decentralised wastewater treatment and recycling, modelling of plasma systems. Refuse-derived fuel characterisation for waste-to-energy applications. Green methanol and green hydrogen production.

Turbomachinery:
Fabrication of axial flow turbine-driven multistage pump and its detailed testing are conducted at the department. The constructed pumps work with an input head of 2-3 meters and pump water to 20-25 meters with an overall water-to-water efficiency of 50%. A hydraulic piston pump was experimentally tested at the department and implemented in Netanar village in Bastar on Kodari Bahar stream; it was commissioned in June 2022, supplying drinking water for 30 families, 40,000 liters per day. It is driven by a head of 3 meters and pumping to 34 meters continuously with electrical energy (flow input is 12-14 L/s). An MoU between IISc and the Chhattisgarh government was formed in December 2022 for the implementation of multiple non-electric hydro-powered pumps; pumps were installed in three villages.

Wastewater treatment:
Biological wastewater treatment with focus on aquaculture effluents, biocarrier development, biofilm reactors, greywater treatment, nitrification, nutrient recovery, organic micropollutants (emerging contaminants), saline effluents, and water recycling.

Bioenergy and biomass:
Green hydrogen towards fuel cell application is the major focus through the thermo-chemical conversion of biomass. Establishing the hydrogen purity to meet the ISO specification is achieved. As a part of biorefinery, the syngas generated paves the way for green chemicals and fuels like methanol, ethanol, DME, and syngas for green ammonia and fertiliser. Downstream utilisation of fuels for application in Solid Oxide fuel cell (SOFC), PEM fuel cells.

Sustainable separation technologies:
Recovery of valuable components from waste streams, extraction of a synthesised commodity from the reaction medium, or purification of an effluent stream before discharge into the environment are some examples where separation technologies are critical. Ongoing projects in this domain are solvent recovery from industrial waste streams using pervaporation, phytochemical extraction using reverse osmosis and nanofiltration, and arsenic uptake from groundwater using a rurally sustainable scheme using bioadsorbents.

Low-carbon construction materials and smart manufacturing: Low-carbon 3D printable materials for maximising carbon dioxide (CO_2) sequestration in buildings; CO_2 utilisation to develop novel construction materials; Earth-based building blocks using construction and demolition (C&D) fines and carbon dioxide; innovative design using 3D printing to remove the dependence on formwork and introduction of value-added features; treatment methods to improve engineering properties of building materials containing industrial by-products; bio-based building materials – introducing structural changes to tune the rheological properties and engineering performances for construction application. Sustainable catalytic pathways: Biomass conversion into fuels and chemicals; rare sugars production; plastic re/upcycling; new strategies for the catalytic conversion of biomass into functional chemicals such as amines and carbamates; conversion of waste plastics into monomers and fuels; fundamental understanding of sustainable waste management and utilisation, particularly in the critical areas of fuels and polymers.

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3.5.8

Divecha Centre for Climate Change

Department of Design and Manufacturing (DM) is among the most research and technology intensive design and manufacturing schools in India, steeped in the ambience of Indian Institute of Science (IISc). DM is the design and manufacturing lead of IISc.

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Current **Research**

Hydrological modelling in Parvati basin, Western Himalaya
This study utilised the Spatial Processes in Hydrology (SPHY) model to understand the contribution of various components in the runoff of the Parvati basin, western Himalaya. The Parvati river is a tributary of the Beas river, and it originates from Mantalai Lake. The basin consists of 279 glaciers with an area of 395.6 km2. The glaciers in the basin are located at an altitude range from 3850 to 6563m.

The Spatial Processes in Hydrology (SPHY) model is a fully distributed cryospheric-hydrological model. It gives daily runoff as output. The model is in a Python-based environment using PC Raster, and its source codes are freely available. The inputs for the model are land use/ landcover (LULC) map, soil map, digital elevation model (DEM), snow cover, glacier maps, soil parameters and meteorological parameters such as daily precipitation, daily minimum and maximum temperature, and daily average temperature. Each component of the water balance equation is calculated in each grid cell of the basin and routed to the outlet point by the model. The SPHY model uses a degree day approach for estimating the melt from snow and glaciers. It uses different melt factors for snow, clean ice and debris-covered ice to calculate the melt from various surfaces.

In SPHY, glaciers are considered melting surfaces which can partly or completely cover the grid cell. Snow and glacier melt is calculated using the degree-day approach, and the melt rates of snow, debris-covered, and debris-free glaciers vary (Terink et al., 2015). In our analysis, the model is set up to simulate daily discharge for the calibration and validation period 2003-2010, based on discharge measurements available from 2 measurement locations, one on the Parvati River and another on the Tosh Nala. The model parameters are calibrated based on the daily discharge simulated by the model. The final calibrated parameters are given in table

The resulting R2 and Nash-Sutcliffe Efficiency (NSE) values for Site 1 and Site 2 are 0.86, 0.77 and 0.84, 0.77, respectively. These values signify that the model shows good agreement between the observed and simulated values. After calibration and validation, the model catchment is extended till the outlet of the Parvati basin and then the model simulations are then run at daily scale to understand the different percentages of the contribution from each of the components.

The cryosphere contribution to the total runoff in the basin is estimated as 55%, with 35% from glaciers and 20% from snow, respectively. Rain and baseflow contribute 22% and 23%, respectively, to the total runoff at the outlet of the Parvati basin.

Core **Research**

Glaciers, aerosols and their impacts on climate, climate change and women's Empowerment; climate change and energy demand from residential cooling; unequal growth and precarity in rural India; economic modelling of climate policies, water quality studies in rural and peri-urban areas. Climate change biology – our studies have revealed the importance of soil bacteria which play a crucial role in biogeochemical cycles, soil health, human health, agricultural practices and food security.

Hanging glaciers inventory
Hanging glaciers are suspended on cliffs or mountain faces, usually above a valley or a lower glacier. These glaciers hang precariously on mountainsides, often resulting from snow accumulation and ice flow from higher altitudes. Identifying and mapping hanging glaciers are essential for understanding glacier dynamics, monitoring climate change, and assessing potential hazards such as icefall collapse or avalanche risks.
The hanging glacier inventory for Alaknanda and Bhagirathi Basin is being carried out the year 2025. Recent observations indicate significant glacier retreat, which has increased the number of hanging ice masses. 219 and 261 hanging glaciers are identified in Alaknanda and Bhagirathi basins,

respectively. The delineation and mapping of hanging glaciers were performed using high-resolution Sentinel-2 imagery (10 m spatial resolution) at a scale of 1:5000 or finer. The definition provided by Pralong and Funk (2006) is adopted for identifying, mapping, and classifying hanging glaciers. According to this definition, a hanging glacier is an “unbalanced avalanching glacier."

The hanging glaciers were analysed using multiple geometric parameters, including area, surface slope, basal slope, orientation, and mass content. Glacier volumes are delineated using the GlabTop 2.0 glacier thickness model. An inventory is developed as a vector dataset (shapefile), incorporating attributes that detail each identified hanging glacier's geometric and physical characteristics. The volume data were generated in raster format for the glaciers and their unstable hanging masses. For classification and volume estimation of hanging masses, profiles were delineated for each glacier using thickness data derived from the GlabTop 2.0 model and high-resolution ALOS PALSAR Digital Elevation Models (DEMs).

This work provided critical insights into the spatial distribution and volumetric characteristics of hanging glaciers, contributing to a better understanding of glacier dynamics in the Alaknanda and Bhagirathi Basin. The ongoing efforts in the Kali and Yamuna basins will further strengthen the regional inventory and improve assessments of glacier-related hazards in the Central Himalayas.

Glacier lake inventory

A multi-temporal glacial lake inventory is required to identify potentially dangerous glacial lakes and their spatial and expansion pattern. The Normalised Difference Water Index (NDWI) method is used for mapping. Satellite images of Landsat-8 (years) and Landsat 4-5 (years) are used for the analysis. NDWI images are derived using the combinations of SWIR and green bands for Landsat- 8 images. For Landsat-5 images, a combination of NIR and green bands are used. In addition, visual interpretation and manual correction were done due to the presence of shadowed areas, cloud cover, and the smaller lakes' size.

In the Alaknanda Basin, 120 glacial lakes are identified in 2021, covering a total area of 220 hectares. The number of lakes has increased from 62 in 1994 to 120 in 2021, with the total area expanding by 73.2 % during this period. In the Bhagirathi Basin, 75 glacial lakes are identified in 2021, covering a total area of 157.7 ha. The number of lakes has increased from 54 in 1994 to 75 in 2021, with the total area expanding by 70.3 % during this period. In the Yamuna Basin, 36 glacial lakes are identified in 2021, covering a total area of 46.1 hectares. The number of lakes has increased from 30 in 1994 to 36 in 2021, with the total area expanding by 27.4 % during this period. In the Kali Basin, 27 glacial lakes are identified in 2021, covering a total area of 131.5 hectares. The number of lakes has increased from 24 in 1994 to 27 in 2021, with the total area of the lakes expanding by 41.5 % during this period.

Snow cover analysis

Snow cover variation significantly impacts freshwater availability, energy budgets, and glacier mass balance, affecting the livelihoods of millions in snow-dependent regions. However, despite its importance, snow cover remains one of the least studied components of the Earth's system compared to other land surface components. The research seeks to explore snow cover dynamics in the Himalayan region.

As the initial phase, the variability of snow cover across the entire Hindu Kush Karakoram Himalayan (HKH) region from 2000 to 2023 is analysed. Findings indicate that areas such as the Hindukush, Karakoram, and Western Himalayas (WH) consistently sustain a larger snow cover area compared to the Central (CH) and Eastern Himalayas (EH), suggesting that snow cover within the HKH may exhibit varied behaviour due to distinct elevation and climate characteristics. Additionally, the annual snow cover cycle over the HKH is analysed to understand the monthly influences on snow cover extent. Results show that snow cover reaches its maximum during December and January, while the lowest coverage is observed in August and September. Seasonal variability analysis further reveals that winter experiences the greatest snow cover extent, while summer showed a substantial reduction in snow-covered areas.

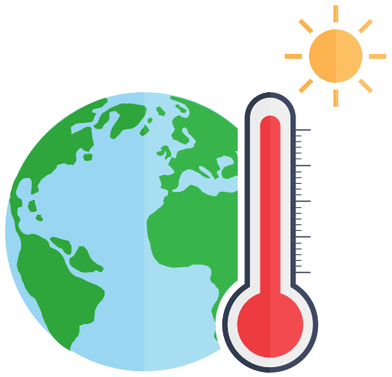
To capture seasonal dynamics, snow cover in the HKH region is analysed across four defined seasons: DJF (winter), MAM (summer), JJA (monsoon), and SON (post-monsoon). Results indicate snow cover peaks during winter (DJF) and reaches its minimum during the monsoon (JJA). The Karakoram and Western Himalayan regions exhibit higher and more persistent snow cover throughout the year due to their higher elevations and significant glacier presence. Snow cover in these areas is more resilient through the summer months, showing a slower melt rate than other subregions. In contrast, the Eastern and Central Himalaya exhibit the lowest snow cover, particularly during the monsoon (JJA) and post-monsoon (SON). Although these regions experience substantial snowfall in winter, their comparatively lower elevations and warmer temperatures contribute to accelerated seasonal melting and reduced snow persistence. This seasonal classification highlights significant intra-annual variations in snow cover, reflecting the influence of seasonal climate patterns on snow dynamics in the HKH region.

A detailed analysis is conducted on the Beas Basin to understand snow cover's spatial and temporal variability from 2000 to

2023, using MODIS daily snow cover data processed in Google Earth Engine. The temporal variability analysis indicates an overall increase in snow-covered areas over this period. However, breakpoint analysis reveals that, despite this increasing trend, snow cover has shown a slight decline or stability after 2010

In contrast, the lowest snow cover is observed in JJA (summer/monsoon) and SON (post-monsoon), primarily due to warmer temperatures and precipitation in the form of liquid.

The study further investigated snow cover variability with elevation for the period 2000 to 2023. Different elevation zones like a) lower than 2300 b) 2300-3300 c) 3300-4300 and d) 4300-5300 and e) greater than 5300 m are considered for the analysis. Snow cover is most extensive at higher elevations, especially between 4300-5300 m, while a notable reduction is observed at lower elevations. Higher elevations maintain near-maximum snow cover, whereas snow cover in lower elevations varies with snowfall. This reduction in snow cover at lower elevations is likely a result of regional warming, which accelerates melt rates and limits snow accumulation.



The same methodology applied in the Satluj, Ravi, Chenab, Jhelum and Upper Indus basins and analysed decadal variation in snow cover as two time frames, 2001-2010 and 2011-2020. An increase in snow cover area is estimated in the second decade as 2.37% ± 1.89, 6.47% ± 2.72, 9.17% ± 3.96, 0.97% ± 3.28 in Chenab, Jhelum, Ravi and Satluj basins respectively. But in Upper Indus, the snow cover area is decreasing by 2.78% ± 1.85 in the 2011-2020 time frame.

In situ ^{10}Be dating of moraine samples from the Western Himalaya

10Be is a cosmogenic nuclide that will be formed on the Earth's crest when cosmic rays interact with different minerals on the Earth's crust. Dating those isotopes in the samples shows how long they are exposed to the surface. Moraine samples are collected from the Baspa and Parvati basins, Western Himalayas for this study. Dating those samples gives an idea of the timing of different glacial advances in the region. The analysis was carried out on 20 samples from three glaciers in the basins. Initially, nine samples are considered from the Shaune Garang and Naradu glaciers of the Baspa basin and Sara Ugma glacier of the Parvati basin.

The experimental aspect is to extract pure quartz from the rock and then separate BeO from the extracted quartz to carry out the Accelerator Mass Spectrometric (AMS) measurements. The methodology mainly includes both physical and chemical treatment of the samples. During the physical treatment, the samples will be cleaned, ished, crushed, and sieved to a size of 0.25 – 1.00 mm. Later, the crushed samples will be taken for chemical treatment, which includes hydrochloric acid ishing,

where the organic contents can be removed. These will be later subjected to Sodium poly Tungstate treatment, where the various minerals can be separated based on their density variation. These can be further treated with hydrogen fluoride solutions to remove the meteoritic beryllium from the samples. At this stage, purified quartz can be obtained. Once the quartz is separated, the methodology is based on the extraction of BeO in the sediments. First, the quartz is digested using a hydrogen fluoride solution. Later, anions and cations are separated from the sample and BeO is finally extracted.

The BeO is subjected to oxidation and the charged particles are taken for the AMS measurements. The estimated results are in the form of ^{1}Be /9Be ratio. From the ratio, the number of ^{1}Be atoms in the quartz is calculated. Further calculations with these data give the exposure age for each sample. Moraines mark the boundary of the past glaciation of a terrain. Exposure ages from moraines also gave the timing of past glaciation. Obtaining age data is challenging because the Himalaya has a rugged terrain and difficult to access. We are able to obtain some age data from the Baspa and Parvati basin. The experimental aspect of the research is nearly complete. The current focus is on paleoclimatic reconstruction from processed data.

Assessment of groundwater quality in Eastern Karnataka

Physico-chemical characteristics of groundwater from 45 villages from 11 districts of eastern Karnataka have been analysed

for cation and anion abundances, as well as, for heavy metals including Uranium. 42% of the water samples belong to the Ca-Mg-Cl type; 30% to the Ca-Mg-HCO3, 16% to the Ca-Na-HCO3, 9% to NaCl, and 3% to NaHCO3 types. Water-rock interaction is the dominant process controlling the major ion chemistry. Out of 45 villages, excess of fluoride, nitrate and uranium are found in 23, 28 and 26 villages respectively. Phosphate is higher than 1mg/l threshold prescribed by the BIS in all the villages. Lithium exceeds the permissible limit in 27 out of 43 localities. Arsenic exceeds the permissible limit for drinking water only in one village. These contaminants are presently being removed by the RO process prior to water supply to the rural houses under drinking water supply schemes. Groundwater in 21 out of 45 villages is suitable for agriculture, while groundwater of 31 villages is useful for some industries.

Uranium contamination in the groundwater of Eastern Karnataka

DCCC reported the discovery of uranium contamination in the groundwater of eastern Karnataka in 2019. Groundwater samples from 46 villages in Eastern Karnataka exhibit U concentrations ranging from 1.9 to 2744µg/L, with 78% and 66% of sites exceeding the threshold of 60µg/L set by the Atomic Energy Regulatory Board (AERB), India for drinking water. These high U levels are primarily geogenic. The δ 238 U and U activity ratios (234U/238U) were determined and the evidence indicates generally oxidising groundwater environment, with localised U-reducing conditions. The (234U/ 238U) of groundwater varies from 1.2 to 5.4, indicating a dynamic interplay of α-recoil effects, preferential leaching of 234U, and the dissolution of high U zone (s) in granitic rocks. Statistical analysis of geochemical and field parameters reveals three distinct redox environments: oxidised, intermediate, and U(VI) reducing environments.

Adsorbent for uranium from groundwater

Uranium has emerged as a chemical pollutant in the groundwater in large areas in India. Although reverse osmosis has been able to reduce the uranium content, even with 90% efficiency, it cannot remove the uranium content to desirable level of less than 60µg/l, when the uranium concentration in the groundwater is more than 1000µg/l. Further the wastewater from the RO units is highly contaminated in uranium and finds its way back into the environment. A new adsorbent designated as AA@FXe capable of adsorbing uranium and some associated pollutants to greater than 99 per cent level has been developed and tested on lab-scale. Application for IP Tel is being filed for the product as well as the process.

Microplastics in groundwater in the hard-rock aquifers in Karnataka

Microplastics have emerged as contaminants in groundwater regime also. These anthropogenic contaminants although have been reported recently from soft rock aquifers of coastal areas, they are almost unknown from the hard rock aquifers in the hinterland. Preliminary studies have led to the discovery of polyethylene, polyamide, polypropylene, polyethylene terephthalate microplastics in the groundwater from the rural areas of eastern Karnataka. It is noteworthy that these are found in areas far away from peri-urban areas.

Assessment of water condensation from the atmosphere using hydropanels

Theoretical estimation of water yield from the condensation of humidity from the atmosphere using hydropanels in the different districts of Karnataka during the different seasons has been made. This method would be useful to understand water production under stand-alone conditions in remote areas for supply of safe drinking water.

Empowered Women Key to Climate Adaptation

Intra-household occupational/ livelihood diversification is one of the most common adaptation strategies to combat climate variability – mostly as a precautionary strategy. Among agrarian households, where droughts are frequent and severe, expected income dips are supplemented with non-farm income. This essentially involves men of the household diversify/ migrate out of agriculture leaving women in charge of farming activities. In our study, first, we examine how men and women farmers differ in terms of output when operating in context of climate variability. Second, we prove that these differences are closely linked to women's agency and gender relations.

AC ownership and Energy Usage in India

AC ownership in India has been increasing, especially in urban areas. This is a combined effect of rising temperatures and improved per capita income. In our study, we examine the relationship between AC ownership, household income and the heat index. Further, we attempt to understand the impact of this relationship on the energy demand and growth in the next two decades.

Capital Accumulation and Fractured Structural Transformation

In this study, we examine the impact of fissured/fractured rural transformation on the employment of the rural workforce. High-cost low return and overcrowded agriculture sector, capital and resource intensive-highly productive and low labour absorbing formal sector and low-valued/de-valued but highly sought after informal sector shaped employment in rural India. Interlinkages between these sectors has created-disproportionate distribution of resources; gulf between demand for and production of goods and services for the rural sector-for both production and consumption; capital and skill divide. This in turn created a mass of rural labour force stuck at the bottom rung of the production value and earning capabilities. Interactions of these economic factors with stresses from climate change are also considered.

Economic modelling of Emissions Trading Scheme (ETS)

This study uses a Computational General Equilibrium model to simulate the impact of the Indian Government's announced Emissions Trading Scheme on the electricity sector. The model focuses on the emissions intensity reduction and energy efficiency in the electricity sector, and the transition towards renewable energy due to impact of the ETS and renewables targets in the Nationally Determined Contribution policies.

The role of historic global inequality in avoided climate destabilisation

This study introduces a novel framework to evaluate responsibility for climate change. The global warming implication of a universal adoption of a particular country's lifestyle emissions trajectory, called the carbon footprint temperature (Tcf) is used analyse the implications of this framework.

Climate implications of elevated BC and impact on free space optical communication

With a view to understanding the climate implications and impact on free space optical communication of elevated aerosol layers in the atmosphere, customised payloads were designed and developed by DCCC scientists , jointly with the scientists and engineers of the National Balloon Facility of TIFR Hyderabad, for in-situ measurements of the vertical structure of BC through the atmosphere from ground to about 12 km altitude aboard high-altitude balloons. After successful completion of several tests, a series of 3 balloon launches were conducted between November 2023 and March 2024 from the TIFR BF, Hyderabad. Each experiment has utilised a 3023 m3 zero-pressure (ZP) polyethylene balloon designed and fabricated at TIFR BF, Hyderabad to carry the scientific payloads. The hydrogen inflated ZP balloons were supported by four launch balloons to provide the initial lift during the launch.

After successful completion of the ascending phase, the balloons were command terminated at the ceiling altitude on the same day, and the payloads were descended in a parachute. The payloads were successfully recovered after each flight and re-used. The measurements are being analysed by the scientists.

Aerodynamically shaped tethered balloon experiments

To understand the vertical distribution of BC aerosol within the lower atmosphere, tethered balloon experiments were conducted at TIFR Balloon facility, Hyderabad on 22.08.2023, from 5.50 AM to 6.15 PM. A 9.9 m3 tethered Polyethylene kytoon, inflated with hydrogen, has been used as the aerial platform, while a 3-phase motorised winch has been used along with nylon strips to control the

altitude of the balloon. A GPS enabled iMet–4 radiosonde was used for obtaining altitude and meteorological parameters throughout the flight. Five flights were conducted, three during the forenoon and two during the afternoon hours covering both sunrise and sunset hours. An Aethalometer (AE-33) operated in the surface throughout the flight time to know the surface variations of the BC aerosols. The microAethalometer (AE51) was turned on 30 minutes prior to every flight for stable observations. It was turned off after second and third flights. The general trend of the flight observations was matching with the surface observations. The AE51 data are being analysed with simultaneous observations of meteorological data, made during the same day.

Continuous measurements of short-term climate forcing elements

DCCC had established a climate research centre at the second campus of IISc, in Challakere, in Chitradurga district. Continuous measurements of short-term climate forcing elements were carried out from this location for a long time. These data have been analysed to understand the long-term changes due to human interventions and also to quantify the role of synoptic meteorology in modulating the aerosol loading over this remote region, through long-range transport from the arid regions west Asia, western India and eastern Africa leading to enhancement in aerosol loading in the upper regions of the atmosphere, while the lower regions and near-the surface remain rather pristine. As expected for such a remote location, near-surface aerosol concentrations were generally low, with their temporal variability largely controlled by background meteorological conditions. However, the column-integrated aerosol optical depth (AOD) was unexpectedly high—comparable to values typically observed over semi-urban continental regions—indicating significant aerosol loading aloft despite the low surface concentrations.

Atmospheric implications of natural disasters

As a part of studies on climate implications of natural disasters, a case study has been carried out on the genesis and upper atmospheric impacts of extensive and massive wildfires that occurred over Australian region and its impacts on the regional radiative balance and atmospheric chemistry. An analysis based on Aura's Microwave Limb Sounder data revealed that enhanced hydrolysis of dinitrogen pentoxide (N O) significantly increased nitric acid (HNO) concentrations in the high-latitude lower stratosphere during early 2020. Using a novel methodology to retrieve polar stratospheric cloud (PSC) formation pathways from spaceborne lidar observations, it was found that the elevated HNO condensed on bushfire-emitted aerosols, leading to the formation of 82% liquid nitric acid trihydrate (LNAT), which subsequently converted into 77% ice – resulting in an anomalously high areal coverage of ice PSCs.

Inter-intuitional research collaborations

As a part of building inter-intuitional research collaborations, an atmospheric aerosol monitoring laboratory has been set up jointly by scientists of DCCC and the Indian Institute of Science education and research (IISER) at Thiruvananthapuram, in the valley region of the western ghats. Preliminary observations indicate that despite the remoteness of the location and minimal local anthropogenic activity, total black carbon (BC) concentrations were found to be strongly influenced by long-range transport of particles from fossil fuel combustion, from the urban areas upwind, contributing approximately 75% of the observed BC. Unlike the typical tropical pattern where boundary layer dynamics largely govern the diurnal variability of BC, our measurements indicate a weak coupling between boundary layer processes and BC concentrations. This is primarily due to advected plumes from a distant urban source dominating the local BC levels.

Glacier stored water

Glacier stored water is estimated in Beas basin. Laminar flow method is applied to the glaciers with area greater than 1 km² and V-A scaling is used for the remaining small glaciers. Glacier surface velocity is calculated using the Landsat 8 images of the years 2022 and 2023 for glaciers with an area greater than 1 km² using COSI-Corr combined with ENVI. Cloud-free satellite images captured between July and October with minimal snow cover

are selected for the analysis. The mean surface velocity across all 93 glaciers is recorded as 9.87 m/year, with the highest mean velocity of 16.77 m/year observed in a glacier with an area of 31.03 km² and the lowest mean velocity of 3.99 m/year in a glacier with an area of 1.50 km². The basin exhibits an average glacier depth of 47.29 m. Using these depth estimates, the glacier ice volume is calculated. The total ice volume of the 93 glaciers, estimated using the laminar flow method, is determined to be 18.94 km³. Based on this, a volume–area scaling equation is developed, yielding a proportionality constant (CA) of 0.0306 and a scaling exponent (γ) of 1.2587. This scaling equation calculates the ice volume of the remaining 478 glaciers in the basin as 2.83 km³. Consequently, the total glacier-stored water in the Beas Basin is estimated to be 21.8 km³, equivalent to 19.6 Gt of ice mass.

Glacier mass balance studies

Glacier monitoring using remote sensing techniques overcomes the limitations of field-based observations due to the difficult weather and terrain conditions. Glacier mass balance estimations are necessary to understand the status of glacier stored water. Improved Accumulation Area Ratio (IAAR) method is one of the method which utilises both satellite and meteorological station data to continuous monitoring of glacier mass balance at basin scale. But an underestimation of mass changes occurring due to the use of basin average precipitation gradient. Therefore, the method has been modified by calculating individual precipitation gradient for each glacier and estimating the mass balance. We applied this method to the Baspa glaciers and estimated glacier mass balance as -0.60 ± 0.04 m.w.e.a-1 (Fig. 13). These estimates are closer to the field observations. RMSE of IAAR with single PG is 0.8 m.w.e.a-1 and that of IAAR with multiple PG is 0.2 m.w.e.a-1Cumulative mass loss using IAAR is 1.01 Gt. and the same using modified IAAR is 2.7 Gt.

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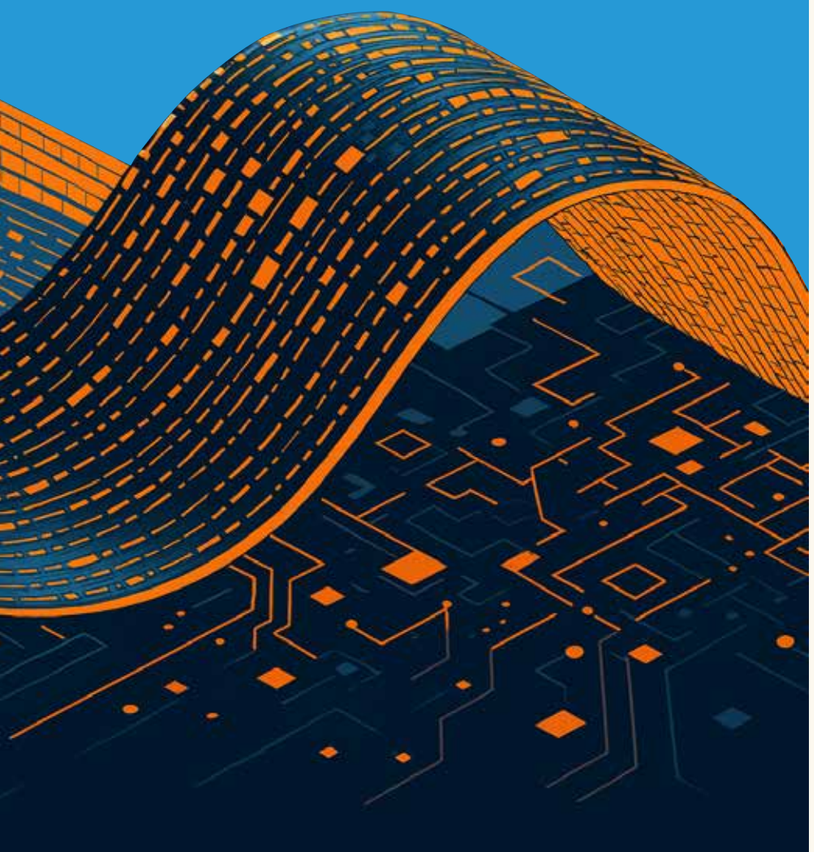
DEEPAK SUBRAMANI | PhD (Cambridge), Assistant Professor

3·5·9 *Materials Engineering*

Established in 1945 as the 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, Master's and doctoral degrees, it is recognised as a leading academic centre in materials education and research.



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IN NUMBERS

23	Academic Staff
3	Scientific Staff
157	PhD Students
59	MTech Students
235	Publications
24	PhD Conferment

Chair: RAJEEV RANJAN

Current **Research**

Rajeev Ranjan
Understanding the presence of metastable states and field-driven structural transformations is necessary for developing insights regarding the weak and high field properties of piezoelectric alloy systems. (1-x)$Na_{0.5}Bi_{0.5}TiO_3$-(x)$BaTiO_3$ is one of the important Pb-free piezoelectric alloy systems which has been extensively investigated over the years. Structure-property correlation insights into piezoelectric systems require understanding of the temperature-composition as well as composition-electric field phase diagrams.

This group performed x-ray diffraction study in situ with electric (E) fields at close composition intervals in a wide range 0.0 x 0.18 and discovered the occurrence of field-driven reversible interferroelectric transformations in a vast composition space 0.02<x<0.14, away from the morphotropic phase boundary. They present the first comprehensive x-E phase diagram of (1-x)Na0.5Bi0.5TiO3-(x)BaTiO3 system. This phase diagram can precisely explain the composition trend of both the weak-field (dielectric and piezoelectric) and high-field (electrostrain) properties of this system.

Subho Dasgupta
A major initiative has been launched in the area of printed and flexible electronics in 2016. In a major breakthrough, the group has fabricated a fully printable organic-inorganic composite semiconductor material. The ultra-flexible TFTs fabricated with such materials show linear mobility in excess of 45 cm^2/Vs, at the same time no performance degradation for a bending fatigue test with bending radius of 1.5 mm. The work has been granted Indian patent recently. The group has also developed a printable silver ink that essentially have infinite shelf life and is curable at as low temperature as 80°C. The laboratory has developed methods to fabricate high performance printed thin film transistors (TFTs) and circuits that can be realised on inexpensive and flexible polyethylene terephthalate (PET) and paper substrates and can operate at >100 kHz operation frequencies. This has been achieved with non-standard device architecture and near vertical electronic transport. The group has also demonstrated the first fully-printed transition metal dichalcogenide (TMD) TFTs and circuits with high current density, On-Off ratio and operation frequency. Furthermore, the group has also developed fully-printed sensor tag with printed read-out electronics. A patent for the same has been filed. Lastly, the group has demonstrated fully-printed subthermionic transport, negative capacitance field-effect transistors (nc-FETs) with both all-organic and organic-inorganic hybrid dielectric/ferroelectric stack. In addition, fully printed smart sensor tag with printed sensors, amplifiers and (along-to-digital converters) ADCs has been demonstrated. Along the same line, a fully-printed, self-powered, anti-counterfeit tag with printed supercapacitor, sensor, resistor, ADC, current drive circuit and colour change material as the visual indicator has been fabricated.

Praveen C Ramamurthy
There is an ongoing research programme in the field of organic electronics, which focuses on interdisciplinary research on broad horizons of organic/polymer-based devices, ranging from the synthesis of high-performance materials, i.e., conducting polymers,

Core **Research**

Metals and alloys; structural alloys; superalloys; iron making; high temperature deformation; materials processing and advanced characterisation; ceramics; high temperature coatings; electronic and structural ceramics; electronic packaging materials; energy materials; printed and flexible electronics; ferroelectric, magnetic, and multiferroic materials and devices; sensors; computational modelling; polymers and nanocomposites; biomaterials and more.

nanocomposites, and nano-structured materials and studying their fundamental properties for application in Organic Photovoltaics (OPVs), Organic Field Effect Transistors (OFETs), sensors, and actuators. One crucial installation facility is the arrangement of the four glove boxes integrated with several processing and characterisation housed inside a mini cleanroom. Additionally, there are a few specialised optical and material characterisation equipment like photoluminescence (PL), Ultraviolet-visible (UV-vis) spectroscopy, Fourier Transform Infrared spectroscopy (FTIR), and profilometer for thickness measurement. Moreover, the laboratory has a state-of-the-art facility for material synthesis and sophisticated purification techniques. Recent research frontiers involve (a) developing high-efficiency perovskite solar cells through device engineering and interface defect passivation, (b) comprehensive study degradation mechanisms in perovskite solar cells, (c) development of nano-fabricated OFETs with novel architectures, (d) transparent electrodes and bifacial solar cells (e) charge transport in solar cells and OFETS, (f) Solid State Sensors, (g) material synthesis for application in photovoltaics, FETs and sensors, (h) density functional theory simulations (DFTs) for structure-properties correlation (i) device encapsulations and packaging-synthesis and development of cellulose-based encapsulants, and (j) in-house developed water vapor transmission rate (WVTR) measurement system with trace H_2O sensing with cavity ring-down spectroscopy (CRDS). In summary, the laboratory research aims to address critical issues in organic and perovskite-based devices by systematically studying transport and degradation dynamics, incorporating material synthesis, device fabrication, characterisations (electrical/ optical/ material) and sophisticated spectroscopic techniques.

Bhagwati Prasad

Exploring thin film heterostructures of metals, oxides, and 2D materials. The group's research focuses on applications in memory, sensing, and energy storage, leveraging the principles of spintronics, ferroelectrics, piezoelectrics, and magnetoelectrics. Prasad leads a team of 18, which includes postdocs, research associates, PhD students, master's and undergraduate students, and interns. Over the past year, they have achieved significant milestones, including demonstrating ultrahigh-density energy storage devices, developing ultrasensitive magnetic sensors, discovering current-dependent switching in spin-filter tunnel devices, and developing energy-efficient voltage-controlled spintronics devices. They are also investigating novel materials for spin-orbit torque switching. The group has been successful in securing funding from various organisations, including SERB-Exponential Technology, SERB-CRG, ISRO-STC, CEFIPRA, SERB-ITS, Axis Bank Foundation, and STARS-MOE, enabling them to establish cutting-edge experimental facilities. These include Pulsed Laser Deposition, DC and RF sputtering units, Magneto-optical Kerr Effect (MOKE), and a cryogenic-based Magnetic and Transport Measurement System. As a recognised expert in his field, Prasad has contributed extensively to editorial services, serving as the Principal Editor of *MRS Advances* and a member of the Editorial Board of *Nature Scientific Reports*. Additionally, he has played a key role in organising symposiums at conferences like the Materials Research Society Fall Meeting, and as a member of the conference organising committees at NVMW24 in San Diego, USA, and IEEE EDTM in Bangalore, India. In recognition of his group's research work, Prasad has been awarded the Infosys Young Investigator Award.

He also served as the faculty convenor of the Open Day 2024 at IISc, Bangalore. He has given invited talks at 14 national and international conferences and delivered presentations at seven organisations in the FY 2023-2024. This fruitful period has also seen the granting of 5 US patents to him and the publication of research articles in prestigious journals such as *Advanced Functional Materials* and *Nature Communications*.

Sachin R Rondiya

This group conducts interdisciplinary work that involves physics, chemistry, and engineering approaches to improve device performance. This diverse expertise allows his team to address a wide range of issues in nanotechnology and advanced functional materials for the development of energy conservation materials and devices. His group primarily focuses on developing higher-efficiency solar devices using both solution-based and vacuum-based methods.
In the field of perovskite research, many groups have identified stability issues with 3D perovskite materials in recent years. However, some recent papers have shown that this stability issue can be addressed with a new family of materials with a two-dimensional (2D) structure, commonly known as 2D perovskite materials. As a result of these discoveries, the landscape of the perovskite community has changed. These two-dimensional (2D) perovskite materials, such as Ruddlesden-Popper (RP) perovskites or Dion-Jacobson (DJ) perovskites, are challenging to synthesise. Despite this, Rondiya's team, which includes more than 10 students, has developed chemical and solution-based synthesis methods to produce these complex materials in pure form over the past two years. They have already published two papers *(ACS Omega* 2024, and *ACS Langmuir* 2024) that explain interface-driven and loss mechanism-centric phenomena in 3D/2D halide perovskites, as well as their structural, optical, and band alignment properties. His group has achieved close to 15% efficiency with 3D perovskites and is now working on 3D/2D perovskite devices, aiming to reach nearly 23% efficiency. The group focuses on various advanced spectroscopic techniques, including femtosecond transient spectroscopy, THz spectroscopy, and temperature-dependent photoluminescence spectroscopy, to control defects in devices. This approach is helping them uncover hidden scientific insights in these emerging materials and devices for energy applications.

Kaushik Chatterjee

This group has been working on engineering bioinspired nanostructures that can kill bacterial cells by physical contact. In contrast to conventional strategies of using (bio)chemicals, these mechanobactericidal surfaces have important applications in developing strategies to tackle antimicrobial resistance (AMR). A primary research focus in this field has been replicating and emulating bioinspired nanostructures on various substrates. Yet, there has been little prior work on engineering high aspect ratios nanostructures on polymer substrates, despite their widespread use in our daily lives. The research team generated high aspect ratio nanostructures on polyethylene terephthalate (PET) surfaces by maskless dry etching to study and elucidate their antibacterial and antibiofouling properties. They found that both high and low-aspect ratio structures effectively neutralised gram-negative bacterial contamination by imparting damage to their membranes but were unable to inactivate gram-positive cells. Interestingly, the clustering of the soft, flexible tall nanopillars resulted in cooperative stiffening, as revealed by the nanomechanical behaviour of the nanostructures and validated with the help of finite element simulations. The nanostructured surfaces were robust enough to withstand forces encountered in daily life. These strategies have immense potential in a wide variety of applications, from healthcare to packaging, to minimise bacterial colonisation of polymers.

Ashok Raichur

The overall theme of this group is to study novel nano-sized and nanostructured materials for drug delivery and tissue engineering applications. During the past year, the group reported developments in the following areas. The utility of snail mucus as a biomaterial along with agarose as scaffolds was studied and reported. An enhancement in mechanical properties and improved biocompatiblity was reported. Snail mucus also improved adhesion of human chondrocytes to agarose. In another study, methacrylated mucin was developed as a bioink for preparing scaffolds and biocompatility studies are underway. Cus-Au nanohybrids were synthesised and their application in phototheranostic application was explored. A novel nanosome with a dual targeting functionality to treat cancer was developed and is being patented.

Suryasarathi Bose
The group explores the structure-property relationship in polymer blends and nanocomposites with a special emphasis on self-assembled multiphase systems, engineered materials for sustainable water remediation, and smart and advanced materials for EMI shielding applications. In addition, the group's focus is to develop strategies for effective plastic upcycling and recycling using vitrimer chemistry. Unique hydrogels for removal of microplastic from water is also being developed in the group.

To achieve this, a sustainable triple interpenetrating polymer network (IPN) hydrogel, incorporated with polyoxometalate (POM) nanoclusters was designed to specifically target two model MPs, polyvinyl chloride (PVC) and polypropylene (PP).

Unique designer vitrimer were developed to up-cycle polyolefins (PP, PE etc.) in-situ during mechanical recycling and were further 3D printed into value added products like outdoor furniture. Using similar concepts, thermoplastic epoxies were developed using novel bio-based curing agents. Various covalent adaptable networks were installed to recycle, re-purpose epoxies. The epoxy vitrimers showed enhanced mechanical properties and can replace the traditional epoxies-that can't be recycled.

The group also focuses on designing functional nanocomposites for EMI shielding application. Unique microstructures with 'shish kebab' type morphology – with ZnO as 'kebab' and Carbon urchin (CU) as 'shish' – were designed using microwaves. The composites showed excellent shielding effectiveness of −40.6 dB SE.

Aloke Paul
This group has designed new experimental methods for studying the complex diffusion processes in multicomponent metallic alloy systems. They have mainly focused on solving the biggest challenge in solid-state diffusion, which remained unsolved during the last decades. It was textbook knowledge that meaningful diffusion coefficients could not be estimated in a multi-component system following the diffusion couple method. They can now estimate diffusion coefficients in any multicomponent systems by proposing completely new design thoughts of the diffusion couples and rewriting the equations relevant to such diffusion profiles. These methods are utilised to explain diffusion-controlled growth and microstructural evolution in Pt or Pd-modified NiAl bond coats and Ni-based single-crystal superalloys, which was not possible until recently because of the unavailability of suitable methods. They are also generating a mobility database in Ni- and Fe-based multicomponent systems to correlate with materials' various high-temperature physical and mechanical properties.

Satyam Suwas
This group significant progress was made in developing the understanding of creep, fatigue, and fracture behaviour of additively manufactured stainless steels and nickel base superalloys. A model has been proposed that explained the enhanced fracture toughness of additively manufactured alloys. Elucidating the synergistic effects of hierarchical alloying and severe plastic deformation on the microstructure, and mechanical property evolution was another activity carried out by the group. The effect of irradiation induced microstructural changes on mechanical property was also investigated. A very significant enhancement in strength was noticed in the irradiated materials.

Vikram Jayaram and Praveen Kumar
This group examined the intricate interplay between sample size and strain gradients on the creep response of metallic materials. By

choosing an innovative sample design based on a cantilever and mapping strain field using digital image correlation, their group has been able to systematically vary strain gradient throughout a small cantilever while keeping the sample size effect constant. This study led to the development of closed-form analytical equations, which allow estimation of creep properties of large-sized, standard samples by testing a miniaturised sample, which is non-trivial and a first in the field of small-sample testing. This work has direct implications in the field of structural health monitoring (SHM) and residual life assessment (RSA) of in-service components.

Surendra Kumar Makineni

The research focuses on gas turbine engines (GTE) power passenger/military aircraft, ships, and power plants whose efficiency and reliability greatly depend on the high-temperature materials used for their components. They experience severe stress (up to 800MPa) and temperature gradients (600 to 1300°C) under a pressurised corrosive gaseous mixture environment during their operation. A major portion of the engine components are made up of Ni-base superalloys that exhibit an excellent combination of creep and corrosion resistance. Solutes segregation effects to the defect structures produced during the creep of superalloys are believed to influence their high-temperature performance. This study reveals the selective segregation of solutes to the defects in a multi-component single crystal γ/γ' Ni-base superalloy (CMSX4). The defect structures formed in γ' are superlattice-extrinsic-stacking faults (SESFs), micro-twins, and anti-phase boundaries (APBs). The former were formed during creep at 800°C (applied stress 800 MPa), while APBs were formed at 1000°C (applied stress 200 MPa). Atomic-scale compositional and structural analysis of these defects reveals a clear dependence of segregation behaviour on their local internal fault structure. More specifically, during micro-twinning, they proposed that the type of observed solutes diffusing toward the fault depends on minimising the fault energy at each step of its structural evolution. The results indicate variation in Al composition along the twin boundaries and higher composition of W/Ta confined at the Al-depleted portion of the boundaries. Based on the segregation behaviour, they introduced an additional step of reordering in Kolbe's mechanism of micro-twinning that can be one of the rate-limiting steps for creep deformation. At 1000°C, they showed enrichment of Mo/W along with the Re at the core of dislocations pinned at γ/γ' interfaces. They also observed these solutes at the APB's fault plane, indicating the occurrence of solute drag during the shearing of γ'. This emphasises and reveals the importance of the solutes Mo/W in contributing towards the "Re effect" during high-temperature creep. Interestingly, Hf was also enriched to the APB fault plane, which might be due to its relatively large negative solution enthalpy in the local disordered structure of APB. These new observations suggest, other than Re, the possible creep rate limiting solutes whose content can be optimised for future alloys with higher temperature capabilities for more energy-efficient and cost-effective turbine engines with lower CO_2 emissions.

Subodh Kumar

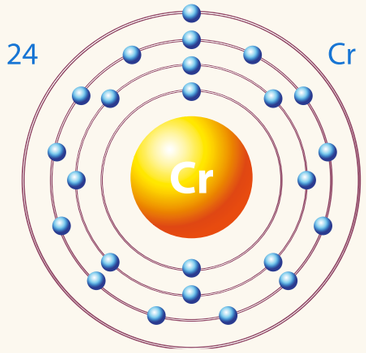
This group focuses on processing, characterisation, mechanical behaviour and corrosion protection of light materials and composites. Within the last one year, they have achieved – significant improvement in flexural strength and interlaminar shear strength (ILSS) of carbon fibre reinforced epoxy (CFRE) laminates by introducing small amounts of nanoparticles such as graphene oxide (GO), carbon nanotube (CNT) and ZnO nano-rods, and making them self-healable by coating carbon fibres with bis-maleimide (BMI) and polyetherimide (PEI); significant improvement in corrosion resistance of AZ31 Mg alloy by imparting layered double hydroxide (LDH) coating on it and further improving this corrosion resistance by adding inhibitor to LDH coating; improvement in tensile properties of AM30 Mg alloy by asymmetric rolling, in which the two rolls rotate at different speeds, and reverse rolling, i.e., changing the direction of rolling by 180°; corrosion resistance of AZ31 Mg alloy improved by five orders of magnitude by applying plasma electrolytic oxidation (PEO) coating followed by layered double hydroxide (LDH) coating on it; interlaminar shear strength (ILSS) and flexural strength (FS) of carbon fiber reinforced epoxy (CFRE) laminate increased by 37% and 38% respectively, and 57% self-healing imparted to it as well as functional properties like deicing and electromagnetic interference (EMI) shielding improved by sizing carbon fiber reinforcement with a polyetherimide and dispersing functionalised graphene oxide nano-particles in epoxy matrix.

GS Avadhani

He has guided one MTech student and guiding one PhD student during the last academic year, along with Satyam Suwas. Also, he has offered a course (UMT310L) during the Jan-Apr session. He has reviewed many international journal papers and also published a paper on "Mechanical response of as-cast equiatomic high entropy alloy CuFeCoNiMn", along with Nitish Bibhanshu, Natasha Prasad, Niraj Nayan, GS Avadhani, RK Ray, Satyam Suwas; in *Intermetallics*, (2022). He has a total of about 50 publications to his credit. Also, he was an organising committee member on different portfolios as well as a treasurer for two international conferences, organised by the department during 2022-23.

Govind S Gupta

This group focuses on fundamental and applied research in process metallurgy. The notable achievements of the group in the past year are: establishing a company (Rescons Solutions Private Limited) under the faculty entrepreneurship programme of IISc; working



with the Australian government (through CSIRO) on a multi-crore green steel project; working on rare earth extraction of elements (a Government of India initiative on strategic metals) with an industry (Adani Enterprises); replacing sand by blast furnace slag in the coating for water carrying pipe (by Tata Metaliks Limited); applying discrete liquid flow theory (developed by our group) to heap leaching process; developing a multiphase model for iron ore reduction by hydrogen in a shaft furnace (towards producing green steel); proposed a method to determine the void shape and size in a packed bed; received an Indian patent on SiC production process; group's PhD student received the highest paid job in IISc.

Abhik Narayan Choudhury

This group has been primarily involved in three major activities related to strategic projects funded by DRDO. The foremost among them has been the exploration of additive manufacturing as a route for the production of single-crystal parts for use in the high-pressure compressor stage of the gas turbine engine. In this direction, a novel multi-physics model was formulated that can be used to simulate the thermal histories during the Laser-based Direct Energy Deposition process. The model is based on the diffuse interface framework that allows the imposition of the boundary conditions with respect to the heat and mass transfer in the melt pool in an elegant manner. The thermal histories derived from the simulations are integrated with a Potts-based microstructure evolution model for a quick estimate of the grain structure that emerges during solidification. While the modeling framework allows for a validation of the experimental microstructures it also enables the determination of the suitable parameter space. Along with this Choudhury is aiding the effort for building an ICME framework for the development of turbine blisks using the powder metallurgy route. Here, his group has formulated a novel framework for the prediction of microstructures during droplet solidification that is relevant for the atomisation process used for the powder production. Lastly, Choudhury's group has contributed to the two releases of their open-source software MicroSim.

Sai Gautam Gopalakrishnan
This group works on computational materials science, specifically using density functional theory calculations and machine learning to understand material behaviour. Specifically, the group works on unearthing new candidate materials for energy storage and energy harvesting applications and understand their thermodynamic and kinetic behaviour. Recently, the group has identified new positive electrodes for Ca-ion, Na-ion, and K-ion batteries, and novel light absorbing semiconductors. The group has also performed significant benchmarking efforts to create better theoretical predictions and worked towards improving understanding on the photoluminescence spectra of well-known 2D materials. Currently, efforts are on to establish optimal transfer learning techniques to overcome data scarcity in materials science and in turn, make more accurate material property predictions.

Given the increasing energy storage demands and limited natural resources of Li, K-ion batteries (KIBs) could be promising next-generation systems having natural abundance, similar chemistry, and energy density. In this study, they have investigated the P_3-type $K_{0.5}TMO_2$ (where TM = Ti, V, Cr, Mn, Co, or Ni) systems using density functional theory calculations as potential positive intercalation electrodes (or cathodes) for KIBs. Combining our voltage and stability calculations, we find P_3-$KxCoO_2$ to be the most promising cathode composition, while P_3-$KxNiO_2$ is worth exploring. They also find P_3-$KxMnO_2$ to be worth pursuing given its dynamic stability and facile migration of K+ at both potassiated and depotassiated compositions. Their work should contribute to the exploration of strategies and materials required to make practical KIBs.

P Padaikathan
He is working on multicomponent aluminum alloys for High Temperature applications: Al-Co-Nb-Ni-Hf-Zr Alloys. To synergise the flow properties also to be mutually inclusive at an elevated temperatures of ~0.5Tm-Al, they attempted to combine the nano-sized lenticular and spherical shaped particles. Needle shaped second phase particles were formed in the matrix of aluminum having the anisotropy of interfacial energy also due to elastic interactions. Dispersions of stable/metastable state of compounds of $Al_9(Nb,Ni,Co)_2$ with monoclinic structures embedded in the aluminum matrix with reduced lattice misfit of ordered precipitates of $Al_3(Hf,Zr)$ obtained from rapidly solidified suction cast route. Improved strength has been observed of the flow properties enabled by multilayered core-shell. With addition of multicomponent the enthalpy of activation rose to 200KJmole^{-1}. The Er added alloys with Ni-Co in Al have shown high temperature stability with a yield strength (300MPa) anomaly at 575K. Yet another activity is nanostructured thermoelectric generating materials processed under the state of far-from thermodynamic equilibrium using thermo-mechanical processing routes by indigenously developed Twin Roll Casting (TRC) technique. A distinct process for combining rapid freezing and plastic deformation occur at a single step. The strips are formed by varied frequencies of copper wheels; this route has better control of microstructures and strength. Nanocomposites produced with Ag/Cu added Bi_2Te_3 for enhanced ZT ~1.5@400K, reduced thermal conductivity 0.5Wm^{-2}K^{-1}at 700K. The samples processed under TRC, enables the n-type conduction to p-type by addition of Ag/Cu having to both defects of interstitial also substitutional atomic species.

Chandan Srivastava
This team worked on several projects: (a) Microstructural engineering in electrodeposited metallic coatings by alloying and altering the electrodeposition parameters. Investigation of the microstructure-corrosion property correlation in metallic coatings. Optimisation of the electrodeposition parameters and alloying constituent and their amount to achieve microstructure with high corrosion resistance performance; (b) Understanding the role of coating strain and solute atom clustering on hydrogen permeation in electrodeposited metallic coatings. It was shown that alloying with larger-sized solute atoms leads to high hydrogen permeation resistance due to the development of compressive stress in the coating matrix. On the other hand, a higher than optimum solute atom concentration leads to solute clustering, which enhances hydrogen permeation resistance due to hydrogen diffusion through the cluster-matrix interface; (c) Development of aqueous electrodeposition methodology for deposition of multi-component coatings. Investigation of the surface oxide chemistry and its effect on the corrosion behaviour of multi-component coatings.

Ankur Chauhan
This research group focuses on understanding material responses under extreme environments. His group recent work has concentrated on multi-principal element alloys (MPEAs) and novel steels as potential fatigue-resistant alternatives to traditional alloys. By strategically manipulating their microstructures and stacking fault energy, his group aims to enhance fatigue resistance, with promising applications in the automotive, aerospace, and energy sectors.

Additionally, Chauhan's group has tackled a key challenge in magnesium alloys by reducing tension-compression yield asymmetry through the introduction of rare-earth elements. Additionally, he has contributed to understanding the response of aluminium alloys to space debris impacts, further advancing the field of lightweight materials. The group has also pioneered the use of ML-based models to predict the mechanical properties of materials under extreme conditions, particularly neutron irradiation. These models can forecast changes in yield strength, creep, and fatigue life of nuclear materials, accelerating material development for advanced nuclear reactors.

Prosenjit Das
The group works in the broad domains of advanced manufacturing, manufacturing process modelling, process metallurgy, physical metallurgy and biomaterials. The achievements of the group within the last one year are: Development of novel gravity die cast Al-15Mg_2Si-4.5Si-0.2Sr-0.5B composite adopting low superheat casting technique, rheoprocessing of novel Al-15Mg_2Si-4.5Si composite adopting cooling slope rheocasting technique to develop light weight automotive and mining components, design and development of stirr cast Al-Si-MWCNT composite based heat sink for high power LEDs, development of novel micro stirr cast (μ-Stirr) CPU heat sinks, micromechanical study of deformation behaviour of rheocast Al-15Mg_2Si-4.5Si composite in view of rheocasting process optimisation, finite element modelling of deformation behaviour of bucket wheel excavator roller and pin assembly in view of process optimisation of their manufacturing route, development of tooth coloured alumina and translucent zirconia toughened alumina dental braces, design and development of lightweight Al-cenosphere-MWCNT hybrid foam for impact and blast-resistant applications,

design and development porous nickel wick for spacecraft/ satellite loop heat pipes, process optimisation and numerical model development to manufacture single crystal gas turbine blades, development of coupled computational fluid dynamics, phase field, finite element and molecular modelling framework to investigate solidification transport phenomena, sintering densification as well as microstructure evolution in aluminium alloys and aluminium matrix composites, alumina/ ZTA ceramic as well as Ni based superalloys such as Inconel 718 and CMSX4 during casting, welding, powder processing via micro injection moulding and additive manufacturing.

Pikee Priya

This research group focuses on the design of materials, processes, and microstructures by integrating multiscale computational methods, including data-driven approaches with experimental studies in the advanced manufacturing of metals and alloys. Currently, the group is working on an ISTC-funded project aimed at improving the printability of AA6061 aluminum alloy for complex satellite structures. AA6061 presents challenges in laser-based additive manufacturing (AM) due to its wide freezing range, which leads to hot tearing. This issue has been mitigated or eliminated through internal inoculation (via Zr alloying) and external inoculation (using TiB particles), both of which promote a fine, equiaxed microstructure. To investigate the solidification behaviour, the team developed a coupled Discrete Element Method (DEM) and Computational Fluid Dynamics (CFD) model for the Laser Powder Bed Fusion (LPBF) process. This model captures thermal gradients and cooling rates that govern the transition between equiaxed and columnar grain structures, which are critical for printability. A data-driven approach was employed to establish the criterion for columnar-to-equiaxed transition (CET). Single-track and multi-track, multi-layer LPBF experiments were conducted to evaluate the effects of inoculation and processing parameters on microstructure evolution. A nearly fully dense AA6061 sample – approaching theoretical density – was achieved using 1% Zr addition. Internal inoculation proved more effective than external inoculation in improving printability.

The research group is also working on data driven techniques to develop processing maps for industrial alloys using ML based classification of printing defects such as lack of fusion, balling and keyhole porosity. Data-driven techniques are also used for the design of High Entropy Alloys for molten salt corrosion resistant applications.

Suchandrima Das

The Crystal Mechanics Lab, initiated in September 2024, is a fast-growing research group comprising one postdoctoral researcher, one PhD scholar, two master's research students, and several project interns. The group focuses on uncovering the microstructural mechanisms that govern material performance under extreme environments. The group combines advanced 3D experimental characterisation techniques with physics-based multiscale modelling to develop predictive, mechanistic frameworks for materials used in nuclear fusion, hydrogen infrastructure, aerospace components, and biomedical implants.

The group employs high-resolution experimental methods such as synchrotron X-ray Laue diffraction, nanoindentation, HR-EBSD, AFM, TEM, and surface acoustic wave measurements, integrated with molecular dynamics, dislocation dynamics, and crystal plasticity finite element simulations. These simulations are tightly validated by experiments and further accelerated using machine learning-enabled surrogate models, enabling the construction of digital laboratories for simulating difficult or expensive physical tests.

A notable innovation is the development of an ion implantation platform with a dual gradient in dose and temperature, allowing rapid generation of spatially graded irradiation damage profiles. This approach significantly shortens the experimental cycle and facilitates high-throughput screening of irradiated material properties, offering a transformative capability for nuclear materials research.

Current research projects include investigating strain-rate-sensitive deformation in neutron-irradiated tungsten alloys; characterising irradiation-induced hardening and strain localisation in tungsten heavy alloys; multi-technique assessment of FeCr alloys (RAFM steel surrogates) irradiated under thermal gradients, using Laue diffraction, AFM, indentation, and modelling; a multiscale simulation framework linking molecular dynamics and dislocation dynamics to crystal plasticity, toward fully physically-informed continuum models; efforts to deduce depth-resolved defect structures by fusing MD-based damage predictions with Laue diffraction-derived strain data – potentially replacing invasive techniques like TEM; investigations into the role of Cr content and irradiation damage level on mechanical performance of FeCr alloys; quantifying indentation size effects in pure and irradiated tungsten using CPFE and experimental validation.

All ongoing work is supported through an IISc startup grant and international collaborations with the UK Atomic Energy Authority and the University of Bristol. The broader goal is to create microstructure-resolved digital twins of materials and components, with high fidelity and industrial applicability.

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PRAVEEN C RAMAMURTHY | PhD (Clemson Univ, USA), Professor
RAJEEV RANJAN | PhD (BHU, India), Professor
R RAVI | PhD (IISc, India), Chief Research Scientist
SACHIN R RONDIYA | PhD (Pune Univ, India), Assistant Professor
CHANDAN SRIVASTAVA | PhD (Univ Alabama, USA), Professor
SATYAM SUWAS | PhD (IIT Kanpur, India), Professor
PIKEE PRIYA | PhD (Purdue Univ, USA), Assistant Professor
SUCHANDRIMA DAS | PhD (Univ, Oxford), Assistant Professor

Honorary and Emeritus Professors

DIPANKAR BANERJEE | PhD (IISc, India), Emeritus Professor
KAMANIO CHATTOPADHYAY | PhD (BHU, India), Emeritus Professor
KT JACOB | PhD (London), DSc (Engg) (London, UK), Emeritus Professor
VIKRAM JAYARAM | PhD (Stanford University, USA), Honorary Professor
KISHORE | PhD (IISc, India), Emeritus Professor
KA NATARAJAN | PhD (University of Minnesota, USA), DSc (IISc, India), Emeritus Professor
S SUBRAMANIAN | PhD (Mysore University, India), Emeritus Professor
ASHOK MISRA | PhD (University of Massachusetts), Emeritus Professor

3.5.10 *Mechanical Engineering*

Mechanical Engineering activities at IISc commenced in 1945 in the Department of Internal Combustion Engineering that later merged with the subsequently created Mechanical Engineering department. Research interests in the department have evolved to span a broad range of areas, from traditional to emerging fields, with applications in related industries.

FACT FILE

Established: 1945
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Degree Programmes offered: PhD, MTech (Res) and MTech

IN NUMBERS

28	Academic Staff
4	Scientific Staff
140	PhD Students
4	MTech (Res)
100	MTech
27	MTech Conferment
15	PhD conferments

Chair: RAGHURAMAN N GOVARDHAN

Current **Research**

Biomechanics and medical devices:
Nonlinear mechanics of soft biological tissues and elastomers; protein rubbers; mechanical characterisation 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.

Fluid mechanics and flow physics:
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 flows; electro-hydrodynamics; atomisation of liquid jets. 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.

Heat transfer and energy systems:
Turbulent Rayleigh-Benard convection; double-diffusive convection, mixed convection, heat pipes, heat exchangers, thermal management of electronic systems; heat and mass transfer in buildings; 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, fuel spray characterisation; trapped-vortex based combustor research, Laser-Induced Incandescence (LII) imaging for soot formation studies, bio-fuels, fuels transesterification, engine performance, combustion diagnostics and emission analysis.

Manufacturing and materials:
Fretting friction mechanics; impact fracture; fracture mechanics and tribology fragmentation dynamics, 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, 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 near-net shaped castings; meso-scale manufacturing with metals.

Mechanics of solids and structures:
Analytical, experimental and computational studies on crack-tip fields and void growth in ductile face-centred cubic (FCC) single crystals, pressure-sensitive yielding, internal friction, flow softening, Poisson's ratio and mode-mixity in the fracture response of bulk metallic glasses (BMGs), formulation of the finite element method with hybrid elements, experimental and computational work in biomechanics of tissue and cells, mechanics of insect boring, role

Core **Research**

Biomechanics and medical devices; fluid mechanics and flow physics; heat transfer and energy systems; manufacturing and materials; mechanics of solids and structures; mechanisms, design and optimisation; micro- and nanoscale processes and devices; robotics and control systems; vibrations, acoustics, and control.

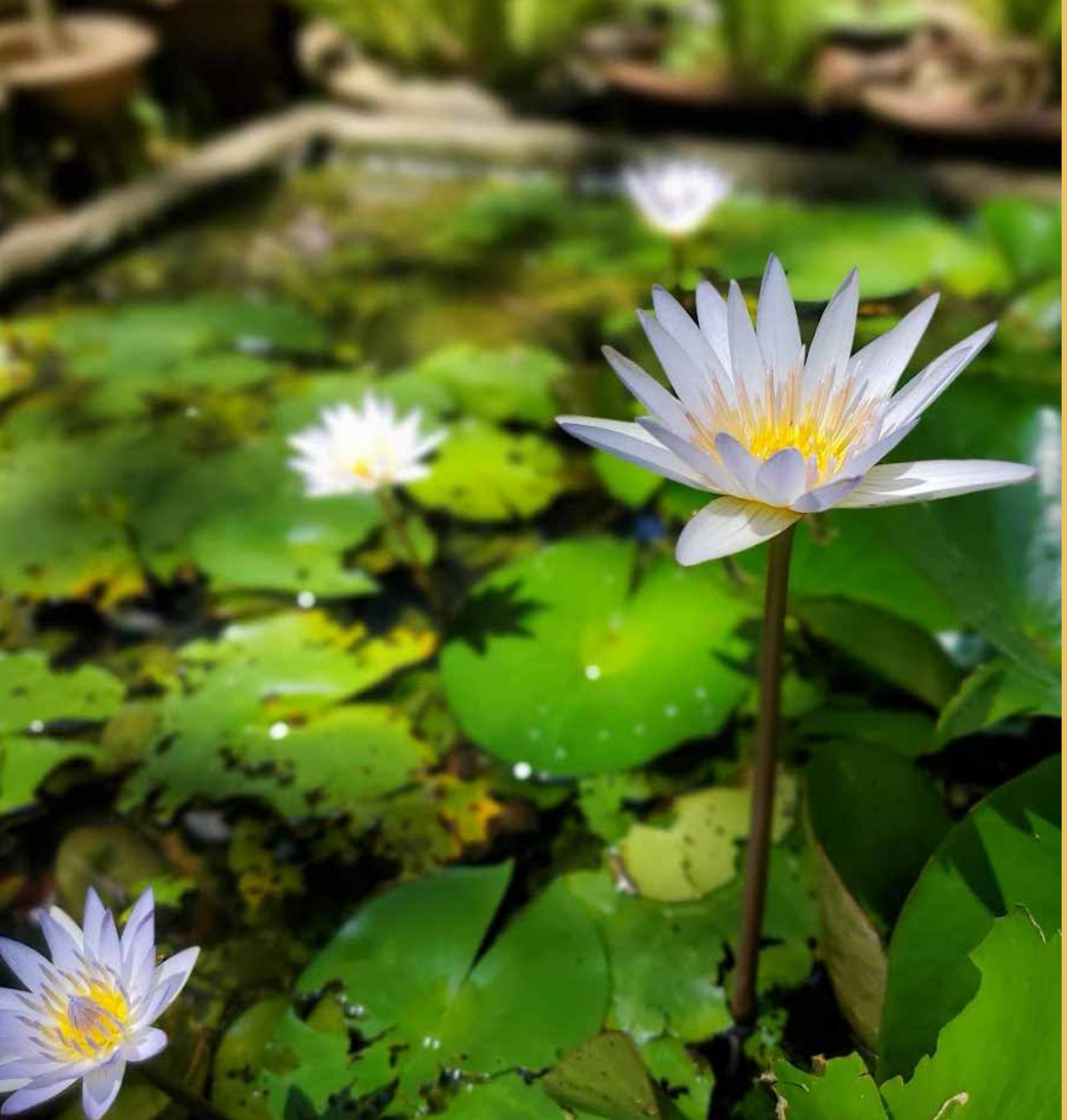
of geometry in slender structures such as beams, ribbons, and shells, mechanics-based design of compliant mechanisms, growth modelling in plant leaves and inverse problems in elastic mechanics, pathways in bistable arches and shells.

Mechanisms, design and optimisation:
Structural and dimensional synthesis of kinematic and compliant mechanisms; theoretical kinematics; multi-disciplinary design optimisation; 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 optimisation, kinematic assembly modelling, geometric and topological modelling.

Micro- and nanoscale processes and devices:
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.

Robotics and control systems:
Foundational and applied aspects of kinematics, dynamics, control and motion planning, multi-fingered hands, wheeled and walking robots, hyper-redundant snake robots, and nonlinear control, motor learning and coordination, pipe-crawling robot, haptic aid for cutting tissue, commercialised endoscopy simulator with haptics and graphics, autonomous micro-robotics, flexible robotics, deep learning for path planning.

Vibrations acoustics and control:
Sound from turbulent flows, asymptotics in structural acoustics, nonlinear structural acoustic interactions, precision motion control, with applications in metrology and robotics, at the micrometer and nanometer length scales, development of new measurement techniques, probes, actuation techniques, and advanced control.

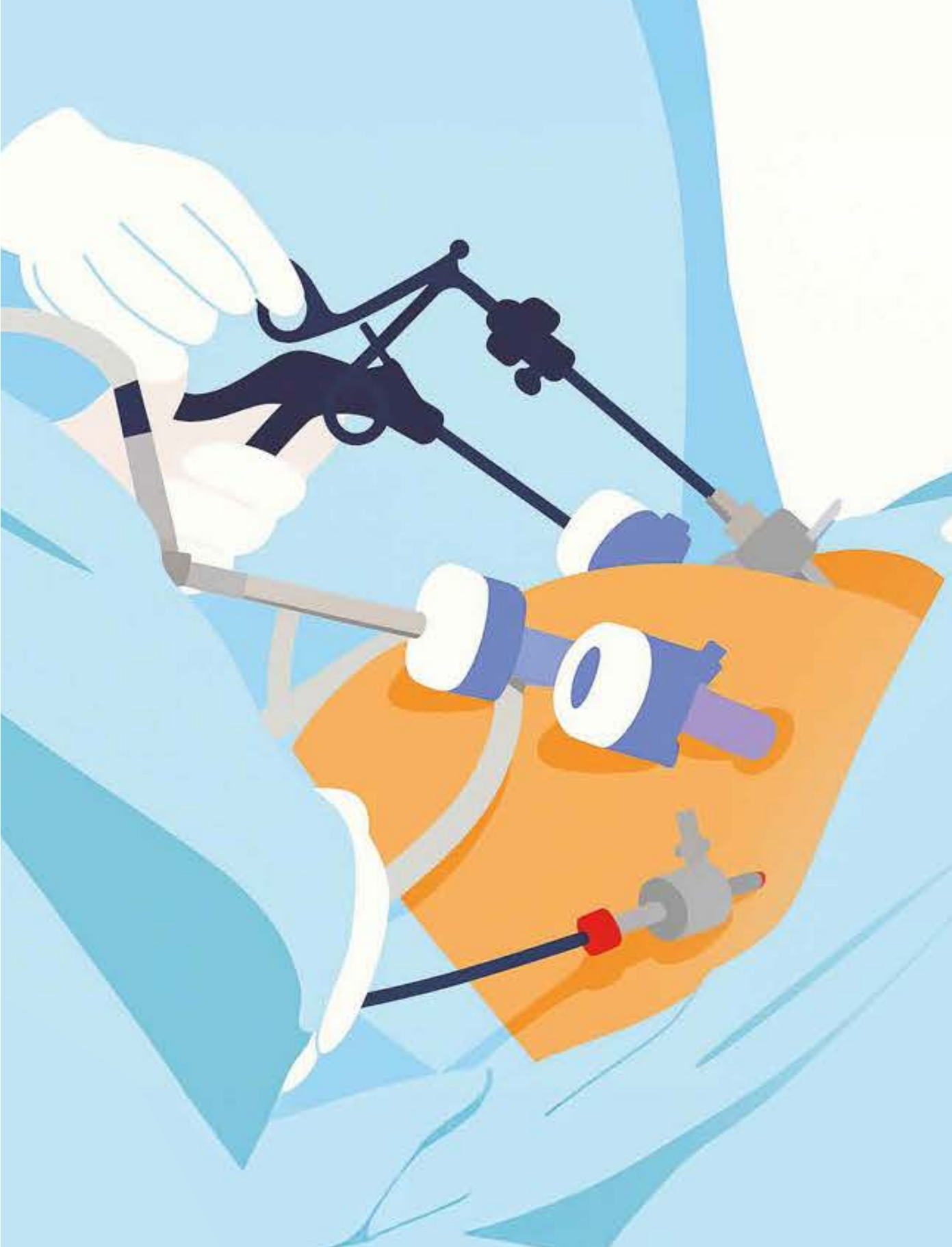


Faculty & Staff

AKSHAY JOSHI | PhD (Caltech), Assistant Professor
ALOKE KUMAR | PhD (Purdue), Associate Professor
AMRIT AMBIRAJAN | PhD (Missouri), Research Professor
ANANTHASURESH GK | PhD (Michigan), Professor
ASHITAVA GHOSAL | PhD (Stanford), Professor
BALACHANDRA SURI | PhD (Georgia Tech), Assistant Professor
CHANDRASHEKHAR JOG | PhD (Illinois), Professor
DEBASHISH DAS | PhD (Illinois), Assistant Professor
GAURAV TOMAR | PhD (IIT Kanpur), Professor
JISHNU KESHAVAN | PhD (Maryland), Assistant Professor
KOUSHIK VISWANTHAN| PhD (Purdue), Associate Professor
MS BOBJI | PhD (IISc), Professor
NAMRATA GUNDIAH | PhD (California), Professor
NARASIMHAM GSVL | PhD (IISc), Chief Research Scientist
NARASIMHAN R | PhD (Caltech), Professor
NAVANEETHA K RAVICHANDRAN | PhD (Caltech), Assistant Professor
RAGHURAMAN N GOVARDHAN | PhD (Cornell), Professor
RAMSHARAN RANGARAJAN | PhD (Stanford), Associate Professor
RATNESH SHUKLA | PhD (California), Professor
RAVIKRISHNA RV | PhD (Purdue), Professor
SAPTARSHI BASU | PhD (Connecticut), Professor
SATISH V KAILAS | PhD (IISc), Professor
SHUBHADEEP MANDAL | PhD (IIT Kharagpur), Assistant Professor
SUSMITA DASH | PhD (Purdue), Associate Professor
VENKATA SONTI |PhD (Purdue), Professor
HIMABINDU M | PhD (Anna Univ.), Senior Scientific Officer
C DHARUMAN | MSc (Engg) (IISc), Senior Scientific Officer
RT NAIK | PhD (IIT Delhi), Principal Research Scientist

Associate Faculty

DIBAKAR SEN | PhD (IISc), Professor
GR JAYANTH | PhD (Ohio State), Professor
GURUMOORTHY B| PhD (Carnegie Mellon), Professor
PRADIP DUTTA | PhD (Columbia), Professor
PRAMOD KUMAR | 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.

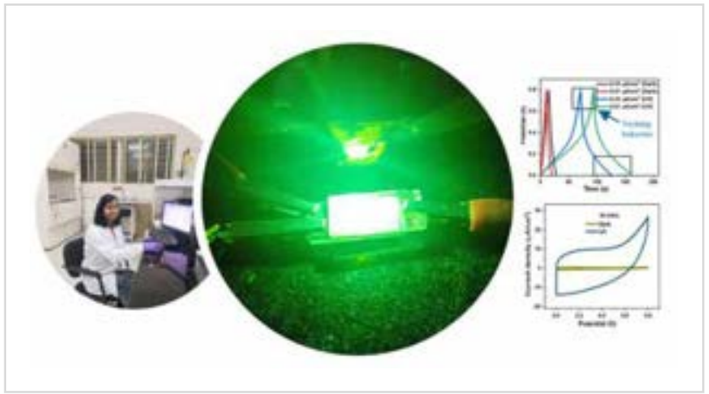
Faculty members in this division have received several awards and honours for their research. Their research has been supported by grants from major agencies and ministries such as the Department of Science and Technology, the Council for Scientific and Industrial Research, the Department of Biotechnology, the Defence Research and Development Organisation, the Indian Space Research Organisation, and the University Grants Commission.

THEMES

Given the diversity of this Division, there are a wide variety of research themes. 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
- DEPARTMENT OF INSTRUMENTATION AND APPLIED PHYSICS
- DEPARTMENT OF MATHEMATICS
- DEPARTMENT OF PHYSICS

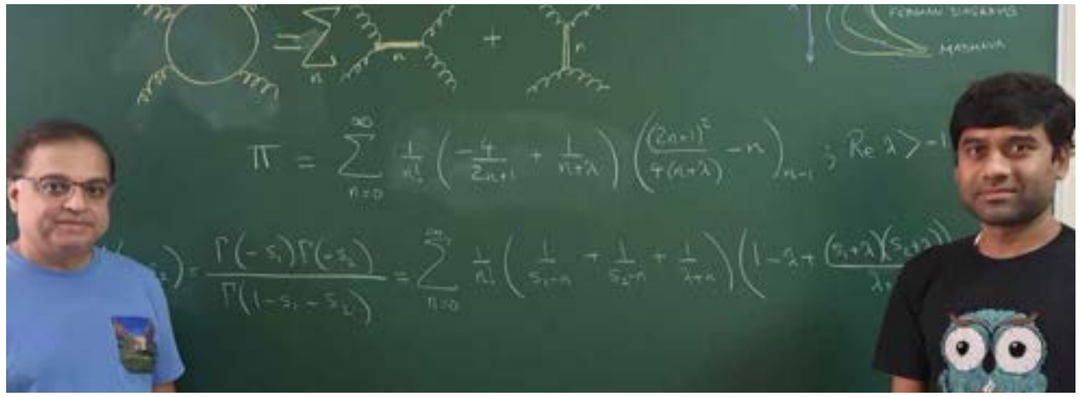


Shining light on new supercapacitor

Researchers at the Department of Instrumentation and Applied Physics and collaborators have designed a new supercapacitor that can be charged by shining light on it. The electrodes of the new supercapacitor were made of Zinc Oxide (ZnO) nanorods grown directly on Fluorine-doped Tin Oxide (FTO). Both ZnO and FTO are semiconductors with appropriately aligned energy levels, enabling superior performance of the photo-rechargeable supercapacitor. FTO, being transparent, allows light to fall on the optically active ZnO nanorods, which charges the supercapacitor. Two electrolytes – a liquid and a semi-solid gel – were used as the conducting medium between the electrodes. Such supercapacitors can be used in various devices, including streetlights and self-powered electronic devices such as sensors.

Reference:
Chauhan PS, Parekh M, Sahoo S, Kumar S, Mahapatra AD, Sharma P, Panwar V, Rao AM, Misra A, Influence of electrolyte on the photo-charging capability of a ZnO–FTO supercapacitor, Journal of Materials Chemistry A (2024).

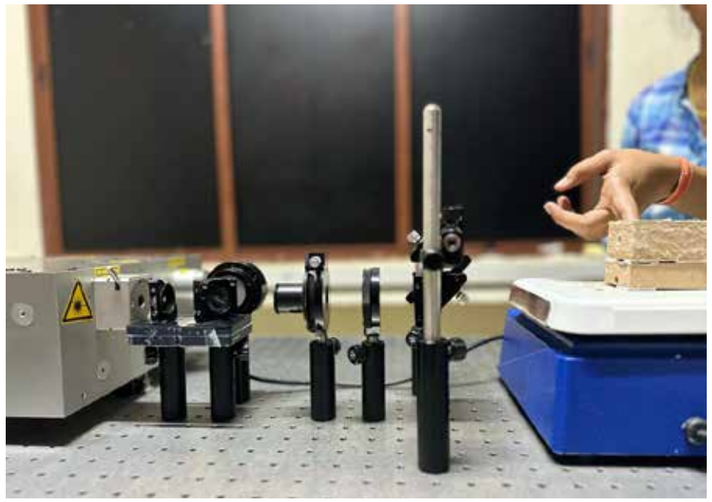
Research **Snapshots**
2024-25



A new way to represent ‘pi’

While investigating how string theory can be used to explain certain physical phenomena, researchers at Centre for High Energy Physics have discovered a new series representation for the irrational number pi. The new formula under a certain limit closely reaches the representation of pi suggested by Indian mathematician Sangamagrama Madhava in the 15th century, which was the first ever series for pi recorded in history. The series that the IISc team discovered combines specific parameters in such a way that scientists can rapidly arrive at the value of pi, which can then be incorporated in calculations, like those involved in deciphering scattering of high-energy particles.

Reference:
Saha AP, Sinha A, Field theory expansions of string theory amplitudes, Physical Review Letters (2024).



Detecting glucose through painless photoacoustics

People who have diabetes struggle with repeated use of needles to check blood glucose levels. A new technique developed by researchers at the Department of Instrumentation and Applied Physics offers an alternative. When a laser beam is shined on biological tissue, the tissue components absorb the light, and the tissue heats up slightly (less than 1°C). This causes the tissue to expand and contract, creating vibrations which can be picked up as ultrasonic sound waves by sensitive detectors. Different materials and molecules inside the tissue absorb different amounts of the incident light at different wavelengths, creating individual "fingerprints" in the emitted sound waves. Importantly, this procedure does not damage the tissue sample being studied.

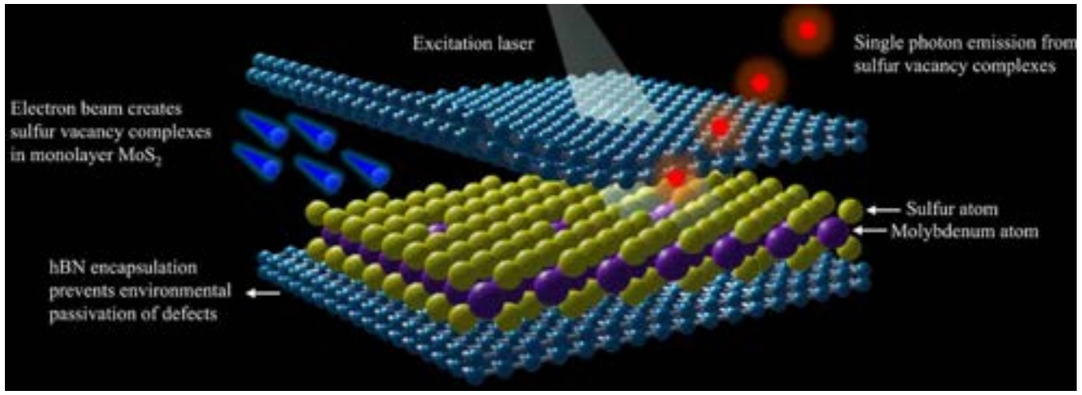
Reference:
Padmanabhan S, Prakash J, Deep tissue sensing of chiral molecules using polarisation enhanced photoacoustics, Science Advances *(2025).*

Research **Snapshots**
2024-25

Electrons exhibit glassy behaviour in a good metal

A team of researchers from the Department of Physics, IISc; TIFR Hyderabad, Penn State (USA) and DESY (Germany) have found the first evidence for glass-like relaxation of electrons in the metallic regime of electron doped $KTaO_3$ which is a classic example of incipient ferroelectric in its pristine form. Even more surprising is the observation that glassiness seems to stem from quantum fluctuations associated with the zero-point motion of atoms – a factor which is generally considered irrelevant in the description of window glasses. This opens up a route for exploring glassy dynamics of electrons in a well-delocalised regime.

Reference:
Ojha SK, Hazra S, Bera S, Gogoi SK, Mandal P, Maity J, Gloskovskii G, Schlueter C, Karmakar S, Jain M, Banerjee S, Gopalan V, Middey S, Quantum fluctuations lead to glassy electron dynamics in the good metal regime of electron doped $KTaO_3$, Nature Communications *(2024).*

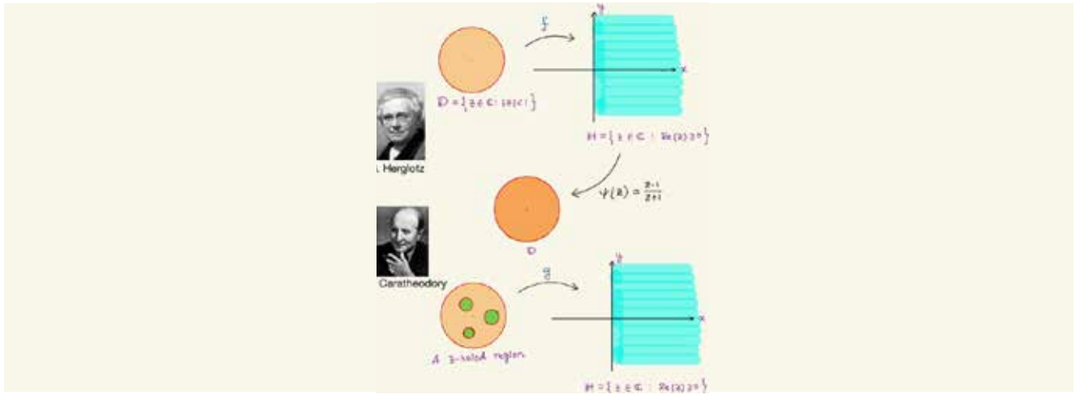


Creating single photon emitters for quantum technologies

At the core of quantum technologies lies the critical need for single photon emitters (SPEs). But creating SPEs at exact locations is a challenging problem. Researchers at the Department of Physics, with collaborators at CeNSE (IISc), CNRS (France) and NIMS (Japan), have developed a fundamentally different approach for generating SPEs in a single layer of 2D semiconducting MoS2. The team used ultra-low energy (<5 keV) electron beam irradiation and created environmentally stable SPEs with high spatial resolution (~50 nm, and extendable down to 10 nm). This is a disruptive technology for creating SPEs in 2D materials and similar materials. It can also enable novel fundamental physics concerning defect-defect coupling and electron-matter interactions.

Reference:
Dash AK, Yadav SK, Roux S, Singh MP, Watanabe K, Taniguchi T, Naik A, Robert C, Marie X, Singh A, Quantum light generation with ultra-high spatial resolution in 2D semiconductors via ultra-low energy electron irradiation, Advanced Functional Materials *(2025).*

Research **Snapshots**
2024-25



Nanoparticle-based remediation of chromium-contaminated water

In 1911, Gustav Herglotz proved that an analytic function (a complex differentiable function) defined on the open unit disc and going into the right half plane is the same as a positive increasing function defined on the unit circle. Constantin Carathéodory in 1926 proved that if the function, instead of going into the right half plane, lands in the unit disc (where it started from in the first place), then it can be approximated by very nice functions. Researchers at the Department of Mathematics show that these two well-known classical results are equivalent. They then vastly generalised to include functions which are defined on holed domains and take values in the set of infinite matrices.

Reference:
Bhattacharyya T, Bhowmik M, Kumar P, Herglotz's representation and Carathéodory's approximation, Bulletin of the London Mathematical Society *(2024).*

3.6.1 *Centre for Cryogenic Technology*

CCT has been extending its commitment to research (both PhD and MTech (Research)), and teaching. In addition, two additional facilities, namely cryo-cell preservation facility and in house liquid helium facility, have been developed. The existing liquid nitrogen supply facility along with other two facilities serve various entities (labs/facilities/centres/departments/companies) of the Institute. Specifically, the Centre provides LN2 and cells to the Institute community for carrying out research at cryogenic temperatures. Looking into the increased trend of liquid nitrogen requirement over years, in-house infrastructure is in the process of upgradation to ensure uninterrupted supply to all in the institute and other entities.

FACT FILE

Established: 1971
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IN NUMBERS

3 Scientific Staff
16 Publications (journal: 10, conference: 6)
5 Patents

Chair: PARTHA PRATIM MONDAL

Current **Research**

Transfer of cryogenic fluids is a daily occurrence in cryogenic labs and systems. Hence, efficient transfer of cryogenic fluids with minimal evaporation is an important aspect of all cryogenic transfer lines. Studies are in progress both for rigid and flexible cryogenic transfer lines. Our faculty is also involved in the design and development of cryo-transfer lines for various missions of national importance.

Production of ultra-low temperatures without the use of cryogens is another important area of cryogenics for space and defense applications. Cryocoolers can achieve very low temperatures for these applications wherein the regenerator plays the most important role in producing ultra-low temperatures. Studies are in progress for various regenerator materials such as lead, Er_3 Ni, $HoCu_2$, and so on, in the temperature range of 30K - 4.2K towards development of indigenous miniature cryocoolers for space applications. Cryogenic temperature sensors of the cryogenic rocket engine control many vital parameters of the launch vehicle for successful transfer of the payload to a specific orbit. The cryo-temperature sensors of the cryogenic rocket engine are being calibrated at CCT with precise accuracy for reliable operation of the launch vehicles.

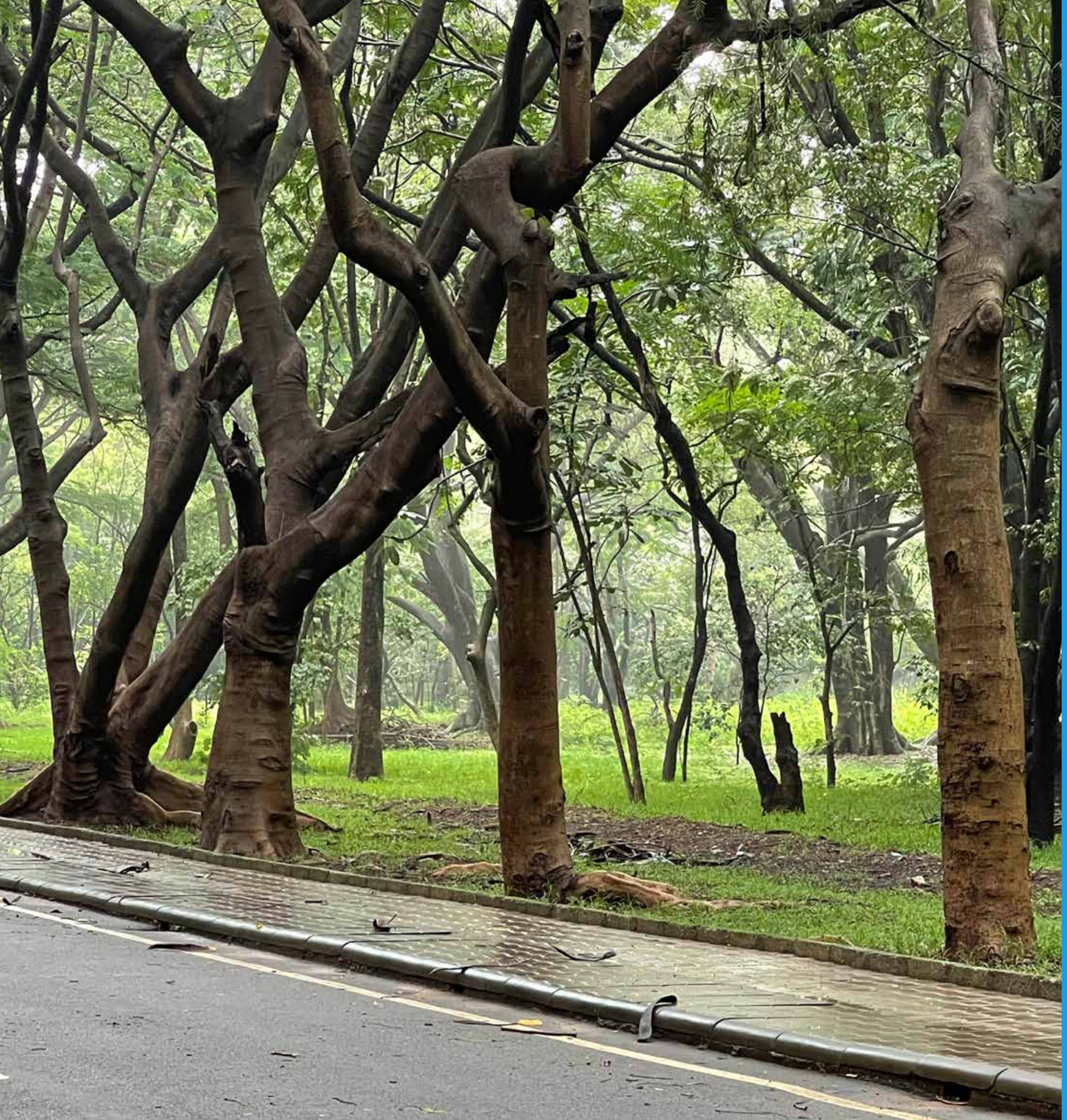
Recently, a new project on super-resolution imaging and light sheet microscopy based on ultra-low-temperature detectors has been funded by the Department of Biotechnology, New Delhi. The research work is focused on the development of optical microscope operating at low temperatures that is capable of spatio-temporal super-resolution, optical systems design, low-temperature detectors and cryo-cell preservation. The lab is actively engaged in developing new optical imaging techniques based on single molecules at low temperatures and light-sheets for applications in physical and biological sciences, including cryo-cell preservation, cryo-electron microscopy and revival to study fundamental biology. The main thrust is to develop and extend these advanced techniques for applications in fundamental low temperature physics and biology.

Since many years, CCT has continuously supported LPSC, ISRO to calibrate their triple redundant propellant level sensors for both LOX and LH2, which play a very critical role in successful launch of rockets. In this year, 27 level sensors have been successfully calibrated and delivered to LPSC, Bengaluru.

Dimensional stability and linearity are major issues for the long-term performance of the diaphragms of pressure transducers which are extensively used for propellant pressure measurements. These diaphragms are cryotreated at 98K for 36 hours in a dedicated cryotreatment system using liquid nitrogen to enhance both dimensional stability and linearity. This year, nearly six hundred and fifty diaphragms were successfully cryotreated and delivered to LPSC, ISRO.

Core **Research**

Cryogenic engineering research is rapidly advancing in multiple directions in space technology, medical science, superconductivity studies, cryocoolers, super-resolution microscopy, cryo-electron microscopy, biological sciences, and so on. In line with high expectations, faculty and students in CCT are engrossed in experimental research in several areas of cryocooler technology, cryogenic systems and instrumentation, calibration of temperature and level sensors for ISRO, thermal conductivity studies at low temperature, strength properties of materials at cryogenic temperatures, cryogenic treatment on metals, development of high-resolution microscopy (with -88°C detectors), imaging, cryo-cell preservation and ultra-low temperature detectors.



Faculty & Staff

PARTHA PRATIM MONDAL | Professor

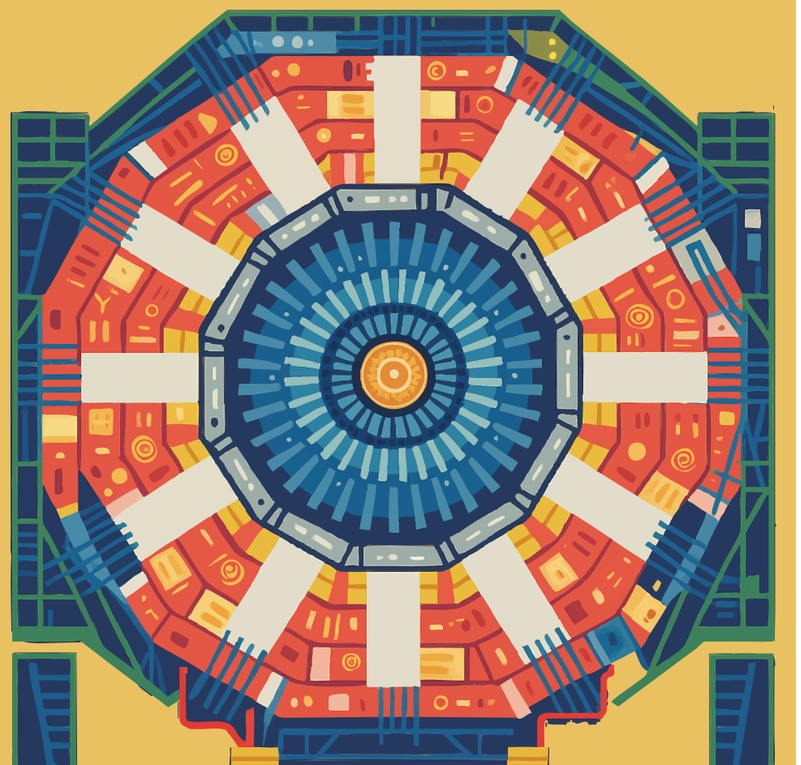
UPENDRA BEHERA | PhD (IISc), Principal Research Scientist

D S NADIG | M Tech (IIT Kharagpur), Principal Research Scientist

3.6.2

Centre for High Energy Physics

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



FACT FILE

Established: 2004
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Degree Programmes offered:
PhD and Int PhD

IN NUMBERS

12 Academic Staff
20 PhD Students
18 Int PhD Students
22 Journal Publications
3 Int PhD Conferments
3 PhD Conferments

Chair: SUDHIR VEMPATI

Current **Research**

Low dimensional condensed matter systems
It was shown that the periodically driven Aubry-Andre model with quasi-periodic potential and a nearest-neighbour hopping amplitude exhibits a more richer phase structure than its static counterpart. Spin-splitting of bands in single-layer graphene was observed experimentally and a theoretical model was proposed to explain this phenomenon.

Particle phenomenology
Renormalisation group summed perturbation theory scheme has been improved to determine the strange quark mass. Machine Learning models for tagging the top quarks using N-sub-jettiness and energy correlation functions as inputs were developed. The parameter space of the minimal supersymmetric standard model was explored using collider and astrophysical constraints. It was shown that only a very narrow region of light electroweakinos was allowed. This region is within the reach of Run-3 of the Large Hadron Collider. A new method to calculate the QCD equation of state based on cumulant expansion with improved convergence was developed.

Quantum field theory
Edge modes and super selection sectors in gauge theories were studied in detail. A manifestly duality invariant action describing the edge modes in gauge theories was studied. It was shown that the crossing symmetric dispersion relation for 2-2 scattering leads to a connection with knot theory and q-deformed algebras.

Entanglement entropy
The quantum entanglement properties of the graviton have only been recently investigated. The contribution of the edge modes of the graviton to entanglement across a spherical surface was evaluated and its relation to Harish-Chandra characters was pointed out. The growth of entanglement entropy due to quantum quenches caused by curvature excitations was studied in detail.

Astro-particle physics and cosmology
The implication of dark matter sub-structures to electron recoil and electron direct detection rates in dual phase Xenon experiments were studied. The sensitivity of these experiments to resolving dark matter sub-structure was explored. The possibility of re-heating of cold neutron stars due to accretion of dark matter was explored. It was shown that such warm neutron stars could be detected by the James Webb Telescope. The most symmetric generalisation of the standard cosmology compatible with cosmic flow was proposed.

A key observation in this cosmology is that cosmic flow can grow while anisotropy dies even at late time acceleration.

An automated Mathematica package to derive the system of partial differential equations (GKZ-system) satisfied by a Feynman Integral and to solve it in terms of hypergeometric functions was developed. The package was demonstrated on several one loop and two loop Feynman integrals.

A review which aims to provide a pedagogical introduction to the analytic conformal bootstrap programme was published. This review has details of large spin perturbation theory, Mellin space methods and the Lorentzian inversion formula.

Core **Research**

The core research areas are quantum field theory, 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, phenomenology of standard model and its extensions, string theory, astro particle physics, black hole physics, quantum field theory applications to condensed matter physics, quantum information and quantum computing. The experimental high-energy physics is a part of the CMS experiment at CERN, Geneva.

Faculty & Staff

B ANANTHANARAYAN | PhD (Delaware), Professor

BIPLOB BHATTACHERJEE | PhD (Calcutta), Associate Professor

JUSTIN R DAVID | PhD (TIFR, Mumbai) | FASc, FNASc, Professor

PRASAD SATISH HEGDE | PhD (Stony Brook),
Associate Professor

JYOTHSNA RANI KOMARAGIRI | PhD (TIFR, Mumbai),
Assistant Professor

CHETHAN KRISHNAN | PhD (Texas), Associate Professor

RANJAN LAHA | PhD (Ohio), Assistant Professor

GAURAV NARAIN | PhD (SISSA), Assistant Professor

NIRMAL RAJ | PhD (Oregon), Assistant Professor

ANINDA SINHA | PhD (Cambridge), Professor

SACHINDEO VAIDYA | PhD (Syracuse), Professor

SUDHIR KUMAR VEMPATI | PhD (PRL, Gujarat), Professor

Honorary Faculty

DIPTIMAN SEN | PhD (Princeton), FASc, FNA, FNASc, Professor

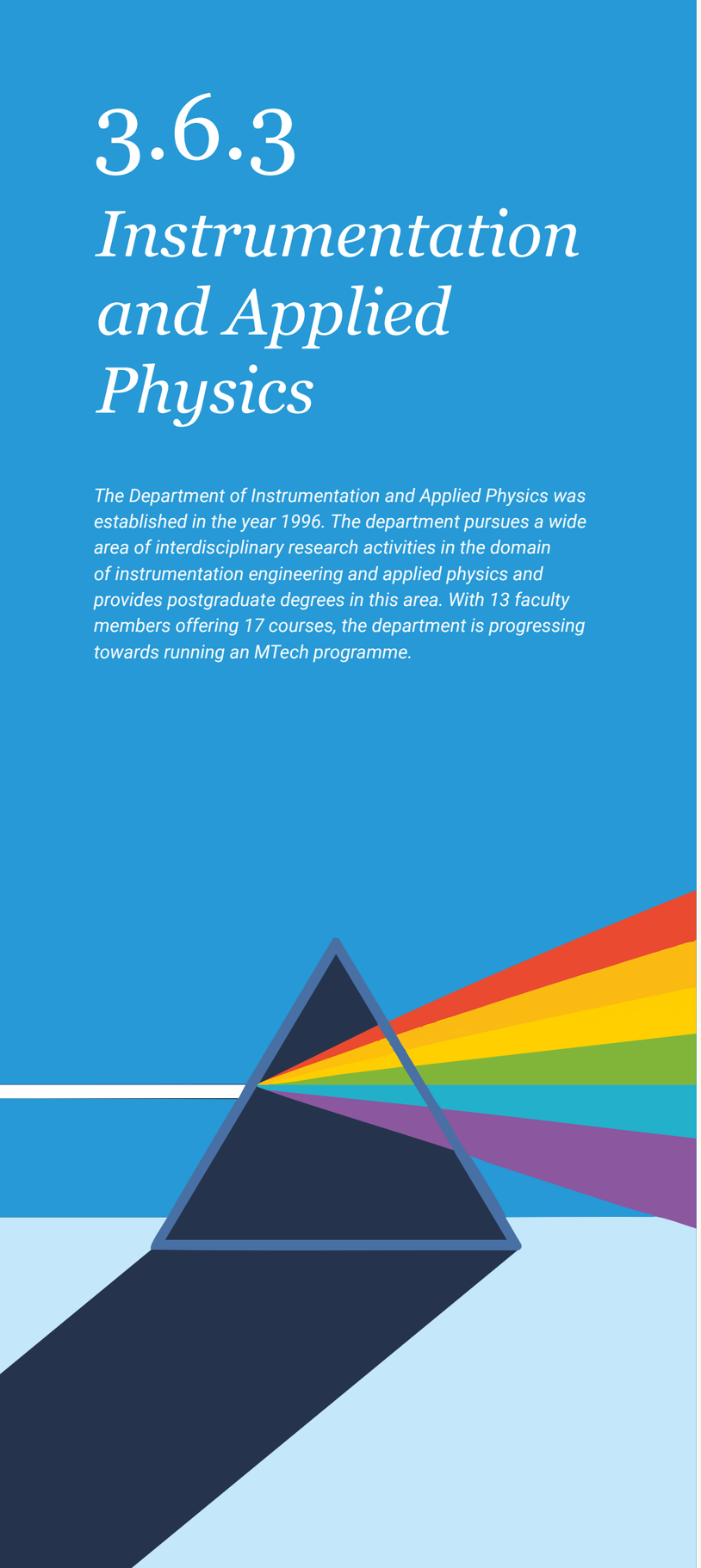
APOORVA PATEL | PhD (Caltech), Professor

INSA Senior Scientist

ROMESH KAUL | PhD, (Delhi 1976), FASc, FNA

3.6.3 *Instrumentation and Applied Physics*

The Department of Instrumentation and Applied Physics was established in the year 1996. The department pursues a wide area of interdisciplinary research activities in the domain of instrumentation engineering and applied physics and provides postgraduate degrees in this area. With 13 faculty members offering 17 courses, the department is progressing towards running an MTech programme.



FACT FILE

Established: 1996
Phone: +91-80-2293 2269
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Email: office.iap@iisc.ac.in
URL: iap.iisc.ac.in
Degree Programmes offered: PhD, MTech (Research) and MTech

IN NUMBERS

13 Academic staff
2 Scientific staff
30 Publications
5 Patents
14 PhD students
15 MTech Students (4 IAP, 11 Quantum Tech)
7 MTech research

Chair: SANJIV SAMBANDAN

Current **Research**

The research in the department is highly interdisciplinary and spans the horizons of physics and engineering, applied to the areas of device physics, healthcare, quality control, food-processing, life-sciences, electronics among others. The varied research can be summarised to applied photonics (sensing, microscopy and nanoscale imaging), materials research (material science and engineering, surface engineering) and integrated systems (integrated systems and electronics, system design and instrumentation).

The QTL lab works on Josephson quantum limited amplifiers of different kinds, as well as single and entangled microwave photon sources. They are working on improving the quality factors of superconducting qubits and theoretically pursuing research into non-Markovian open quantum systems.

Nanostech lab works on highly confined 0-D materials - quantum dots, encompassing their synthesis, characterisation and application. The lab is working on synthesising and developing various types of QDs including Carbon-QDs, TMDC QDs, Perovskite QDs, InP QDs and CdSe/CdS thick shelled QDs etc. Development of QD filled fibres as single photon sources for is also being carried out. Highly stable carbon dots have been developed which are stable for 10 days in ambient conditions.

The FIST lab at IAP is working on developing glucose sensing using polarised photoacoustic effect in which they are trying to understand the utility of photoacoustic signals to estimation optical rotation by chiral biomolecules, and in turn estimate glucose concentration. They also work on understanding the physics of

Core **Research**

The core research areas pursued in the department encompass quantum computation and quantum optics with superconducting circuits, quantum dots, quantum dot fibres, carbon quantum dots, QD based single photon sources, terahertz spectroscopy, cavity-quantum electrodynamics, terahertz communication, metasurfaces and nanophotonics, metasurface, reconfigurable photonics, large area nanostructure, optical instrumentation, 2D materials and heterostructures, spin-valley qubits in graphene, moire quantum matter, dielectric and gate engineering in 2D systems, single molecule physics, super-resolution microscopy, light sheet microscopy, imaging cytometry, optical tweezers, quantum imaging, point-of-care diagnostics, optical instrumentation, microfluidics, invitro diagnostics platforms, photoacoustic imaging/ sensing, inverse problems in image reconstruction, deep learning for image reconstruction, polarised photoacoustics, deep tissue optics, biomedical optics, glucose sensing, atomically thin interfaces for molecular sensing, self-powering micro-supercapacitors, precision motion control, microelectromechanical systems, scanning probe microscopy, micro-robotics and nanometrology.

polarised photoacoustics. In the project based on miniaturised photoacoustic sensors, they are trying to develop LED and pMUT-based photoacoustic sensor which could potentially enable point-of-care measurements for various biomarkers like oxygen saturation, blood pressure, and glucose estimation. Further, they are working on developing deep learning-based tools to accelerate photoacoustic image reconstruction and evaluate the performance with limited data scenarios.

The Flexible Electronics lab works on thin film devices and inkjet printed electronics. The focus is on semiconductor device physics and analog integrated circuits applied to building systems for applications such as healthcare, environment, space applications etc. Their group is currently working on integrated circuits on biodegradable materials, electronic pill made of resorbable materials, modelling and development of a new corrugated TFT device for enhanced gain, new circuit ideas for self-compensating circuits such as self-balancing inverters.

The Optics and Microfluidics Instrumentation lab is working on development of accurate point-of-care quantification of haemoglobin, point-of-care technology for Sickle Cell Anaemia (SCA) diagnosis, point-of-care technology platform using optothermal ultrafast PCR, development of a pulse-oximeter-sized device for the detection of sickle cell anaemia, system for quantifying absorbance and scattering in blood samples in visible region, miniature optical spectrophotometer and single test kit development.

The Nanoscale Devices laboratory focuses on developing the necessary tools and techniques to understand and explore correlated electronic phenomena in low dimensional heterostructures. The broad research scope encompasses state-of-the art nanofabrication and low temperature electron transport techniques to investigate novel electronic states in quantum materials.

The Nanobioimaging lab pursues both fundamental and applied research in the broad area of optical and applied physics with a special emphasis on single molecule physics. This research area includes, single molecule physics, light sheet microscopy, optical tweezer, super-resolution microscopy, nano fluidics and devices, optical microscopy, fluorescence microscopy, ultrafast imaging, imaging cytometry and quantum imaging. The research work is focused on the development of optical microscopes that is capable of spatio-temporal super-resolution and optical systems design. The lab is actively engaged in developing new optical imaging techniques based on single molecules and light-sheet for applications in physical and biological sciences.

The Sensors and Self-powered Devices lab is working on a project which aims to provide solutions for the Gaganyaan project in the detection of the level of oxygen and methane in the crew chamber. Sensors were fabricated and successfully tested to provide the capability as per the requirements of the project. Other projects use meta-FET devices for the optoelectronic communication within the visible range. On-chip supercapacitors provide an advance platform for the energy storage with a capability to integrate with the CMOS devices in various applications.

The Laboratory of Advanced Nanostructures for Photonics and Electronics study and develop new process technologies such as cost-effective process which can be used to fabricate micron or sub-micron feature sized photonic and electronic devices and components, finding a suitable material platform for this process, to develop instruments based on optics for large area fabrication of nanostructures. In last few years to attain the above process technologies, three main projects were considered: using liquid metals to develop soft, stretchable mechanochromic devices, and using DLP based process to develop 3D lithographic systems.

The research at TeraQuanta lab aims to explore nanophotonic and quantum devices in terahertz frequencies, with a specific goal to investigate the physical properties and quantum dynamics in the hybrid vacuum-matter system. Ultimately, impact of the research ascribes in finding new and powerful ways of controlling and

manipulation of terahertz light at the nanoscales and in the quantum regimes to instigate and drive the development of novel devices and innovative technologies in the emerging realm of THz Nanotechnology and cavity quantum matter. Two main problems that the group is focusing on are -THz spectroscopy of nanomaterials and micro/nanophotonic inspired THz cavity quantum electrodynamics.

The Nanometrology research lab is involved in studying voice coil motor-based nano-positioners. They have developed voice coil motor-based nano-positioning systems that simultaneously possess large range (several millimetres), high speed, high positioning precision and multi-axis actuation capability. For parametrically excited magnetic manipulators, they have demonstrated, both through theoretical modelling and experiments, that parametric excitation can be employed to trap and re-orient magnetic micro-particles. In squeeze-film based stage levitation project, Foster's type-II networks were designed and implemented to drive piezo-actuators at high frequencies and with arbitrary periodic waveforms. In active ball and socket joints project, a magnetically actuated ball and socket joint was developed. They also work on large range, linear piezo-electrically actuated nano-positioners where they have identified scaling laws for the best achievable linearity for multi-stage bridge amplifiers and their dependence on the amplification factor and the range.

In the area of ion mass spectrometry, work on power series expansion of axially symmetric toroidal harmonics for toroidal ion trap was undertaken. A different study used an optical grating with irregular spacing and the nature of light coming out was analysed. This has application in precision spectroscopy mainly in astrophysics. Differentiation in a non-invasive way between different types of brain lesions is important in both diagnostics and treatment. This work concentrated on differentiating Ischemia and brain tumour using statistical analysis.

The FBG Lab works on development of newer techniques for monitoring strains using fibre optic sensors, addressing the important need of developing integrated systems for structural health monitoring of aircrafts, ships etc. Their group is also involved in the development of fibre optic sensor system for underwater applications including tsunami sensing.

SIGNIFICANT ADVANCES AND INNOVATIONS:

Over the last academic year, we have developed a photoacoustic polarisation–enhanced optical rotation sensing (PAPEORS) system, capable of estimating optical rotation from photoacoustic signals and correlating it with chiral molecular concentration for depths up to 3.5 mm. PAPEORS achieved a detection limit of 80 mg/dl while using circularly polarised light with serum samples, demonstrating the potential for deep-tissue chiral molecular sensing. PAPEORS is poised to hold promise for in-vivo sensing and easy miniaturisation using single wavelength.

Multi-wavelength pulsed laser sources are essential for photoacoustic imaging (PAI), where each wavelength targets specific endogenous absorbers such as lipids, haemoglobin, and water. Hence, we explored a promising approach using a cascaded Raman fibre laser, based on a passively Q-switched Yb-doped fibre laser combined with a fibre-optic tunable filter. The system offered continuous wavelength tunability across the second near-infrared window (1060–1600 nm) and, through harmonic generation, extends into the visible range (530–600 nm). It delivers nanosecond pulses (40–200 ns) at repetition rates of 20–80 kHz, with pulse energies up to ~10 µJ in the NIR-II region and ~0.1 µJ in the visible. This work highlights the potential of a fibre-based, single broadband tuneable source to simplify hyperspectral PAI system design.

We have also developed a portable multi wavelength system for optical interrogation of the High-performance Optical Spectroscopy (HPOS) assay for accurate diagnosis of Sickle Cell Anemia. The system consists of an optical setup for sample interrogation and a single board computer for data acquisition. The system was optimised for low power usage and the acquired data can be transferred using wireless connectivity. The biochemical assay was optimised to improve the separation of optical properties of the samples when interrogated with the newly developed optical system. A novel data analytical method was also developed that significantly improves the accuracy of classification. Successful Technology Transfer, post joint development of HPOS Technology, to ShanMukha Innovations Pvt. Ltd., FSID incubated startup, which enabled IISc to join the CSR initiative with IOCL and GoK-NHM (Project CHAnDAna) for strengthening 422 Primary Health Centers (PHCs) of Karnataka in 2024 and perform point-of care diagnostic testing of two lakh tribal population in Mysuru, Kodagu and Chamarjanagara districts aligning with the National Sickle Cell Anemia Elimination Mission. A total of 712 Community Health Officers (CHO) and 2849 ASHA workers have been trained to effectively use IISc's technology in delivering quality comprehensive care for the tribal population across 2056 villages.

Further, we have developed a new way to estimate haemoglobin (Hb) using a 2-LED Point-of-Care (PoC) device. The core of this approach is an algorithm that calculates the absorbance difference between the two LEDs, which significantly reduces errors in haemoglobin quantification.

To realise such a high-throughput multicolour interrogation modality, we have developed a light-sheet based flow imaging system that is capable of visualising multiple sub-cellular components with organelle-level resolution. This is possible due to the unique optical design that combines an illumination system comprising two collinear light sheets illuminating the flowing cells and a dedicated dual-colour 4f-detection, enabling simultaneous recording of multiple organelles. The data is then computationally processed (filtered using ML algorithm, shift-corrected, and merged) and combined to reconstruct the 3D multicolour volume. Drug treatment studies were carried out for healthy and cancerous HeLa cells to check the performance of the proposed system.

The photoacoustic/optoacoustic (OA) signals are typically distorted by spatial impulse response of the transducer and the estimation of pressure distribution becomes inaccurate, which is apparent in the reconstructed optoacoustic tomography (OAT) images. We aimed at improving the degraded OAT images by eliminating the effect of spatial impulse response (SIR) of the transducer array. We modelled and corrected the SIR for two transducer array configurations namely focused-concave array and unfocused-linear array transducer. The comparison revealed that SIR affect was more prominent with the focused-concave array case compared to unfocused-linear array case.

We also developed a novel multiscale, multi-material fabrication platform that combines lithographic patterning with droplet-on-demand (DoD) material deposition for applications in optics, electronics, and packaging. This hybrid approach leverages mask/maskless lithography, photolithography, direct laser writing, and nanoimprint lithography (NIL) for precise nanoscale features, while DoD techniques such as inkjet, aerosol jet, and electrohydrodynamic printing (EHD) enable controlled deposition at micro- to millimetre scales. A key feature of this technology is its ability to process diverse materials, including high-index polymers, dielectrics, active materials, functional oxides, conductive inks, and optical and structural composites, enabling the fabrication of integrated photonic circuits, microelectronics, and advanced packaging solutions. It also facilitates the precise deposition of passivation layers, conductive traces, and encapsulation materials essential for IC and photonic integrated circuit (PIC) packaging.

Our department is also involved in 2D materials research, wherein we developed a novel non-linear transport technique that works at zero magnetic field and provides important insights into the Fermi surfaces and topological properties of moire materials. We developed planar tunnelling as a unique probe to moire materials.

On the quantum technology front, we have also developed a general protocol for generating high-dimensional multipartite entanglement and applied it to trapped ion systems. A protocol for exciting a superconducting qubit without input microwave excitation, using diabatic transitions to generate single microwave photons was pursued.

On the core engineering front, multiple projects were taken up like identification of power-law dependence of linearity on range and amplification factor in case of multi-stage bridge amplifiers, demonstration that parametrically trapped magnetic particles can be employed as 6-degree-of-freedom end-effectors. Fosters' network-based drivers for piezo-actuators to track high-frequency, large amplitude, periodic waveforms. Demonstration of optimal actuator design for voice-coil motors and diamagnetically levitated stages.

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SAI SIVA GORTHI | PhD (EPFL), Associate Professor

TAPAJYOTI DAS GUPTA | PhD (Ecole Polytechnique), Assistant Professor

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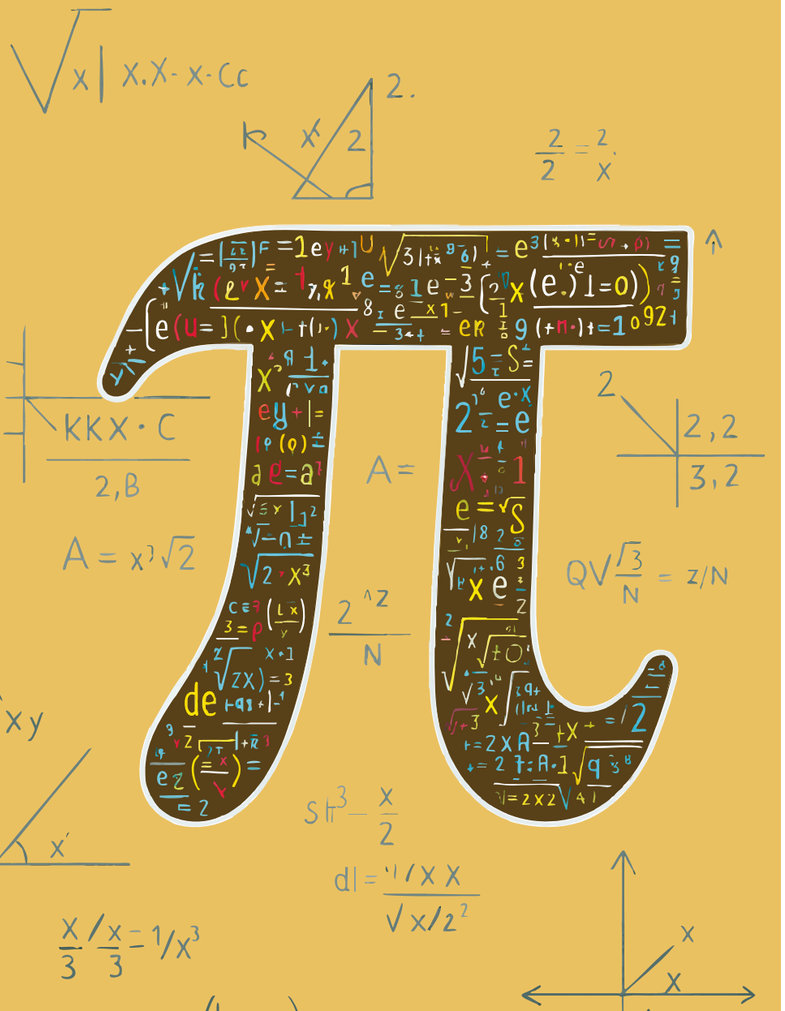
CHANDNI U | PhD (IISc), Associate Professor

MANUKUMARA MANJAPPA | PhD (NTU Singapore), Assistant Professor

3.6.4
Mathematics

The Department of Mathematics comprises 28 faculty and over 60 affiliated researchers. Its research profile represents diverse interests, ranging from pure to applied mathematics, and collaborations in related fields. It has a vibrant atmosphere in which members with different interests collaborate with each other and with researchers internationally.



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IN NUMBERS

28 Academic Staff
05 Inspire Faculty
20 Postdocs
25 PhD Students
22 Int. PhD Conferments
06 Int PhD Conferments (April 24-March 25)
06 PhD Conferments (April 24-March 25)

Chair: AK NANDAKUMARAN

Current **Research**

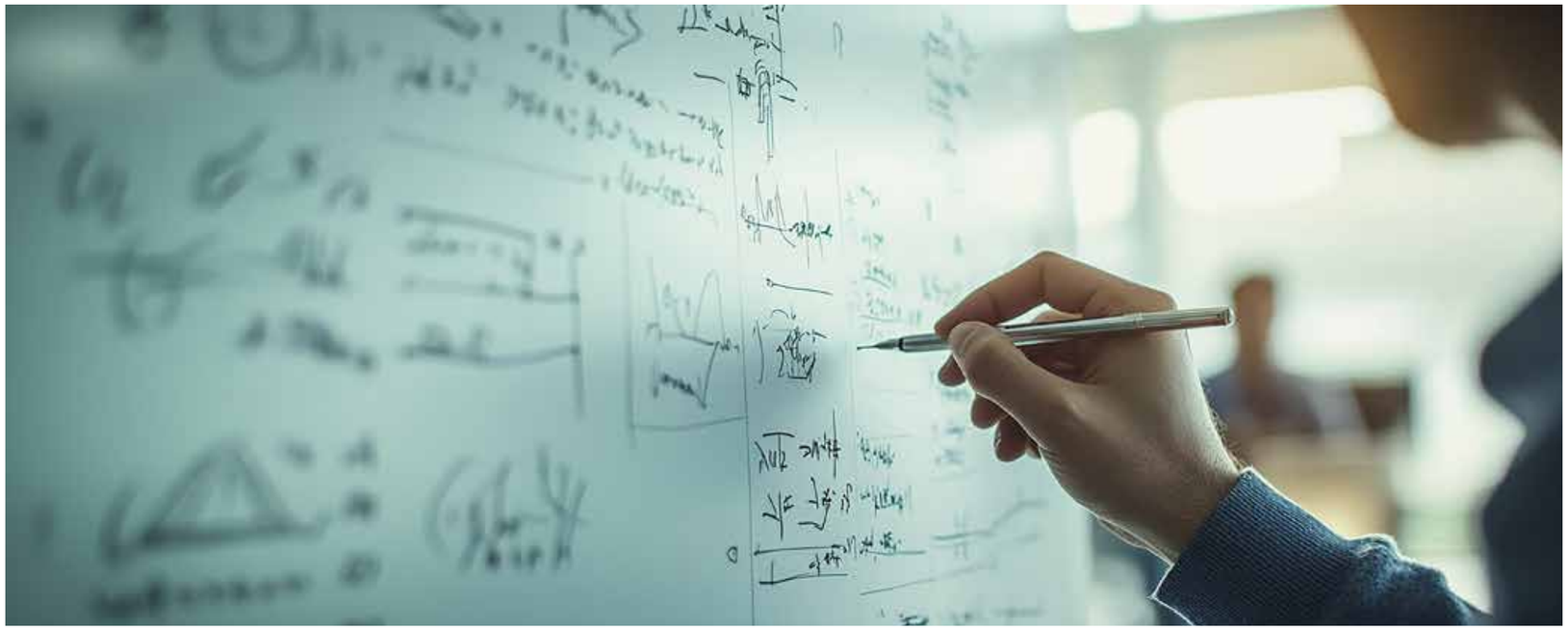
The collective research output of the Department of Mathematics during 2024–2025 reflects the strength of its foundational expertise and its commitment to exploring emerging frontiers. From tackling geometric analysis in singular spaces and advancing operator theory, to contributing to the resolution of long-standing conjectures in number theory and expanding stochastic models through graph limits, the department continues to play a leading role in global mathematical innovation.

Partial Differential Equations and Variational Analysis
Research in this area addressed central questions in both Euclidean and non-Euclidean settings. New results established compactness and regularity for Yang–Mills energy in super-critical dimensions (i.e., dimensions higher than four), under sharp curvature constraints, pushing the boundaries of classical gauge theory.

A particularly significant development was the establishment of excess decay estimates for the p-Laplacian in the Heisenberg group, a foundational result in the regularity theory of nonlinear PDEs in sub-Riemannian geometries. This represents a major advancement in understanding the fine structure of solutions in settings where

Core **Research**

Partial Differential Equations, calculus of variations, numerical analysis of PDEs, combinatorics, functional analysis, operator theory, harmonic analysis, mathematical physics, statistical physics, algebraic number theory and automorphic forms, representation theory, probability and stochastic processes, differential geometry and topology, geometric analysis, several complex variables, complex analytic dynamics, computational geometry, metric geometry.



standard Euclidean tools fail and lays the groundwork for future results in geometric analysis on non-Euclidean spaces.

Further studies extended to the homogenisation of optimal control problems governed by PDEs, including convergence results crucial for multiscale modelling. Computational advances were achieved via the development of adaptive finite element methods for linearised Navier–Stokes and Stokes equations, providing rigorous error estimates and practical reliability.

Geometry, Topology, and Complex Differential Structures
Substantial contributions were made to higher Teichmuller theory through the study of representations of surface groups into higher-rank Lie groups. Work in complex differential geometry examined the Yamabe problem for vector bundles and proposed alternative variational formulations based on Hermitian–Einstein metrics and Yang–Mills flows.

Kahler geometry saw further development with results on rigidity and comparison theorems for metrics with conical singularities, expanding classical geometric theory to singular spaces. These studies also offer implications for moduli space structures and canonical metrics in complex geometry.

Representation Theory and Algebraic Combinatorics
In representation theory, new results addressed positivity phenomena in semisimple Lie algebras, particularly concerning trace positivity under constraints inspired by Hodge theory. Research on symmetric groups explored the asymptotic behaviour of character values and structural aspects of induced characters, deepening the combinatorial understanding of classical representation theory.

Connections between combinatorics and statistical mechanics were also strengthened through investigations of partition cores and dimer models, yielding new algebraic interpretations and combinatorial identities.

Operator Theory and Functional Analysis
Progress in multivariable operator theory included the development of models for doubly commuting operator tuples and an enriched functional calculus for contractive systems. The theory of Hilbert modules over function spaces such as the bidisc and symmetrised bidisc was expanded, contributing to the interface between function theory and operator algebras.

Additional work established a zero-product theorem for Toeplitz operators on Bergman-type spaces, refining understanding of operator interactions on complex domains.

Harmonic and Fourier Analysis
Research in harmonic analysis extended classical approximation theory to abstract settings, including hypergroups. Results characterised the L^p-asymptotics of approximate identities in weighted function spaces, with implications for generalised Fourier analysis on algebraic structures beyond groups.

Probability Theory and Stochastic Structures
New universality results were derived for stochastic processes via resolvent-based techniques. These results apply to random walks in inhomogeneous spatial settings, including those modelled by graphons—limit objects for sequences of dense graphs. This framework connects probability theory, graph limits, and spectral analysis.

Other work in probability examined fine asymptotic behaviour such as the law of iterated logarithm for lemniscates and the zero sets of random polynomials, linking stochastic processes with complex geometry.

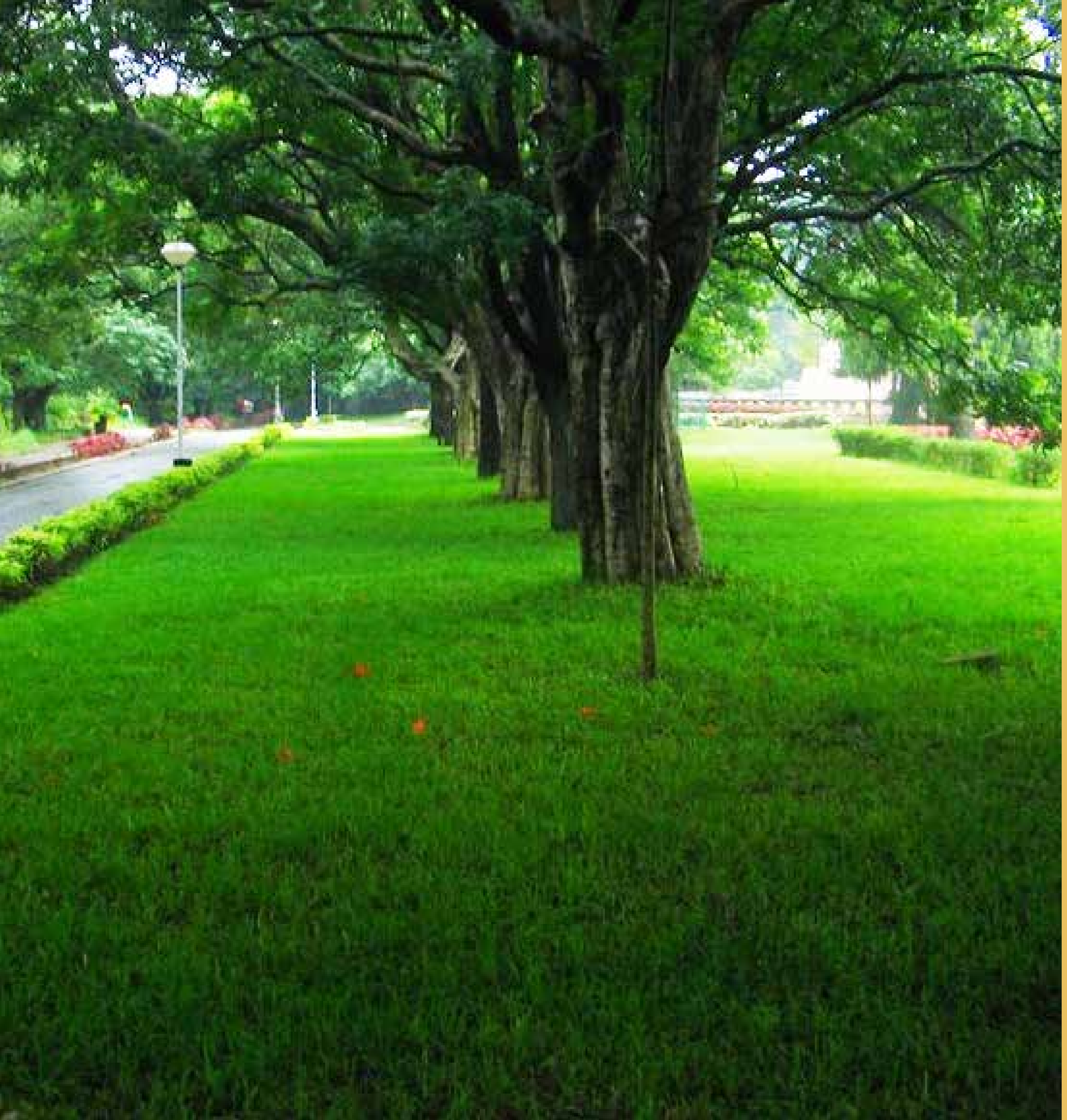
Number Theory and Arithmetic Geometry
The department's number theorists contributed significantly to the study of automorphic forms, including analytic bounds on L^4-norms and sup-norms for forms on Hilbert modular surfaces and Maass waveforms. Advances were made in the study of Hilbert modular forms, particularly regarding unramifiedness of weight one eigenforms and congruences involving Eisenstein series.

Work related to the Stark conjecture progressed through the algebraic construction of Brumer–Stark units and explicit formulations within Iwasawa theory. Further developments in this area addressed deep links between modular forms and Galois representations.

Several Complex Variables and Metric and Computational Geometry
Research in several complex variables focused on intrinsic metrics and holomorphic extension problems. Notably, quantitative lower bounds were established for the Carathéodory distance on complex domains, contributing to a deeper understanding of biholomorphic invariants and their behaviour across different geometries.

Holomorphic extension problems were also studied in the context of CR (Cauchy–Riemann) geometry, especially those involving hybrid extensions across real-analytic submanifolds. These investigations combined analytic techniques and geometric reasoning to explore when CR functions admit holomorphic extensions into ambient complex spaces.

Further work intersected with computational geometry, particularly in the design of data structures and algorithms for representing semi-algebraic sets—geometrically defined sets characterised by polynomial inequalities. These contributions link complex analytic theory with algorithmic approaches, with applications in symbolic computation and real-analytic geometry.



Faculty & Staff

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NMI Distinguished Associates:

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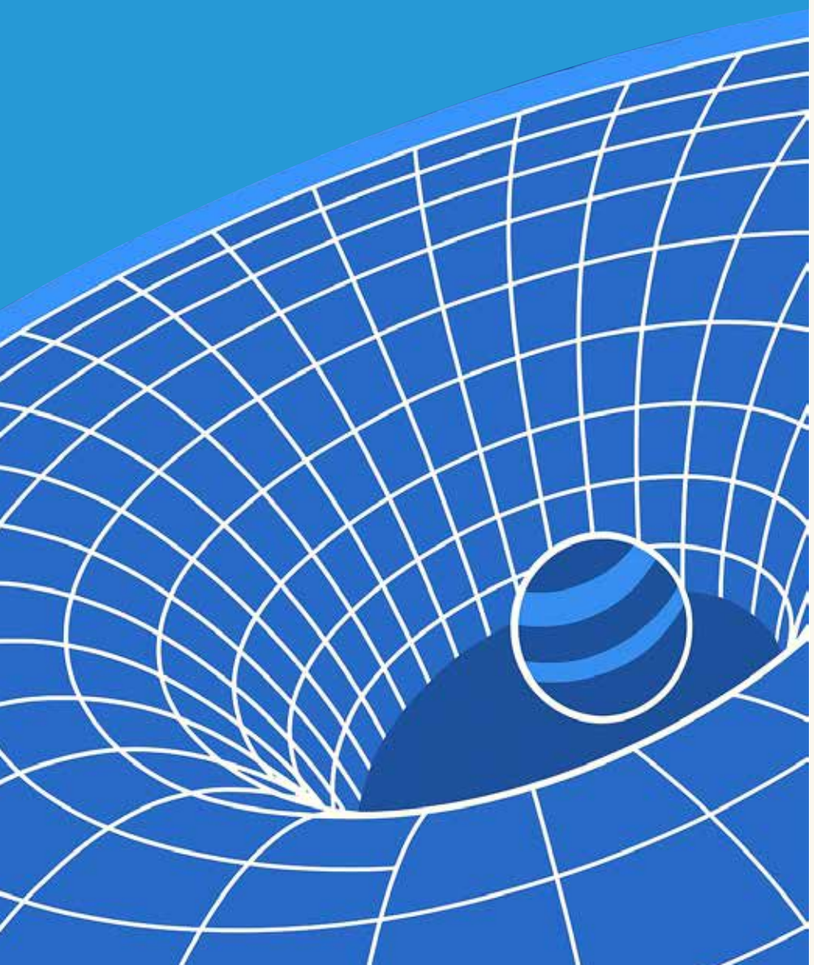
K B SINHA, FASc, FNA, FTWAS

3.6.5 *Physics*

The Department of Physics was established in 1933 by the Nobel Laureate CV Raman. Illustrious names of Indian science such as Homi Bhabha, Vikram Sarabhai, RS Krishnan, GN Ramachandran, S Ramaseshan and TV Ramakrishnan have been associated with this department. It is now a well-established research centre for condensed matter physics and astrophysics. Since 1982, the department has been successfully running the Joint Astronomy Programme (JAP), a unique PhD programme in Astrophysics and Cosmology along with IIA, ISRO and RRI.



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PhD, Int PhD and BS/MS (Research)

IN NUMBERS

13 Academic staff
27 Academic Staff
5 Scientific
6 Technical Staff
113 PhD Students
116 Int PhD Students
96 Publications
7 Int PhD Conferment
20 PhD Conferment
2 JAP Conferment
4 MS Conferment

Chair: JAYDEEP KUMAR BASU

Current **Research**

Theoretical Condensed Matter Physics
In soft condensed matter physics, extensive molecular dynamics simulations were performed to understand the proton dynamics of water confined in graphene nano slit. Investigations of nonequilibrium pattern formation and nonequilibrium transport were carried out to investigate signalling and response of cancer cells and immune cells. New insights were obtained on active turbulence in inertial self-propelled systems, odd elasticity, and emergent liquid crystalline order in cold dense domains in phase-separated two temperature active matter.

In quantum condensed matter physics, an emergent glass phase was discovered in the Kitaev model using density-matrix renormalisation group in the presence of a magnetic field. A novel scaling theory in the many-body Hilbert space and new order parameter description in terms of a correlation function for thermal to many-body localisation phase transition was formulated. The existence of various intriguing atomic insulating phases and a series of superfluid phases across the BCS to the BEC crossover were demonstrated for fermions coupled to discrete gauge fields. A new first-principle method for computing quasiparticle band structure and absorption spectra of materials with strong spin-orbit coupling by using spinor wave function within GW and Bethe-Salpeter equation was developed. A theory of unusual quantum oscillations in hybridisation-gap insulators was constructed.

Experimental Condensed Matter Physics
Two-dimensional electron gas under a strong transverse magnetic field is a powerful platform for studying interesting phenomena at the interface of two topological phases. Multifractality in the fluctuations of Hall conductance was experimentally demonstrated for the first time using such a 2D electron gas system undergoing a topological phase transition. Magneto-transport and thermoelectricity measurements revealed broken-symmetry states in magic-angle twisted bilayer graphene (TBG) at half-integer band fillings and zero external magnetic fields. In another work, because of the strong electronic interactions in non-dispersive bands of magic-angle TBG, a giant thermopower was experimentally probed. Exploiting quantum noise and Lindblad formalism, sideband cooling of mechanical resonators was achieved using a transmon qubit in c-QED setup. Flux-flow instabilities across BKT phase transition in KTaO3 (111)-based 2D superconductor have been explored. A universal method based on optical contrast between imaging systems was experimentally demonstrated for identifying the layer number in two-dimensional materials. Selectively strong coupling of B excitons of MoS2 to a hyperbolic metamaterial (HMM) was found, showing that the HMM works as an energy-selective coupler for multiexcitonic systems.

In photonics, fractionally quantised transport of spatial solitons was proposed and experimentally demonstrated in a system of waveguide arrays realising a nonlinear Thouless pump.

Core **Research**

Astronomy and Astrophysics:
Cosmology, early universe physics, black holes, nuclear astrophysics, galactic dynamics, interstellar medium, solar physics, and plasma physics

Atomic and Optical Physics:
Topological photonics, femtosecond laser fabrication, ultrafast optical phenomena Experimental Condensed

Matter Physics:
Spectroscopy, electrical transport, low-temperature physics, two-dimensional materials, thermoelectrics, superconducting quantum devices, photonic topological materials, biophysics

Theoretical Condensed Matter Physics:
Strongly correlated electrons, topological insulators, twistronics, many-body quantum dynamics, soft matter, biophysics, and nonlinear physics

Ligand field-induced electronic structure of bulk α-RuCl3 single crystals was probed using unpolarised photoluminescence (PL) spectroscopy under linearly polarised excitation in the visible region. Charge transport has been investigated in PEDOT:PSS showing delocalisation and insulator-metal transition. A half-Heusler type high entropy alloy Ti2NiCoSnSb was shown to exhibit interesting thermoelectric properties such as enhanced Seebeck coefficient and electrical conductivity. By investigating the resistance fluctuations near the Lifshitz transition in WTe2 devices, the effects of interband scattering were explored. Cr-doped lithium ferrites were synthesised, characterised, and then, the tuning of magnetic properties in such compounds were studied. Raman and X-ray diffraction measurements on (Eu1-xBix)2Ir2O7, FePS3, Ag3LiIr2O6 and SinBi4Te7 revealed a wide variety of phenomena, including metal-insulator transition accompanied by paramagnetic to all-in/all-out (AIAO) spin ordering, the presence of a Weyl semi metal phase, and anomalous temperature dependence of phonon modes. Ge-Te-Se glasses that are suitable for infrared optics applications were prepared with high thermal stability and minimal fragility. An increased nonlinear susceptibility and refractive index is reported in quaternary In-Sb-S-Se thin films upon annealing at different temperature which makes the substrate suitable for nonlinear photonic applications.

In soft matter experiments, the self-assembly of functionalised colloidal membranes and collective phototaxis of microalage Chlamydomonas reinhardtii are being explored.

Astronomy, Astrophysics and Cosmology

The research interests of the astronomy, astrophysics and cosmology group cover a vast range of topics such as solar physics, magnetohydrodynamic turbulence, galactic dynamics, accretion discs, physics of compact objects, nuclear and plasma astrophysics, numerical simulations, intergalactic medium, radio astronomy, neutral hydrogen 21-cm, turbulence in the interstellar medium, observational cosmology, inflationary cosmology and physics of the early universe. In solar physics, further work on the mean-field theory of meridional circulation was done to show how it arises out of an interplay between the centrifugal and thermal wind terms. In galactic dynamics, a new mechanism to generate lopsidedness in a large fraction of observed galaxies was proposed. In accretion physics, stability of accretion discs and flows around compact objects was studied in the presence of large-scale magnetic field and detection possibility of continuous gravitational waves from rotating magnetised neutron stars was analysed. In plasma astrophysics, multiphase turbulence in the intracluster/circumgalactic medium using numerical simulations, interaction of an inclined AGN jet and the observations of Fermi bubbles in the galactic center and massive star clusters as accelerators of PeV cosmic rays were studied. Detection of HI 21-cm emission from a strongly lensed galaxy at redshift z=1.3 was reported and various studies were carried. In theoretical cosmology, warm inflationary models were studied for the generation of primordial black holes (PBH) as dark matter candidates and the PBH evaporation signatures such as dark radiation were also studied. A new scenario for the alleviation of Hubble tension was also proposed within the framework of Horndeski theories.

Plasma Physics

Global gyrokinetic simulation of microturbulent transport for LHD stellarator and ADITYA-U tokamak were carried out. These global simulations verify and validate the experimental observations, such as the nature of the modes, frequencies, and transport coefficients.

Other highlights

Raman and x-ray diffraction studies on Ta2NiS5 and pyrochlore iridates (Sm1−xBix)2Ir2O7, Pr2Ir2O7, Gd2Ir2O7, Dy2Ir2O7 and Er2Ir2O7 have revealed pressure-induced structural phase transition from orthorhombic Cmcm structure to another orthorhombic Pmnm structure, at 4.2 GPa and an additional phase transition at 10.8 GPa, associated with a semiconductor to metal transition in Ta2NiS5 and pressure-induced iso-structural phase transition in pyrochlore iridates (A2Ir2O7, A= Sm, Pr, Gd, Dy and Er) and Bi doped (Sm1-xBix)2Ir2O7 and this transition correlates inversely with the A-site cation radius, as the transition pressure Pc decreases from ~10.8 GPa (Er, smallest cation) to ~7.5 GPa (Pr, largest cation).

Vijay B Shenoy:

This group theoretically demonstrated a new class of semi-metallic phases called "Delicate Semi-Metals". The semi-metallicity here is protected by unstable homotopies. A second highlight from this research group is the investigation of arboreal topological phases of free fermions. This group demonstrated that fermionic system on tree-like structures can host many novel phenomena; these include a new type of arboreal universality in phase transitions, protected edge modes even in metallic phase.

Sumilan Banerjee:

This group developed a new dynamical mean theory formalism to calculate quantum entanglement in correlated electronic systems. They established a novel connection between chaotic transition in classical stochastic dynamics and semiclassical limit of a measurement-induced transition in monitored quantum systems.

Anindya Das:

Quantum information transfer using charge-less carriers, such as spin wave excitations (magnons) and Goldstone modes, holds great potential for next-generation quantum devices, enabling data processing and transmission with extremely low power consumption. In a study, the authors utilise quantum Hall ferromagnets in graphene and bilayer graphene, which, under a strong magnetic field, are expected to host gapless collective excitations that are thermally conductive despite being charge insulating. To investigate these excitations, the researchers employ advanced

thermal transport techniques to probe heat flow.

Subroto Mukerjee:
This group discovered novel vortical transport coefficients for electron systems in the hydrodynamic regime and calculated them in terms of the Berry curvature arising from band structure. They also obtained the Onsager reciprocity relations for vortical coefficients from principles of microscopic reversibility.

In a collaboration with the experimental group of Arindam Ghosh, they calculated the thermal conductivity and electrical conductivity to explain the observed violation of The Wiedemann-Franz law in the Dirac fluid regime of graphene.

In a collaboration with the experimental group of Anindya Das and the theoretical groups of Sumilan Banerjee and Nandini Trivedi (Ohio State University), they calculated the thermopower at low temperatures and high magnetic fields in magic angle twisted bilayer graphene and demonstrated the existence of local moments.

In a collaboration with the group of Urbasi Sinha (Raman Research Institute), they demonstrated intraparticle entanglement in noisy quantum channels and showed that, counter-intuitively, noise can contribute to the revival of entanglement.

They showed that a PT symmetric non-Hermitian quantum kicked rotor can display a transition from an integrable to a chaotic phase and from a PT symmetric to a PT symmetry broken phase. They further demonstrated that in this system the breaking of PT symmetry is a sufficient condition for chaos.

Akshay Singh:
An easy-to-implement memristor was demonstrated, composed of hexagonal boron nitride and graphene layers, which can be manipulated with light to achieve multiple non-volatile resistance states. An optical imaging method for measuring the quality of interfaces in two-dimensional materials was demonstrated. In synthesis, the type of defects and amount of strain in differently prepared atomically thin MoS2 by a comprehensive experimental-theoretical approach was shown.

Jaydeep K Basu:
This group has developed a method to enhance and purify light emission from 2D semiconductor colloidal quantum wells (CQWs) at room temperature. By integrating these tiny light sources with specially designed dielectric metasurface resonators (MSRs), they have created a system that emits pure light with high efficiency. The integration of CQWs with MSRs led to a significant enhancement and spectral purification of the light emitted by the CQWs. They demonstrated that their setup can transport light over long distances on a chip, which is useful for creating on-chip light sources. Their experimental results were supported by theoretical and numerical models, explaining the data in terms of modified light-matter interactions (Lamb shifts and Purcell decays).

Anil Kumar PS:
This group has prepared three sets of PMA (perpendicular magnetic anisotropy) multilayer samples to investigate current-induced magnetisation switching. The first set involved Ta/Pt/Co/Pt multilayers with modifications to the Co/Pt interfaces through the introduction of Au spacer layers. The second set featured Ta/Pt/Co/Au and Ta/Pt/Au/Co/Au multilayers, while the third set included Ta/Pt/Co/Pt/Ta, Ta/Pt/Au/Co/Pt/Ta, and Ta/Pt/Au/Co/Pt/Ta/Co/Pt samples. Results from current-induced magnetisation reversal (CIMR) studies demonstrated that inserting an Au layer at the bottom Pt/Co interface significantly lowered the current density required for magnetisation switching (Jc), with reductions of up to approximately 58% for the Ta/Pt/Au/Co/Pt/Ta sample compared to the unmodified structure. Additionally, field-free magnetisation switching was achieved in specific multilayers at a critical current density of 1.55 × 10^{11} A/m².

They investigated the magneto-transport properties of two types of (111)-oriented Dy Ir O thin films; one mainly relaxed and the other strained. Below their respective magnetic ordering temperatures, both Dy^{3} and Ir^{4} ions adopted an all-in-all-out spin configuration. Analysis of field-dependent resistivity revealed that, at a critical field, Dy^{3} spins switched,

shifting to a 3-in-1-out or 1-in-3-out arrangement. This induced domain imbalance among Ir^{4} ions, resulting in magnetoresistance hysteresis. In anomalous Hall effect (AHE) measurements, a topological-like Hall signal appeared near the field where the Dy spin configuration changed and Ir domains became unbalanced. Notably, the strained film displayed a spontaneous Hall signal, attributed to broken cubic symmetry, while the relaxed film did not.

Faculty & Staff

SUMILAN BANERJEE | PHD (IISC), Associate Professor
JAYDEEP KUMAR BASU | PHD (CALCUTTA), FASC, Professor
AVEEK BID | PHD (IISC), ASSOCIATE PROFESSOR
PRASAD VISHNU BHOTLA | PHD (IISC), CHIEF RESEARCH SCIENTIST
ANINDYA DAS | PHD (IISC), Associate Professor
TANMOY DAS | PHD (NORTHEASTERN), Associate Professor
SUJA ELIZABETH | PHD (IISC), CHIEF RESEARCH SCIENTIST
R GANESAN | PHD (IISC), PRINCIPAL RESEARCH SCIENTIST
ARINDAM GHOSH | PHD (IISC), FASC, FNASC, FNA, Professor
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PRERNA SHARMA | PHD (TIFR MUMBAI), Associate Professor
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VIBHOR SINGH | PHD (TIFR MUMBAI), Associate Professor
PRANTIKA BHOWMIK | PHD (IISER CALCUTTA), Assistant Professor
SHIBANANDA DAS | PHD (COLOGNE, GERMANY), Assistant Professor
SHUBHADEEP BISWAS | PHD (TIFR MUMBAI), Assistant Professor

Associate Faculty

ARVIND AYYER | PHD (RUTGERS), Associate Professor
AMBARISH GHOSH | PHD (BROWN), FASC, Professor
DIPTIMAN SEN | PHD (PRINCETON), FASC, FNASC, FNA, Professor

Honorary & Distinguished Faculty

SRIRAM RAMASWAMY | PHD (CHICAGO), FASC, FNASC, FNA, FRS, Professor
ARNAB RAI CHOUDHURI | PHD (CHICAGO), FASC, FNASC, FNA, Professor
CHANDAN DASGUPTA | PHD (PENNSYLVANIA), FASC, FNASC, FNA, FTWAS, Professor
CHANDA J JOG | PHD (NEW YORK), FASC, FNASC, FNA, FTWAS, Professor
H R KRISHNAMURTHY | PHD (CORNELL), FASC, FNASC, FNA, FAPS, FTWAS, Professor
RAHUL PANDIT | PHD (ILLINOIS), FASC, FNA, FTWAS, Professor
AK SOOD | PHD (IISC), FASC, FNASC, FNA, FTWAS, FRS, Professor

3·7

Centers

Under the Director

3.7.1 *JRD Tata Memorial Library*

Established in 1911, the JRD Tata Memorial Library at the Indian Institute of Science is one of India's oldest and most modern science and technology libraries. Over more than a century, it has built a rich collection of books, journals, reports, theses, Indian patents, and standards, including rare reference materials and back volumes of key journals. In addition to its vast print resources, the library offers a comprehensive range of e-journals, eBooks, and online databases, serving as a vital information hub for the campus community.

In 2024–25, the JRD Tata Memorial Library significantly enhanced its academic collections by adding 401 books, 85 gifted/donated books, 13 eBooks, and processing 68 books for departmental libraries. Additionally, 237 e-journals, 383 PhD theses, and 29 MTech (Research) dissertations were added. The library's total holdings now exceed five lakh physical documents, including books, bound journals, technical reports, standards, and theses. With a focus on digital access, the library primarily subscribes to electronic-only resources, currently offering access to around 13,000 e-journals, 15,000 eBooks, 37,800 standards, and 26,000 conference proceedings, with an annual expenditure of nearly INR 23 crores.

During the reporting period, the circulation section registered 1,736 new members, reflecting the library's continued growth in user engagement. A total of 20,957 circulation transactions were carried out, encompassing borrowing, returning, and renewals of materials. In addition to routine circulation activities, the staff regularly performed reshelving, shelf rectification, and shifting of materials to ensure optimal organisation and accessibility of the library's collections.

Librarian:
UMESHAREDDY KACHERKI

The library continues to maintain pre-eminence in providing access to many e-resources. Some of the significant e-resources include the complete journal publications of the following publishers and societies:

1. American Association of Cancer Research (AACR)
2. American Chemical Society (ACS)
3. American Institute of Physics (AIP)
4. American Physical Society Journals, including Physical review Online (PROLA) Collection
5. American Society for Microbiology (ASM)
6. American Society of Civil Engineers (ASCE)
7. American Society of Mechanical Engineers (ASME)
8. Association of Computing Machinery (ACM)
9. ASTM Journals and Standards
10. Begell House Digital Library
11. Cell Press
12. Cambridge University Press (CUP) – Science Collection
13. Electrochemical Society (ECS)
14. Elsevier collections
15. Emerald
16. EMS and MSP journal packages
17. IEEE / IEL
18. Institute of Physics Publishing
19. Journal of Visualised Experiments (JoVE)
20. JSTOR
21. Microbiology Society
22. Optical Society of America (OSA)
23. Oxford University Press (OUP)
24. Rockefeller University Press
25. Royal Society of Chemistry - All Journals and its Archive
26. Society for Optics and Photonics (SIAM)
27. Society for Industrial and Applied Mathematics (SIAM)
28. Springer Nature – All Nature Branded Journals
29. Taylor & Francis
30. Wiley collection

Newspaper and Magazine Database

1. Edzter.com

New Databases

1. Lecture Notes in Computer Science (LNCS) – eBooks database
2. Tracxn – Market Research Tool

New Subscriptions

1. ASME current conference Proceedings
2. Begell Digital Library
3. SPIE Current Proceedings

One Nation One Subscription (ONOS)

The Government of India's ambitious initiative ONOS (https://www.onos.gov.in), which aims to provide country-wide access to high-impact scholarly research articles and journal publications to students, faculty, and researchers of all the Higher Educational and R&D Institutions managed by the government, has helped JRDTML expand its collection of scholarly content.

Currently, JRDTML has online access to all the full-text journals published by below mentioned 30 prominent publishers through ONOS.

1. ACM Digital Library Journals
2. American Chemical Society Journals
3. American Institute of Aeronautics and Astronautics Journals
4. American Institute of Physics (AIP) Journals
5. American Mathematical Society Journals
6. American Physical Society Journals
7. American Society for Microbiology Journals
8. Annual Reviews Journals
9. ASCE Library Journals
10. ASME Digital Collection Journals
11. Bentham Science Journals
12. BMJ Journals (NA)Access will be activated soon.
13. Cambridge University Press Journals
14. Cold Spring Harbor Laboratory Press Journals
15. Elsevier Journals (Science Direct)
16. Emerald Publishing Journals
17. ICE Publishing Journals
18. IEEE Journals
19. IndianJournals.com
20. Institute of Physics (IOP) Journals
21. Lippincott William & Wilkins (Wolters Kluwer) Journals
22. Oxford University Press (OUP) Journals
23. Project Muse Journals
24. Sage Publications Journals
25. Science (AAAS) Journal
26. SPIE Digital Library
27. Springer Nature Journals
28. Taylor and Francis Journals
29. Thieme Journals
30. Wiley Online Journals

Adoption of Koha Library Management System

The library has implemented Koha, an open-source integrated library system with modules for acquisitions, cataloguing, serials, circulation, reporting, and offline operations during network outages. Its scalability supports both single and multi-branch libraries. The Koha-powered OPAC allows users to search collections, place reservations, and access e-resources like e-books, e-journals, open-access textbooks, and theses, enhancing user experience and operational efficiency.

Conventional and Contemporary Library Services

The library continues to provide a blend of traditional and modern services to meet the diverse needs of its users. Conventional services such as document delivery, photocopying, reference assistance, and referral services remain integral to supporting academic and research activities. Notably, the library serves as a designated UGC Document Delivery Centre for the southern region of India, reaffirming its role in facilitating timely access to scholarly resources for the wider academic community.

Some of the contemporary services provided by the library include:

1. **IISc Publications Repository (ePrints@IISc)**
   ePrints@IISc is one of the country's earliest and largest institutional repositories for the institute's research publication. The erstwhile National Centre for Science Information (NCSI) started the ePrints@IISc service. Since May 2012, the library has been administering and managing the service. The repository collects, preserves, and disseminates the research output created by the IISc research community. The repository content can be accessed through the search and browse functionalities. As of date, the

total number of publications in the repository is more than 67,000.

2. **IISc Theses and Dissertations Repository (ETD@IISc)**
ETD@IISc is one of the country's earliest institutional repositories for theses and dissertations. NCSI started the service in 2005. Since then, the library has been administering and managing the service. ETD@IIScis a digital repository for the theses and dissertations submitted by the IISc students. The repository captures, disseminates, and preserves the theses and dissertations of IISc. The repository content can be accessed through the search and browse functionalities. As of date, the total number of records in the repository is more than 6,835.

3. **IISc Faculty Profiles**
The Indian Research Information Network System (IRINS) serves as a Research Information Management (RIM) platform to collect, curate, and showcase the scholarly contributions of IISc faculty and researchers. This system enhances academic visibility by integrating various academic identifiers, facilitating comprehensive research assessment, supporting institutional ranking frameworks, and streamlining academic reviews. By consolidating research data on a unified platform, IRINS promotes scholarly communication and increases the global discoverability of IISc's research output. The system also highlights metrics such as the top ten most-published faculty and total citation counts. Currently, the IISc IRINS platform hosts profiles for 596 faculty members across multiple departments.

4. **Remote Access to Subscribed Online Resources through Shibboleth-based Single Sign-on Service**
During the lockdown, with many unable to connect to the campus network via VPN, the library swiftly implemented Shibboleth, a federated single sign-on system, to ensure seamless off-campus access to subscribed online resources. Utilising widely adopted federated identity standards (SAML), Shibboleth allows users to authenticate with their institutional credentials, securely granting access while minimising data sharing.

Read and Publishing Transformative agreements:
The library has continued its read and publish agreements with the following six publishers: EDP Sciences, European Mathematical Society, Microbiology Society, Rockefeller University Press, Company of Biologists, and The Royal Society Publishing. These agreements have expanded our access to scholarly content without any enhancements in the subscription renewal costs. The read-and-publish agreements allow our researchers to publish research open access without paying article processing charges. It will have a positive impact on our students and faculty members.

RFID-Based Smart Library Services for Enhanced Access and Management:
The JRD Tata Memorial Library has implemented an advanced RFID system to modernise services and improve user experience. Self-check machines allow users to independently borrow, return, and check account details, while RFID-enabled book drop boxes facilitate easy returns outside the library. A Patron Traffic Counter (PTC) at the entrance automatically records visitor attendance, providing valuable user statistics for service planning. Handheld RFID scanners help staff locate misplaced items and perform quick stock verifications, and RFID-equipped workstations streamline circulation with greater speed and accuracy. This integration enhances resource retrieval, service efficiency, collection security, and overall management.

Enhancing Accessibility through Audio-Enabled QR Navigation:
As part of our commitment to inclusivity, the library has introduced a QR Code Row Guide System to improve accessibility for all users, particularly supporting differently abled individuals. Each QR code provides both offline text information and audio guidance, enabling visually impaired users to navigate collections independently and confidently. This initiative ensures equitable access to library resources, reflecting our continuous efforts to create a barrier-free and inclusive learning environment.

Promoting Wellness and Inclusivity through Ergonomic Support: In support of user well-being and inclusivity, the library has introduced new wellness resources designed to ease physical strain and promote mental health. These include stress-relief tools such as hand grippers and squeeze balls, particularly beneficial for users engaged in extended research sessions. Hands-free book holders are also made available to support comfortable, prolonged reading.

In its continued commitment to improving user experience, the library introduced several important service enhancements during the year. To better support the diverse needs of the academic community, the library now operates 24 hours a day from Monday morning through Sunday morning at 7:00 AM, providing uninterrupted access to its vast resources throughout the week. On Sundays and Institute holidays, the library remains open from 10:00 AM to 5:00 PM. Borrowing privileges have also been expanded across all membership categories, offering greater flexibility and convenience to users. During the reporting period, the library remained operational for a total of 7,518 hours and recorded a total of 1,61,527 user visits in the library system.

As part of its sustainability and user-centred initiatives, the library introduced wall-mounted planters, contributing to a greener, more inviting environment. These planters have been thoughtfully integrated into the compact storage areas, enhancing the aesthetic appeal while promoting environmental responsibility. In addition, to meet the increasing power needs of users, electric plug points have been installed in both compact storage and reading halls on the ground and first floors.

User Engagement Programmes Organised by JRD Tata Memorial Library

1. Use of Web of Science with Research Assistant and EndNote in Research, 2 April 2025.
2. Use of InCites, JCR, and ESI in Research, 3 April 2025.
3. Curie - Your Expert Companion in Academic Writing (webinar), 14 May 2024.
4. Tracxn: On-boarding Session for your Research Needs, 21 June 2024.
5. Exploring Reaxys AI Tool: Best Practices and New Advancement, 10 September 2024.
6. Wiley Author Workshop, 1 October 2024.
7. Enhance Your Research Workflow with Scopus and SciVal, 13 December 2024.
8. Follow-up webinar on Enhance Your Research Workflow with Scopus and SciVal, 24 February 2025.
9. National Library Week: Library celebrated 'National Library Week' betwen November 18-22, 2024. As part of the celebration, online quiz, tutorial on academic integrity, open book quiz, and treasure hunt were organised for the user community. Book Talk in association with students-run Kalpana (Literature Club) was also organised. Students, staff and faculty members have actively participated in all the events and various won prizes.

Other Professional Events Organised by JRD Tata Memorial Library
Library hosted the Bureau of Indian Standards (BIS) 31st meeting of the MSD-05 Documentation and Informational Sectional Committee on 2 December 2024. The meeting was attended by the members BIS Sectional Committee and officers of the library. The committee deliberated on standardisation of practices relating to libraries, documentation and information centres, indexing and abstracting services, bibliographic formats, conservation and preservation of print and non-print medium, archives, information science, document imaging applications, data processing, and aspects relevant to processing and handling of documents. Reviewed the status of formulation of various relevant standards and formed new panels for working on proposed new standards under the scope of the committee.

Professional Contributions
Senior library professionals at the JRD Tata Memorial Library have continued to demonstrate leadership and academic engagement through their active participation in the scholarly community. They have been invited as speakers at national and international conferences,

served on advisory boards, academic committees and panels across reputed institutions. Their research contributions, published in esteemed journals and conference proceedings, reflect the library's dedication to advancing the field of library and information science and addressing emerging challenges in the digital knowledge landscape.

Publications

1. Ahirwal, Ashish Kumar, J Shivarama and M Mariappan, Thematic Evolution of Publications on Augmented and Virtual Reality within the Healthcare and Medicine categories', 2nd National Conference on Artificial Intelligence & Machine Learning in Digital Health Transformation & Social Sciences, *Virtual & Augmented Reality* (2024).

2. Ahirwal, Ashish Kumar, J Shivarama and M. Mariappan, Correlations Between Citation and Mendeley Readership: An Altmetric Study of Pharmaceutical Sciences Scopus Scholarly Publications of India, 2nd National Conference on Artificial Intelligence & Machine Learning in Digital Health Transformation & Social Sciences, *Virtual & Augmented Reality* (2024).

3. Kavi, Pradeep P and Singh, Dharamvir, Scientometric Portrait of Prof. Roddam Narasimha, an eminent Indian Aerospace Scientist. *Kelpro Bulletin.* 28(2), pp. 37-55, (2024).

4. Kavi, Pradeep P and Singh, Dharamvir, Research Productivity of Indian Institute of Science (IISc) Bengaluru 2002 – 2021: A Study. *Library Herald.* 62(4), pp. 542-564, (2024).

5. Kavi, Pradeep P and Singh, Dharamvir, Analysis of Electronic Theses & Dissertations (ETD) Submitted to IISc for the Period 2004-2021: A Study. National Conference on Connecting Users to Library Resources through Innovative Technologies. *SALIS* 2024. Coimbatore. pp. 193-200, (2024).

Francis Jayakant

1. Jayakanth, Francis. Understanding the Role of Persistent Identifiers in scholarly Communication. *Festschrift Volume in Honour of KA Isaac,* (2025).

INVITED TALKS

Umeshareddy Kacherki

1. "Best Practices in Library and Information Science" during the webinar organised by The LNM Institute of Information Technology (Deemed University), Jaipur. 29 June 2024.

2. "Research Lifecycle and the Role of Libraries" at the Dept. of Studies and Research in Library and Information Science, Tumkur University, Tumakuru. 31 August 2024

3. "Applications of AI in Scholarly Communication" during 12th Convention, Promotion of Library Automation and Networking in North-Eastern Region (PLANNER) - 2024, organised by Information and Library Network (INFLIBNET) Centre and Rajiv Gandhi University, Itanagar, Arunachal Pradesh. 21 September 2024.

4. "Scholarly Communication and Artificial Intelligence" during the seminar on 'Shaping the Future Libraries' organised by the Dept. of Library and Information Science, Karnatak University, Dharwad. 8 February 2025.

5. "Hybrid Libraries: Striking a Balance Between Print and Digital Resources" during the National Conference on Modern Library Technologies and Services (NCMLTS-2025) organised by Manipal Academy of Higher Education (MAHE). 29 March 2025

Suresh Balutagi

1. "Wellness in Libraries: Thursday Talks with IISc Bengaluru", organised by Taylor and Francis India, 18 April 2024.

2. "Best Practices @ JRD Tata Memorial Library, Indian Institute of Science, Bengaluru", Organised by LNMIT, Jaipur, 29 June 2024.

Francis Jayakant

1. Delivered comprehensive lectures covering key topics in Information Science for IV semester students at the University of Madras, including web servers (Apache & Internet Information Server), CGI programming (JavaScripts and PHP), and various protocols (SOAP, Open URL, OAI-PMH).

2. Leveraging Content Management Systems for Digital Library Development: A Focus on DSpace-CRIS. Advanced Practices and Emerging Technologies in New Era Libraries, Faculty Development Programme, Christ University, Bengaluru, April 9-11, 2025.

3. Leveraging AI for Professional and Personal Development. Professor Kaula Endowment Lecture, 2025, University of Madras, Department of Library and Information Science, 21 February 2025, Chepauk, Chennai.

4. Introduction to Turnitin: Understanding Plagiarism Prevention & Academic Integrity. Advanced Level Training Programme on Intellectual Property Rights, Karnataka State Council for Science and Technology (KSCST) and Dept of Collegiate and Technical Education (DCTE), Govt. of Karnataka In association with IPTel, Indian Institute of Science (IISc) and Bengaluru Science and Technology (BeST) Cluster, February 3-7, 2025, S V Narasaiah Auditorium, Dept. of Instrumentation and Applied Physics (IAP), IISc.

5. Importance of Persistent Identifiers in Research Data Management: Overview of DataCite and Its Role. One-Day Awareness Programme on Research Data Management (Sponsored by DataCite-GAF Programme) organised by Information and Library Network (INFLIBNET) Centre, Gandhinagar, Gujarat in collaboration with Indian Institute of Science Education and Research Bhopal, Madhya Pradesh, November 16, 2024

6. Research Data Management. Linking, Informing and Sharing: Building Resilient Education and Library Systems (ICLIS-2024) multi-disciplinary" during 25- 26th July 2, Jain University, Bengaluru.

7. Introduction to Data Repositories: A Pillar of Open Science Infrastructure. Open Science Workshop Webinar Series: Introduction to UNESCO Open Science Framework. April 1-5, 2024, DSP-CPR, IISc.

HONOURS AND RECOGNITIONS

Francis Jayakant

1. Continuing as a DataCite ambassador for 2025, joining a prestigious cohort of individuals dedicated to bridging gaps and empowering communities through data.

PROFESSIONAL ACTIVITIES

Umeshareddy Kacherki

1. Member - "Shodhganga National Steering Committee (SNSC)", INFLIBNET Centre, An Inter University Centre of University Grants Commission, Gandhinagar, Gujarat.
2. Member - "Knowledge Resource Committee", Jayakar Knowledge Resource Centre, Savitribai Phule Pune University, Pune.
3. Member - "University Library Committee", Symbiosis International, Deemed University, Pune.

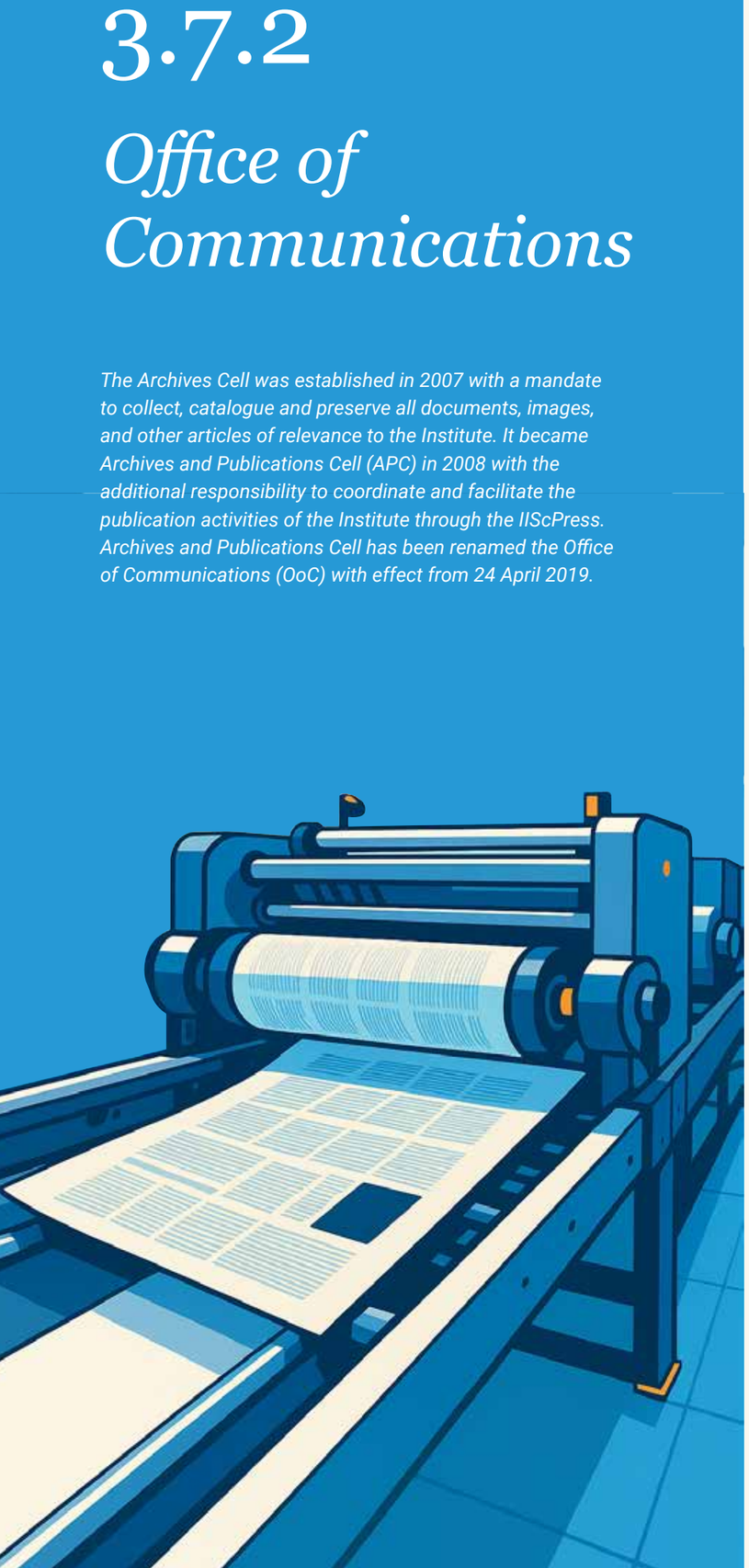
Suresh Balutagi

1. Served as "Conference Director" for the National Conference on Modern Library Technologies and Services (NCMLT- 2025), organised by The Central Library, Manipal Academy of Higher Education (MAHE), Bengaluru, 28th - 29th March 2025.
2. Member of Editorial Board, Journal of Indian Library Association.
3. Member Advisory Board, AEIDA Journal of Multidiscplinary Studies
4. Member RFID Implementation Committee, Indian Institute of Petroleum and Energy (IIPE), Visakhapatnam

3.7.2

Office of Communications

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. Archives and Publications Cell has been renamed the Office of Communications (OoC) with effect from 24 April 2019.



Chair: KAUSHAL VERMA

Some notable initiatives are the following:-

- OoC has extended the copy-editing services to the Institute community, students and faculty members for their papers, thesis, books, and so on.

- The office has established the "Writing Centre" to help and train students with academic writing.
  - **Tutorship:** The Writing Centre appoints paid tutors (senior PhD students and postdoctoral researchers from IISc) who will contribute five to ten hours a week for a period of three months to assist with the activities of the Centre.
  - **Short Course:** The Writing Centre offers multiple sessions of a short course for Master's, Integrated PhD and PhD students called Writing for Researchers.
  - **Undergraduate Course:** The Writing Centre offers a course specifically for undergraduate students called Essentials of Research Communication. The elective, offered in the seventh semester of the undergraduate programme, is designed to help students with their professional communications skills.

- Workshop: OoC also started a short-term science writing workshop through the Centre for Continuing Education

- Gifts and memento display and sale are one of the major tasks at OoC since from 2018. Alongside these, IISc merchandise is available which are open to public for purchase.

- Courses offered at the Office of Communications:
  - The course CO 201 Art of Communication for Leaders is being offered through the Office of Communications which is a 2 credits course for UG, PG and PhD students. This is a course that upskills students in areas such as facing interviews confidently and expressing themselves clearly.
  - The course CO 203 Stars, Optics and Fun is a first-of-its-kind course at IISc is to provide students an opportunity to understand basic astronomy and basic techniques of astrophotography. It will also serve as a platform to get hands-on experience with a range of tools and techniques and an exposure to astrophotography.

- Samvaada is a new initiative that aims to provide an informal platform for IISc staff members to come together and share something about themselves with a larger audience. A total of 4 sessions have been completed and the same are uploaded in the YouTube channel of the Office of Communications.

- IISc- Agastya Science Enrichment Programme 2025: This programme for school students (Class 11-12 students) was organised for the first time in the summer of 2024. It was envisaged as a short immersive programme that offered a range of activities (for the participating students visits to experimental facilities, interaction with IISc student clubs and finally, the short lab projects).

In-house publishing:
OoC is coordinating the overall publication process like copy editing, design and layout and printing of the in-house publications of the Institute to the following documents:

- Annual Reports (Hindi and English)
- Annual Accounts (Hindi and English)
- Court Report
- *Connect* (Quarterly magazine of IISc)
- *Journal of the Indian Institute of Science:* Quarterly (co-published by Springer)
- IISc Directory and Planner
- Student Information Handbook and Scheme of Instructions (Four Year Bachelor of Science (Research) programme
- *Quarks* (A magazine of the undergraduate students)
- IISc note pads
- Faculty information handbook
- Student certificates and transcripts along with folders
- Medal certificates folders
- Faculty award certificates and special folders

- KERNEL (Monthly Newsletter of IISc)
- Translation of IISc Kernel Newsletter to Kannada and Hindi

Paraspar Series:
Office of Communications, IISc started a Paraspar Talk series. This is a platform for conversations about knowledge systems, particularly science. During the past year, 12 lectures were organised.

IISc Press:
The following committee for IISc Press is continuing with effect from January 2017:
Chair:
AMARESH CHAKRABARTI
Members:

- Justin David,
- Arpita Patra
- Mohit Kumar Jolly

Ex-officio Chair, OoC:
Kaushal Verma

IISc Press was established in 2008, with a mission to bring quality books at affordable prices for helping Indian post-graduate education in science and engineering. Anurag Kumar was appointed as the first Chairperson of the IISc Press.

Besides self-publishing, IISc Press publishes a variety of books with its co-publishing partners, and brings out research monographs, collected works of distinguished scientists, lecture notes, textbooks, biographies, popular science books, general books, and other books.

The IISc Press has been publishing books in collaboration with World Scientific Publishing Company (WSPC) since 2008. IISc Press signed a co-publishing agreement with Cambridge University Press (CUP) in 2013 and with Taylor & Francis in 2022.

The series that are published with co-publishers are:
IISc PRESS – CAMBRIDGE SERIES

- Cambridge-IISc Research Monographs
- Cambridge-IISc Centenary Lectures
- Cambridge-IISc Lecture Notes

The following books have been published under these series:

Other than co-publishing agreement, IISc Press has also published the following books:

Geometry:
Just Beyond School Texts
by AK Mallik

The Computation Meme: Computational Thinking in the Indic Traditions
Kanchi Gopinath and Shailaja D Sharma (eds)

JOURNAL OF THE INDIAN INSTITUTE OF SCIENCE:
The Director appointed a new committee for Journal with the external members w.e.f. 9 October 2018:

Editor-in-Chief:
G K Ananthasuresh, P/Mech Engg, IISc

Executive Editor:
Kaushal Verma, P/Mathematics | Chair, Office of Communications

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Sanjay P Sane, NCBS, Bangalore

Aravind Srinivasan, Department of Computer Science and UMIACS at UMD,

Rajesh Sundaresan, P/RBCCPS, IISc

Gaurav Tomar, AcP, Mech Engg, IISc

Editorial Assistant
Leelakshi MV

3·7·3

Office of International Relations

As internationalisation plays an important role in the global outreach of its faculty, students and staff, Institute established the Office of International Relations (OIR) in 1998. It aims at strengthening the collaborations in research and education with existing partners and develop new connections among researchers, educationists, and industrialists by supporting various international programmes and activities that includes the:

Chair:
ABHISHEK KUMAR SINGH

- Overall coordination of the admission of international students to various programmes [BSc (Research), BTech (Math & Computing), MTech/MDes/ MMgmt/MSc (Course), MTech and PhD (Research) and its wider advertisement through foreign consulates, partner institutes and Indian embassies abroad
- Facilitation of the international exchanges and visiting programmes to augment the cooperation in education and research at all levels: students, faculty and researchers
- Formulation of the Memoranda of Understanding (MoU) and agreements with the institutions abroad and their execution
- Coordination of the visits of international academic and diplomatic delegations to the Institute, and planning the Institute's high-level/ academic delegations to foreign universities to explore the potential collaborations and develop strategic relationship
- Identification of the Institutional-level areas of interest for collaborations through online surveys and supporting the scientific networking through joint exploratory workshops, seminars and informative sessions
- Providing all the possible support to international students, faculty and researchers, including the overall guiding for their visa application, campus accommodation and necessary formalities with the FRRO Bangalore
- Liaise between international students/researchers and their sponsoring agencies for the required support
- Organise annual orientation programmes for newly joined international students at the time of their Institute admission and facilitate their networking by connecting them to the Institute' international students, OIR members and student council.

The Institute of Eminence (IoE) status bestowed by the Government of India, has provided a strong impetus to further our internationalisation strategy and increase the number of foreign students and faculty on campus through various programmes. This includes the establishment of bilateral seed funds with selected partners to nurture the joint research proposals, joint PhD supervision and degree programmes, summer internships, study abroad programmes, visiting programmes for faculty, students and researchers from international universities etc.

Academic meetings and Delegations to the Institute:
OIR coordinates the physical and virtual meetings with academic partners, dignitaries and diplomatic staff across the globe, with an objective of identifying the areas of mutual or complementary interest and exploring the potential opportunities for new collaborations or strengthening the existing ones through strategic planning.

During the year 2024-25, we have coordinated a total of 170 online and in-person meetings that included some of the high-level IISc visits by HE Philemon Yang, President of the 79th Session of the UN General Assembly; Sven Hakan Oskar Jevrel, State Secretary for Trade, Sweden; Alison Noble FRS, Foreign Secretary of the Royal Society London; Laura Chaubard, General Director/President of the Ecole Polytechnique, France; Patrick Cramer, President of Max-Planck-Society, Germany; Enrico Palermo, Head of the Australian Space Agency; Ignacio Sánchez, President of the Pontifical Catholic University of Chile; Rik Van de Walle, Rector of University of Ghent; Peter Varghese AO, Chancellor and Prof. Deborah Terry AC, President/Vice-Chancellor of the University of Queensland, Australia; Reginald DesRoches, President of Rice University; Jayathi Murthy, President of Oregon State University, USA; Asher Cohen, President of Hebrew University of Jerusalem, Israel; Tim Jones, Vice-Chancellor, University of Liverpool, UK; Till Baernighausen, Director, Heidelberg Institute of Global Health; Stephan Weyers, Vice-President of the Fachhochschule Dortmund; Peter Lievens, Vice Rector of KU Leuven. Fuyuki ISHIKAWA, Vice President of the Kyoto University, Japan; David Kotz, Provost of Dartmouth College, USA and Chris Hodges, Consul General

at the U.S. Consulate General in Chennai.

In addition, we had a pleasure to discuss the partnership opportunities with South Africa and Namibia by hosting the Technological Higher Education Network South Africa (THENSA) delegation that consisted of the Vice Chancellors of its 10 member universities: Chris Nhlapo (Cape Peninsula University of Technology), Rushiella Songca (Walter Sisulu University), Tinyiko Maluleke (Tshwane University of Technology), Bernard Nthambeleni (University of Venda), Alfred Ngowi (Central University of Technology), Thoko Mayekiso (University of Mpumalanga), Erold Naomab (Namibia University of Science Technology), Stephen Ndlovu (Vaal University of Technology), Thandwa Mthembu (Durban University of Technology) and Nokuthula Sibiya (Mangosuthu University of Technology). This may open several avenues of developing our relationship with the African institutions.

MoU/Agreements with Academic partners:
IISc has numerous long-standing formal cooperation with top international universities/institutes, which allows the partners to explore the collaborations across all the areas of science and engineering. As on March 31, 2025, we have about 115 active MoUs and agreements that supports the academic and research cooperation through joint research collaborations, exchange of students, faculty and researchers and joint workshops/ symposia.

During the reporting period, OIR has facilitated the formulation and execution of 36 MoUs/ agreements with global universities/institutions for enhancing the Institute' academic & research cooperation. Among them, the notable ones were the Joint PhD supervision agreement with the University of Adelaide, Australia; Consortium agreement with the University of Cote da Azur (France), Ashoka University and IIIT, Delhi for the Franco Indian Campus in Health programme, an umbrella MoU with the Consortium of 10 Finnish Universities; Max-Planck Society, Germany; Pontifical Catholic University of Chile; University of Surrey, UK; St. Petersburg Polytechnic University, Russia; Hebrew University of Jerusalem, Israel; University of Technology, Sydney, Australia. This year, we started our institutional-level partnership with new institutes, like University of Saskatchewan, Canada; Fachhochschule Dortmund, Germany; AGH University of Krakow, Poland; University of Oklahoma and Dartmouth College in USA.

Furthermore, a Joint Master's degree programme between our Centre for Nanoscience and Engineering and Taiwanese Universities had been launched from the Academic Year 2024-25 to enable a strong relationship between Indian academia and the semiconductor industry in Taiwan. This programme enables students to access the semiconductor workplace during their Master's programme through academic/industry internships and projects. The collaborating Taiwanese universities include National University of Taiwan, National Chiao Tung Yang Ming University, National Tsing Hua University and National Sun Yat-Sen University.

Bilateral Workshops, Seminars and Informative Sessions:
As done previously, OIR has been instrumental in coordinating several exploratory workshops with international universities by identifying the areas of interests at both sides. It provided a common platform for sharing the research findings of participating members and exploring the potential collaborations through individual meetings and in-depth discussions.

This year, we have been successful in facilitating 13 workshops, seminars and informative sessions, and explored potential collaborative opportunities and knowledge sharing. These included the Joint exploratory workshops with the University of Melbourne, Rice University, University of Adelaide, Dartmouth College and Kyoto University; Special conferral/lecture by Alison Noble, Foreign Secretary of the Royal Society, London; and information sessions for UG/PG students by the University of Toronto and the University College Dublin.

Institute's Nomination Process for various International Opportunities: In addition to announcing the calls/ opportunities by various funding

agencies, OIR coordinates the Institute's nomination process for highly competitive scholarship programmes and opportunities. During this period, OIR has processed the nomination for the following flagship programmes of partner universities:

Australian National University (ANU): Seven of our students visited ANU under their Future Research Talent Programme for fully funded research internships in summer 2024, while five students are offered during the 2025 call. Here, one student was also successful in securing the Chennupati Vidya Jagadish Fellowship and visit ANU.

Walter and Eliza Hall Institute of Medical Research (WEHI): Under Inspire programme, WEHI invites four nominations annually in 2024 and 2025 calls and selects two students per year for nine weeks of research internship with complete fellowship.

National Institute for Materials Science (NIMS) and Nanyang Technological University (NTU):
As a strategic partner, one of our PhD students was successful in getting through the NIMS' International Cooperative Graduate Programme 2024. While two students got the NTU Singapore' Global Connect fellowship in Fall batch, eight students were nominated for the 2025 summer call and waiting for the outcome.

Schmidt Science Fellows postdoctoral programme 2024:
As a nominating partner, four IISc students were recommended for this prestigious fellowship programme, where one of our students reached the final round of selection.

Joint funding and programmes with Strategic Partners:
Like previous year, we continued to work with our selected partners under the joint seed/ fund with an objective of enhancing interdisciplinary and strengthening the collaborative research. This scheme essentially provides seed funds for research projects to galvanise research groups from both sides to work on proof-of-concept ideas,

generate data, apply for larger grants to international funding agencies and identify the students under Joint supervision/ doctoral programme. During the reporting period, we have funded 13 joint projects (~4-5 Lakhs per project) with the following universities:

- Rice University, USA (5)
- Pennsylvania State University, USA (4)
- University of New South Wales, Australia (4)

In addition, our joint doctoral programme (JDP) with the University of Manchester is running successfully through annual calls, where we select 2+2 JDP students every year. We have enrolled four students in 2024 and three in 2025. Most notably, we have recruited our first JDP student with the Australian National University, where the student' home institution is ANU. Although general MoU allows the joint supervision of students, Joint PhD programme involves the identification of a collaborative project between IISc and Foreign University faculty as investigators, where the counterpart is listed as the joint supervisor of the student. The PhD student under this programme can spend up to 24 months at its joint-supervisor's lab, and the degree will be awarded jointly by the home institute. Home institution provides the travel support for student, while the host institute can provide local support, that includes the stipend for visiting period on reciprocal basis.

International Students, Faculty and Visitors at IISc:

Full-Time International Students:
As on March 31, 2025, IISc has about 66 full-time foreign students from different parts of the world. The Institute offers its highly competitive international programmes in Course and research that leads to B Sc (Research), B Tech (Math & Computing); M Tech (Course & Research) in Engineering and Doctoral (PhD) degrees in Science and Engineering.

Annual Admission for the academic year 2024-25:
Call for the international students' annual admission for the AY 2024-25 was announced and we have coordinated the application process for the Course (BTech in Math & Computing, MTech/ MDes/MSc/MMgmt) and Research programmes (Bachelor of Science, M Tech and PhD). We have received a total of 179 applications (133 PG and 46 UG). All the applications were segregated and forwarded to the concerned departments for the screening purpose. During this call, 32 departments have participated, and interviews were held online. Out of 107 shortlisted candidates, 23 (18 PG and five UG) were offered and 18 accepted the admission and joined the Institute on August 1, 2024.

Orientation Programme and Counselling sessions:
On July 31, 2024, we hosted an orientation session for the newly admitted international students, to welcome and introduce them to the institute, on-roll students and OIR committee/staff. The programme was aimed at helping the transition of new students into the academic environment and to promote a sense of belonging to the Institute. Counselling sessions were also conducted to assess the wellbeing of the recently enrolled full-time and exchange students after a month of their joining. The idea was to understand if they were facing any academic difficulties, settling down and need any possible help.

Exploratory visit for the international students:
On September 28, 2024, OIR organised a half day trip to the Science Gallery in Bangalore. At the gallery, students had a unique and enriching experience, blending science, art and technology and focussing on various aspects of carbon and data in our environment through the exhibits. There were hands-on activities as part of the innovative exhibition walkthrough. Afterwards, students enjoyed a Karnataka style meal at one of the well-known restaurants and shopping on the streets of Malleswaram.

Admission for the Mid-Year Research programmes: We opened our online portal for the mid-year Research admissions from October 1 to November 10, 2024. A total of 81 applications were received, and 12 departments participated in the screening and interview process. Out of 33 shortlisted candidates, seven were offered and all accepted the admission.

In addition, annual call for the AY 2025-26 admissions was announced and online application portal was opened from February 04, 2025.

Short-Term Students/Visitors:
IISc has always embraced the importance of short-term international visitors. It provides a stimulating international environment and exchange of best ideas and practices. Majority of our short-term students come with secured funding, which are often sponsored, co-developed by their IISc faculty host or Institute' short-term visiting programmes. During this period, about 309 students, researchers and faculty members have visited or are presently at the Institute for collaborative research/discussions from various universities/institutes around the world. These include visiting scientists, fellows or postdoctoral researchers from Australia, Canada, Ethiopia, France, Germany, Italy, Japan, Netherlands, Nigeria, Russia, South Africa, Sweden, Switzerland, UK and USA. A couple of new and notable additions were Luxembourg and Thailand.

We continued our partnership by hosting a group of 10-12 students with their faculty mentors from Niigata university under Inter-University Exchange Project at Centre for Earth Sciences, Georgia Institute of Technology at Aerospace Engineering and Princeton University at Centre for Ecological Sciences under their 'Summer Study Abroad programme 2024'.

In the coming years, we look forward to working towards expanding our international relations through targeted joint activities and global cooperation by strategic bilateral programmes.

3.7.4 *Centre for Continuing Education*

The Centre for Continuing Education (CCE) has been rendering and organising several refresher/specialised courses for working professionals from different target groups ranging from high school science teachers to research Scientists/Engineers of Industries/Institutions. In view of rapid advancements in science and technology, continuous education for professionals is required to update their knowledge of the latest trends. CCE conducts various programmes for their benefit.

Chair: G L SIVAKUMAR BABU

1. NATIONAL PROGRAMMES:

a) QIP (Quality Improvement Programme)

Programmes Leading to Award of Degrees:

During the current year, under this programme, no students were admitted for PhD and no candidates were selected for ME/MTech.

During the year 2024- 2025		At IISc
	PhD	ME/MTech
Students admitted	Nil	-
On Roll	09	-

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 this year, no short-term courses were conducted due to the change in the guidelines regarding the conduct of the course and the lack of response from the faculty.

2. INDUSTRY PROGRAMMES:

a) CCE - Proficience Programme

The programme is the first of its kind and unique in India. Under the CCE - PROFICIENCE programme in two semesters during the year 2024-25, 18 courses were conducted, 551 students/professionals attended and completed the programme. Under this programme, a sum of INR 11,02,60,802/- has been received, towards application and course fees.

b) Self-supporting Intensive Courses:

The CCE organises various refresher programmes to enable the participation of scientists and engineers working in different organisations. During the year, 45 such courses were organised with a total participation of 2038. Under this programme a total sum of INR 14,64,735/- has been received as overheads 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, preparation of monographs and audio-visual aids for teaching etc. Since 1979, the Centre has provided financial assistance for 101 faculty members for book writing, out of which 56 books have been published/completed. The CCE is using CCE-FACE funds for this purpose.

3. EXTENSION LECTURE PROGRAMME:

Under the Continuing Education Programme, Extension Lectures have been organised 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 organisations, Doordarshan and All India Radio at the popular level. These extension lectures are meant to help with the transfer of information on the latest scientific developments in the Institute and other organisation in India and abroad.

These lectures are arranged not only in Bangalore, but also in centres across Karnataka and sometimes even outside the state. Even though the majority of these are in English, lectures are also arranged in regional languages, upon request.

Extension Lecture Programme with GATE-JAM 2024-25

Faculty Members from the Institute were encouraged to participate in the Extension Lecture Programme during their visit to different Institutions for GATE-JAM DUTY. 55 faculties were involved in providing Extension Lecture under this initiative. Many of these lectures were done alongside demonstration, slides, and models.

4. HOYSALA GUEST HOUSE:

Centre for Continuing Education runs a Hoysala 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 by CCE like short-term courses and invitees to the Institute. This year, revenue of INR 81,82,860/- was collected through Hoysala Guest House.

NEW INITIATIVES AT CENTRE FOR CONTINUING EDUCATION

MTech Online programme

MTech Online programme was introduced in the year 2021 and in the present academic year 23 courses were offered with 964 enrolments and under this programme, a total sum of INR 8,67,60,000/- has been received as revenue to the Institute.

Sheer Joy of Mathematics - A Pilot Science Course

- Newly designed programme targeting audience from different age groups was introduced as a Pilot by Kaushal Verma.

- We had 66 enrollments in the second batch from high school students to working professionals at various higher positions to the programme

Science Certification Programme:

- In partnership with M/s TalentSprint, the Science Certificate Programme was introduced the year with 61 enrolments.

English Language Course for Institute students:

- A new course on English language usage has been introduced for improving the proficiency of regular students by external language expert

- It was an eight-week course which was conducted on Saturdays with 25 enrolments in Batch 2 and 34 in Batch 1 respectively.

3·7·5

Office of Development and Alumni Affairs

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 Office of Development and Alumni Affairs provides support for alumni-related activities and engagement programmes at the Institute.

Chief Development Officer	Ram Turaga
Development Officer	Sooraj Ravindran
Development Officer	Tanveer Sayeed
Projects & Administration	Sheshagiri Rao K N
Donor Relations Manager	Arushi Jain
Technical Designer	Megha Ramachandra

Chair: K J VINOY

Student Affairs

Fellowships and awards play a vital role in supporting students across all academic levels -BSc, BTech, MTech, PhD, and postdocs. They provide crucial benefits like travel grants for conferences, monthly stipends, fee waivers, and recognition through medals at convocations. These initiatives improve student experiences by easing financial burdens, fostering academic excellence, and promoting inclusivity, especially for women, economically weaker students, and outstanding achievers. By enabling access to resources and opportunities, they empower students to excel academically and thrive during their time at the institute.

IISc actively encourages students to attend and present their work at national and international conferences. Such opportunities would allow them to stay in touch with research trends, gain a deeper understanding of their field of interest, and build fruitful collaborations with leading researchers worldwide.

ODAA has received some funds from alumni and other well-wishers of the student community. These may be availed by senior PhD students if they are short of funds available from GARP and other sources for going on international trips to present their work at a highly reputed conference/symposium/ workshop/seminar in their discipline.

Structured efforts to disburse funds efficiently led to over 200 students receiving fellowships and travel grants across various academic programmes. In the year 2024-2025, we have had several CSR, alumni and other philanthropic initiatives who have renewed or even started afresh some new student support initiatives, a few of which are detailed in the section

Hindustan Unilever Women PhD Fellowships

Table of new fellowships awarded for the AY 24-25 and ongoing fellowships

	BSc Research	BTech	MTech	PhD
New (24-25)	18	27	71	23
Total	31	34	168	38

Projects

ODAA continues to drive transformative growth at IISc through a variety of impactful initiatives, from supporting new infrastructure and research grants to launching community-focused programmes.

A few new Initiatives facilitated by ODAA

Walmart establishes New Centre for Tech Excellence @ CSA: The Centre will focus on solving key challenges in AI/ML, computer systems, and theoretical computer science. It supports highly skilled pre-doc, PhD, and postdoc researchers through fellowships and fosters collaborations with leading international universities to drive innovation and breakthrough research.

'Longevity India Initiative':
IISc launches research to understand ageing in India: With India's distinct genetic, environmental, and cultural factors influencing ageing, this initiative aims to bridge the gaps in existing longevity research and develop solutions tailored to the country's unique demographic landscape.

Project Chandana:
Initiative of GoK against Sickle Cell Anaemia: A collaboration between IISc and Indian Oil Corporation Ltd (IOCL), the project aims to screen nearly 2.56 lakh tribal persons over the next two years to diagnose and eliminate sickle cell anaemia. Also launched was a screening device - 'Deep Science based technology (HPOS) device' invented by IISc Scientist Prof Sai Shiva Gorthi.

ZEISS Group in India and IISc collaborate to revolutionise eye-care through AI:
The MoU promises to establish a cutting-edge laboratory dedicated to promoting the usage of Artificial Intelligence (AI) in eye-care and upskilling students in AI technologies. ZEISS is also sponsoring six MTech students for the next three years.

Mobility Engineering Lab Established by TKM:
This facility will help equip the next generation of engineers with the multidisciplinary skills needed to develop advanced mobility solutions. The laboratory will focus on electrified vehicle powertrain technologies, utilising Hardware-in-Loop (HIL) simulation for comprehensive testing and development.

India Semiconductor Workforce Development:
Samsung R&D Institute-Bangalore's collaboration with IISc enhances education through advanced computational tools, provides fellowships for students, fosters innovation in the semiconductor sector, and promotes research and development. This initiative aims to bridge the gap between academics and industry.

Alumni Relations

The Office of Development and Alumni Affairs acts as a bridge that connects IISc alumni to their alma mater. By organising reunions, department visits, and seminars, the office ensures that alumni remain actively engaged with the institute's intellectual and social fabric. It is through ODAA that alumni can give back to the Institute by supporting research projects and instituting fellowships, grants and endowments for students and faculty.

There was a significant increase in the number of alumni batch reunions in 2024, showing stronger engagement with the Institute. The alumni engagement efforts initiated by the Office of Development and Alumni Affairs (ODAA) continue steadily. The alumni portal remains active with over 11,000 registered users and digital ID cards being issued regularly. All graduating students since 2018 are required to register as part of the no-dues process. ODAA also maintains strong engagement through LinkedIn and other social media platforms.

Alumni Contributions

Alumni and other well-wishers have continued to come together in greater numbers to support IISc's mission. This includes new fellowships, travel grants, and generous contributions toward infrastructure and research projects. A few are mentioned below

- **Deep Asher Fellowship by IISc Class of 1998 ME (Int)** aims to award students in the BTech programme based on financial necessity and academic performance.
- **Prof M Satyam ECE Student Travel Grant:**
  M Satyam, former chair at ECE, IISc, passed away on 28 June 2024 in Hyderabad. To pay homage, some alumni and family created a "Prof M Satyam Memorial Endowment" in his memory which will be used towards supporting student travel.
- **JC Roy and Mukti Roy Memorial Medal**
  This medal, established in loving memory of Kunal Roy's parents, honours their enduring commitment to academic excellence and higher education. Their ideals, love, and sacrifices continue to inspire the family to follow in their footsteps. Funded by alumnus Kunal Kanti Roy and his wife Neelam Roy, this endowment recognises the achievements of IISc students in science and technology.
- **Neelam Roy "Women in Biological Sciences" Research Award**
  A new research award has been instituted by Kunal Roy, an alumnus from the batch of BE (Met) (1969-72) and his wife Neelam. The Award shall be presented annually to female PhD scholars within the Biological Sciences division who are in the last year of their doctoral programme.
- **Dr Priyadarshini Panda UG Women Fellowships:**
  Established by Distinguished Alumnus (2020) Keshab Panda, this initiative awards three scholarships or fellowships to female undergraduate students at IISc, covering tuition fees and a monthly fellowship for four years.
- **Class of 1967 BE Endowment**:
  The 1967 BE alumni batch of IISc, from the ET, Metallurgy, and ECE departments, has come together to create an endowment fund to support academic and professional growth. Their aim is to enhance learning and research through lectures by experts, travel grants for students, and sustainable corpus management.

Annual Alumni Reunion 2024

The IISc Alumni Reunion 2024, held from December 20–22, was a vibrant three-day celebration of connection, recognition, and knowledge sharing. The event began with department visits, presentations by young alumni medalists in the afternoon, and high tea at JN Tata Auditorium.

The highlight this year was the introduction of the **IISc Young Alum Medal**, which received an overwhelming number of high-quality nominations—recognising emerging alumni making a mark in research, innovation, and entrepreneurship.

This new honor joins the long-standing **IISc Distinguished Alumnus Award,** strengthening our commitment to celebrating alumni excellence. The nominations received were evaluated by a committee chaired by the Director, IISc.

Six outstanding scientists and engineers were presented the Distinguished Alumnus/Alumna Awards for the year 2024 - George Brody, Sridevi Jade, Shekhar Chintamani Mande, S Unnikrishnan Nair, Jagjit Nanda, and Yadati Narahari. This year's Young Alumnus/Alumna Medallists are Himabindu (Hima) Lakkaraju and Nihar Bhadresh Shah.

Day two featured parallel faculty-led technical sessions on cancer, imaging, and energy research, alongside startup showcases and a keynote by the Director, culminating in the annual alumni award ceremony and high tea. The final day included a nature walk, a panel discussion on strengthening alumni networks, and lunch at MGH.

Tata IISc Medical School

IISc is setting up a multi-specialty, not-for-profit Bagchi-Parthasarathy Hospital along with the IISc Medical School within its Bengaluru campus. The hospital is expected to be operational by the end of 2025, and the first batch of MD-PhD students will be admitted soon after.

The academic centerpiece of this initiative will be an integrated dual degree MD-PhD programme aimed at creating a new breed of physician-scientists, who will pursue careers in clinical research to develop novel therapeutics and healthcare solutions, driven by a bench-to-bedside philosophy. They will simultaneously be trained in the hospital as well as in the science and engineering laboratories at IISc.

New contributions

1. **Tata Group and IISc partner to establish Tata IISc Medical School to pioneer healthcare education and research:** The Tata IISc Medical School will be a centre of excellence that seeks to catalyse a unique model of clinical research and medical education in India, by bringing basic science and engineering to bear on clinical science and practice. It will focus on a variety of specialties including oncology, cardiology, neurology, nephrology, diabetes and metabolic disorders, infectious diseases, integrative medicine, and public health. The Tata IISc Medical School will offer integrated MD-PhD and other dual degree programmes.

2. **Chair Professorship set up by Alumnus SR Venkatramanan and wife, Usha:** The endowment will support, in perpetuity, young faculty members at the Assistant Professor level working on cutting-edge medical research, specifically in areas related to endocrinology and nephrology, with the goal of developing solutions for curing type 1 diabetes in children and to prevent or reverse kidney impairment, to avoid or reduce dependency on dialysis and improve the quality of life for people affected by kidney disease.

3. **Zerodha Supports IISc with New General Surgery Wing:** On the first anniversary of his father's passing, Zerodha co-founder Nithin Kamath, with his family, made a generous donation to the Institute to honor his father's memory. The donation will fund the establishment of the 'Zerodha General Surgery Wing' at the upcoming IISc Medical School and Bagchi-Parthasarathy Hospital.

4. Husband and wife duo Sadanand Hegde & Bharati Hegde have sponsored the new ENT Wing at the Tata IISc Medical School, which is to be named **Bharati & Hegde ENT Wing.**

3.7.6 *Office of Intellectual Property and Technology Licensing*

IPTeL (Intellectual Property and Technology Licensing) is the Institute's gateway to filing for intellectual property protection and technology licensing. The 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 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. From the year 2017 onwards, IPTeL had worked towards testing and getting the IP Management software (ProrIISe) at IPTeL up and running, which was successfully launched in April 2021.

During 2021-22, IPTeL extensively focused on licensing of Covid-related IPs to various companies. The same has been listed in the table below.

Chair:
SURYASARATHI BOSE

Industry/ Company	Technology
M/s BS Biotech	A method for formulating radiation resistant floor and wall laminates having antiviral properties thereof - For Air purification and face mask applications
Airth Research Labs	
Hoyasan Labs	
VST IoT Solutions	
NeoDx Biotech Labs Pvt Ltd	ELISA test to detect COVID19 antibodies in people with prior exposure to the virus
Apollo Micro Systems Ltd	ICU Ventilator
Vasmed Health Sciences Pvt Ltd	
MICROGRAVITY Lab Private Limited	O2 Concentrator
New Torr Pumps & Systems Pvt Ltd	
VST IoT Solutions	
AutoTech Systems	
Aryan Aerospace	
Viprof Electronics	
Supram Industries	
Apollo Micro Systems Ltd	
Vyusta Ventures LLP	
Sanjay Technologies Pvt Ltd	
Kaynes Interconnection systems India Pvt Ltd	
Spectrum Tool Engineers Pvt Ltd	
Maxwell Medical Engineering	
Eduhex Technologies Pvt Ltd	
The Engine Doc Energy Co	
Tejus Impex Pvt Ltd	
RB Troniks	
Vinyas Innovative Technologies	
Oxyzpro	
Electrowing Technologies	
Pro B Products	
Revaron Pvt Ltd	
Jindal Biotech	
Apollo Computing Laboratories	A swing adsorption-based separation unit for generating Medical Oxygen using atmospheric air as the feed – O2 Generator
Accurate Gauging & Instruments Pvt Ltd	
Electrowing Technologies Pvt Ltd	
Helix Pvt Ltd	
The Engine Doc Energy Co	

IPTeL has since been focusing on extending its outreach in terms of IP awareness. The first effort towards this was the following programmes conducted on Research methodology, Intellectual Property Rights (IPR), entrepreneurship, skill development during the year 24-25.

Year	Name of the workshop/ seminar	Associated Organisation	Date
2024	One day Beginner level Training programme	DCTE, KSCST, BeST	19.11.2024
2024	3-day Intermediate level Training programme – Batch 1	DCTE, KSCST, BeST	16.12.2024
2024	Industry – Academia Synergy Workshop Series	DCTE, KSCST, BeST	28.12.2024
2024	3-day Intermediate level Training programme – Batch 2	DCTE, KSCST, BeST	06.01.2025
2025	Industry – Academia Synergy Workshop Series - Theme: Energy Environment & Sustainability	DCTE, KSCST, BeST	16.01.2025
2025	Advanced Level Training Programme on	DCTE, KSCST, BeST	31.01.2025
2025	Intellectual Property Rights (First Batch)	DCTE, KSCST, BeST	31.01.2025
2025	Advanced Level Training Programme on	DCTE, KSCST, BeST	7.02.2025
2025	Intellectual Property Rights (Second Batch)	DCTE, KSCST, BeST	7.2.2025
2025	Brainstorming workshop for DCTE IP Coordinators	DCTE, KSCST, BeST	10.3.2025

Patent Licensing

IPTeL is getting increasingly involved in licensing and pursuing transfer of technologies to various companies. We have, from the year 2017 till now, entered into exploratory agreements with many companies. A sample list of such engagements is as follows:

Industry/Company	Technology
Avay Biosciences	High-purity pristine Gelatin Methacryloyl (GelMA), Alginate/Gelatin (AG), Gelatin Glycidyl Methacrylate (G-GMA) for 3D (bio)printing
Fibroheal Woundcare Pvt Ltd	Layered Composition and Implementations Thereof
Blessings Advertising Pvt Ltd	1. An interpenetrating polymeric network and processes thereof 2. A method for preparation of Polyurethane composite material and composites thereof
Hadasit Medical Research Services & Development Ltd	Type III deiodinase inhibitors and uses thereof
JKN Nanosolutions Pvt Ltd	A method of using tin metal as a reusable, solid-state, metal reducing agent for the synthesis of metal nanoparticles
Wilber Klainiz Pvt Ltd	A composition derived from polyphenols and biodegradable polymers for antiviral textiles and coatings
Airth Research Labs	A composition derived from polyphenols and biodegradable polymers for antiviral textiles and coatings
Hoyasan Labs	Radiation resistant laminates; A method for formulating radiation resistant floor and wall laminates having antiviral properties thereof
Bharat Serums	India's first regional antivenom
Ceramat Pvt Ltd	Scalable manufacturing of bioceramics, design of stirred tank reactor and a process thereof
BioGrammatics Inc	Nucleotide sequence, expression vectors, recombinant yeast cells and applications thereof
Sanki Machine Tools	Eye-Tracking Software technology developed fy I3D lab at CPDM
Airth Research Labs	A method for formulating radiation resistant floor and wall laminates having antiviral properties thereof
Hoyasan Labs	A method for formulating radiation resistant floor and wall laminates having antiviral properties thereof
Ants Ceramics Pvt Ltd	Scalable manufacturing of bioceramics, design of stirred tank reactor and a process thereof
Unified Globaltech (I) Pvt Ltd	Mid-IR photodetectors based on colloidal CuFeS2 quantum dots
Technomed Electronics	Fiber lasers for high power within a medical device – associated optics/alignments/software/integration
Nsoft (India) Services Pvt Ltd	1. Hydraulic grab bucket for sewage desilting 2. Mobile Desilting Machine
Log 9 Materials	Confidential know-how
M-Core Technologies Pvt Ltd	Power System Emulator
Jiva Sciences Pvt Ltd	Multidimensional Fluid Focusing Device
NeoDx	ELISA test to detect COVID19 antibodies in people with prior exposure to the virus
Vasmed Health Sciences Pvt Ltd	1. Measurement of fluid viscosity using MEMS-based cantilever system 2. Catheter tip MEMS pressor sensor
AdobeSP Grid	Generalised substation Panel
CUMI	Method and Process for Production of Silicon Carbide
Pennsylvania State University	FEhydro – software library for hydrodynamic stability analysis
Reva technologies, Pune	H2S Scrubbing Technology
Astha Energy Services PVT LTD	H2S Scrubbing Technology
SLPP Renew LLp	H2S Scrubbing Technology
M/s Praj Industries Ltd	H2S Scrubbing Technology
VoILA 3D	Upcycling Thermoplastic Polyolefins and Multilayered Plastics restricted to Polyepoxy
Biorad Medisys Pvt Ltd	Ultra High Molecular Weight Polyethylene Polymer Blends for Manufacturing of Injection Moldable Orthopedic Implant

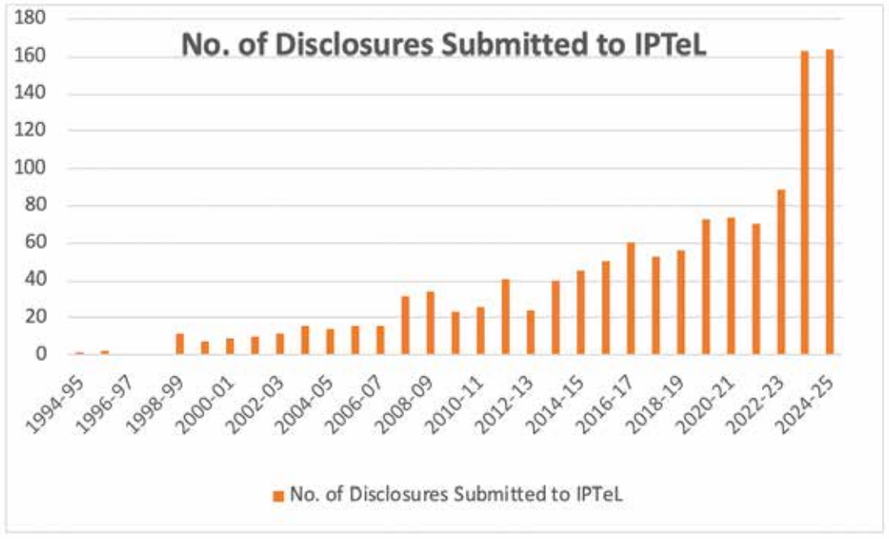
IISc Patents Licensed to IISc Start-ups from 2021-22 onwards:

- Urjalinks Pvt Ltd
- Shanmukha Innovations Pvt Ltd
- Gyroid Photonics Innovations and Technologies Pvt Ltd
- Theranautilus Pvt Ltd
- SciLogic Applied Research Pvt Ltd
- Aagyavision Pvt Ltd
- Samvedan Technology Pvt Ltd
- Mithra Increst Pvt Ltd
- AGNIT Semiconductors Pvt Ltd
- Papyrus Diagnostics Pvt Ltd
- Translead Medtech Pvt Ltd
- HealthSeq Precision Medicine Pvt Ltd
- Carbsorb Solutions Pvt Ltd
- HEM Dimensions Pvt Ltd

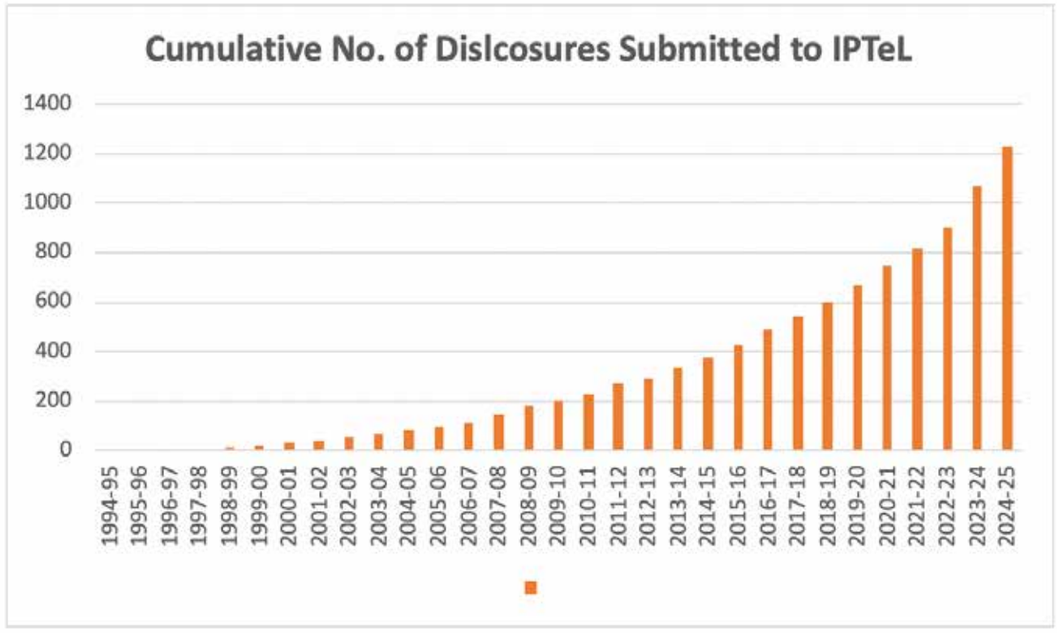
Basic Portfolio Index (1995 – March 2023):

IPTeL embarked on the process of taking the IPTeL-Inventor-Attorney interface online through the IPMS software. IPTeL has also worked towards compiling the data porting of the existing portfolio that was available in soft format into the IPMS software, to aid subsequent automation of most processes requiring manual monitoring, making the IISc IP portfolio management and licensing procedure easier. The IISc portfolio is now available on the software and has also been made available for download in a standard format on the IPTeL website. The current portfolio is as follows:

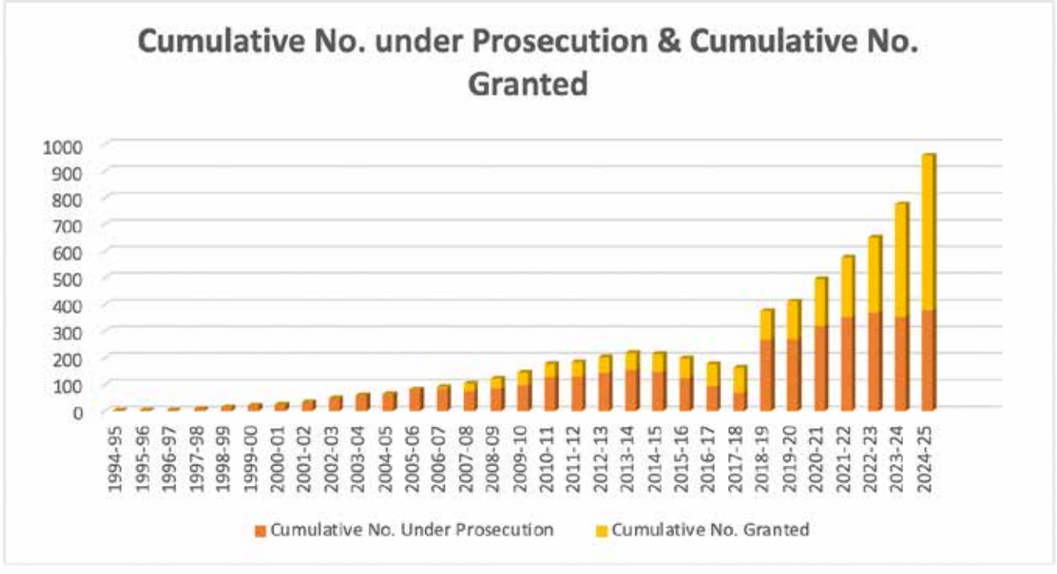
Total disclosures submitted by IISc faculty to IPTeL (1995 – March 2025): 1230



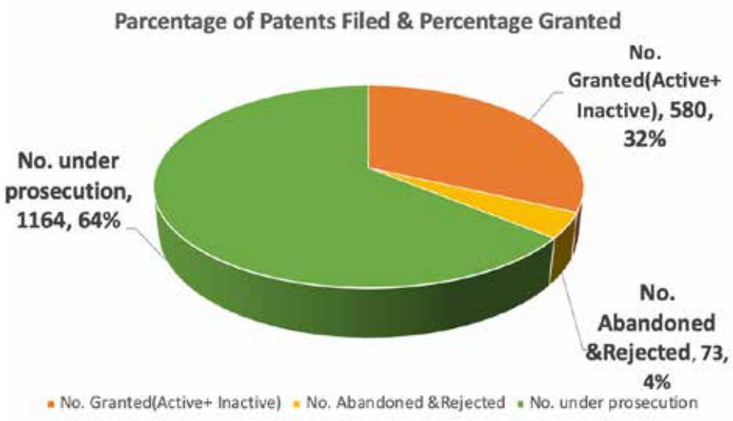
1. Year Wise Break-up of Disclosures Submitted to IPTeL



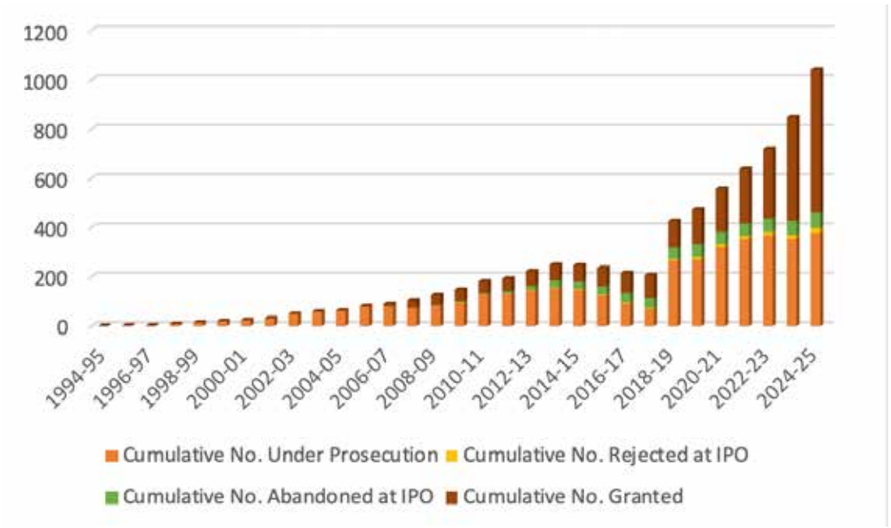
2. Year Wise Break-up of Disclosures Submitted to IPTeL; Cumulative



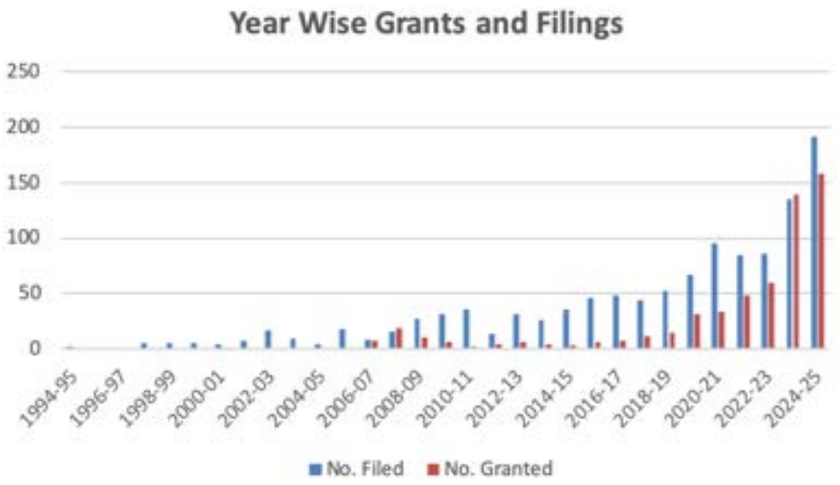
3. Year-wise Break-up of Patent Applications Under Prosecution and Patent Applications Granted (Indian)



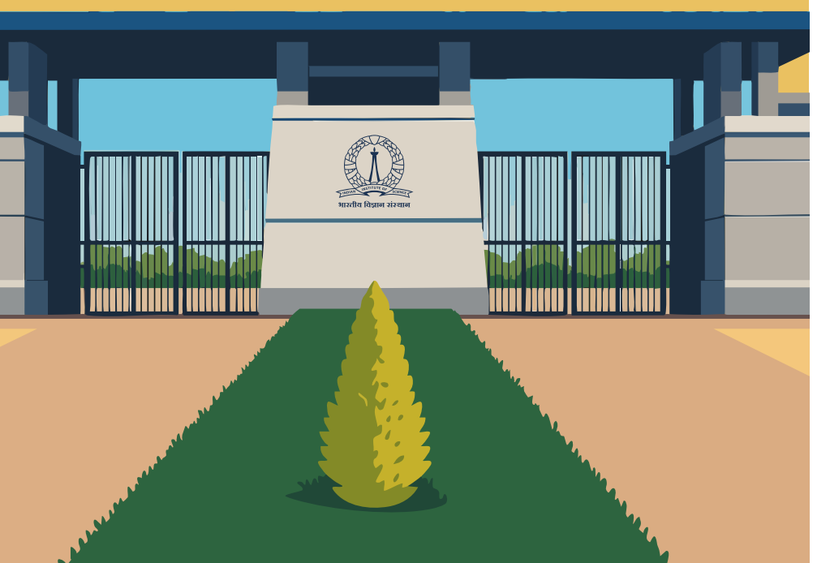
5. Year-wise Break up of Cumulative Nos. of Applications Under Prosecution, Patents Granted and Applications Abandoned/ Rejected at IPO (Indian)



6. Year-wise Break-up of Patent Filin

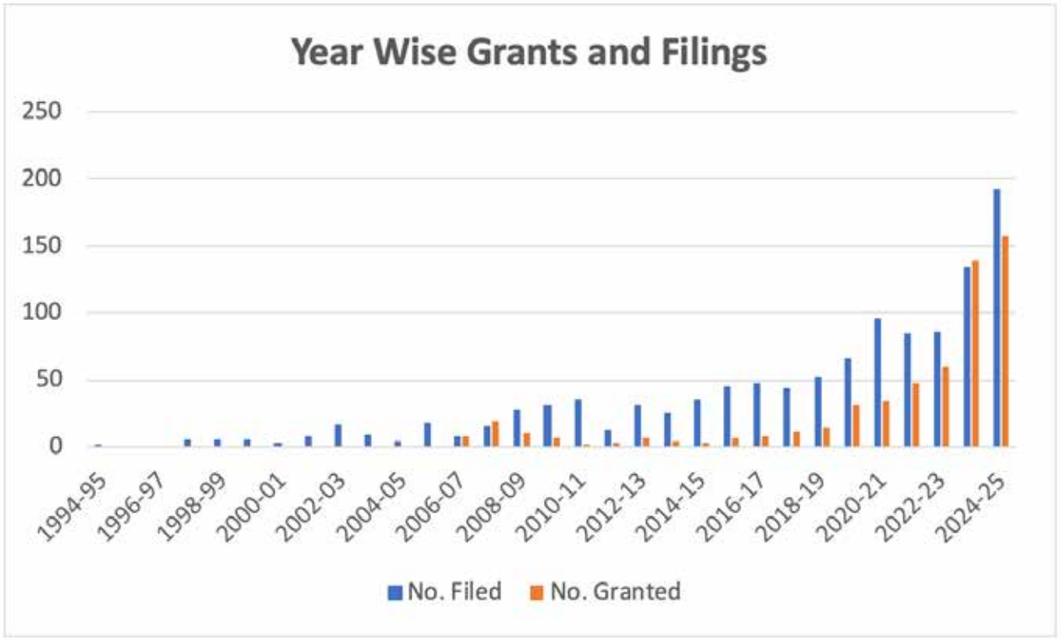


3·7·7 *Challakere Campus*



Chair:
DR. B SUBBA REDDY

The hal-IISC skill development and **talent development center**



KHUDAPURA, CHALLAKERE, IISc section

A. TEACHERS TRAINING PROGRAMMES

Training programmes conducted (April 2024 – March 2025): 20
Total beneficiaries: 1739

Extra-curricular activities for the participants:
To make the teachers more involved in the training activity, the following activities were initiated during the academic year 2024-25.

a. An extra day is added to all the existing training programmes; one day during the training period is treated as a break day. The participants are encouraged to visit historical places nearby like Hampi, Chitradurga Fort, Vanivilas sagar dam and so on.

b. The participants are given an opportunity on one of the evenings for cultural events, the participants themselves perform at the SDC auditorium.

c. Few of the best overall performing teachers are recognised and presented with a memento and certificate on the Valedictory day.

d. Some indoor game kits like chess boards, carrom boards and more are provided for the participants at hostels.

e. Night sky watch is arranged for the participants at SDC auditorium and at hostels.

B. SKILL DEVELOPMENT PROGRAMMES / COURSES

Total courses offered (April 2024 – March 2025): 7
Total beneficiaries: 385

(a) Visit to Lal Bahadur Shastri National Academy of Administration (LBSNAA), Mussoorie. Based on the invitation from Shelesh Nawal, IAS, Deputy Director, LBSNAA, the Convener TDC & SDC delivered a technical talk on "Leveraging capacity of established institutions for mass skilling and collaboration" for the newly inducted 40 officers of the Indian Skill Development Service under the Ministry of Skill Development and Entrepreneurship on 18 April 2024, at LBSNAA, Mussoorie.

(b) V(b) MoU with Uttarakhand Govt for training BSc & MSc Teachers (11 & 12th Feb 2025)

(C) Honourable Visitors

1. Venky Ramakrishna, Nobel Prize winner, and Shashidhara, Director NCBS visited the IISc Challakere campus on 10-11 January 2025. They interacted with TDC Faculty, several of the trained teachers, and students from more than seven government and private schools who participated in the interaction session. They also visited all the laboratories at the TDC and SDC.

2. The NAL team lead by Director, Abhay Pashilkar visited IISc, Challakere campus on 11 May 2024. NAL team was well received by the Convener B Subba Reddy. During a short meeting the Convener explained about the campus, facilities, land availability, water and electricity availability and more. Later a campus tour was arranged.

3. Naina Nagpal, IES, Assistant Director from the Ministry of Skill Development and Entrepreneurship, India, Bangalore and her team interacted with the faculty, teachers and students, and visited all the laboratories at the TDC/SDC.

4. KV Prabhakar, Senior Finance Manager, Infineon Technologies India Private Limited, Bangalore along with senior colleagues visited the IISc Challakere campus on 8 November 2024.

5. NE Sridhar, Chief Sustainability Officer, M/s Titan and his colleagues visited the IISc Challakere campus on 13 November 2024.

(D) Students and Teachers' Visits

During the academic year (2024-2025), more than 1540 students from Government and private high school/PU college/degree students from 17 institutions in and around Challakere, Chitradurga, Davangere and Bellary districts visited the SDC and TDC Center on education trip/ Vigyan Jyothi programmes and so on.

Special interactive sessions with the faculty members was arranged. Students were informed about various aspects of physics, chemistry, biology and mathematics. The students were also allowed to conduct laboratory experiments on their own with the support of TDC Faculty.

(E) National Science Day Celebration

The National Science Day (birth day of CV Raman) was celebrated at the IISc Challakere campus on 28 February 2025. About **5,500 students, teachers, others participated from the** nearby schools and colleges of Chitradurga, Davangere and Bellary districts.

The following activities were demonstrated:

1. Models and experimental arrangements in science subjects such as physics, chemistry, biology and mathematics
2. Poster presentations both in Kannada and English pertaining to science and skill related activity to benefit the rural/semi urban school and college students.
3. Posters related to the activity at Divecha Center and other labs at Challakere campus
4. Basic installation and flying of small drones at planned intervals was demonstrated
5. Mini rocket model launching at planned intervals was demonstrated.

(F) Some Important Data on Programmes

(a) Teachers Training Programme

Details of State-wise Teachers trained at Talent Development Center (TDC) from 2011-2025

Sl. No	State	JNV	KV	BSC	MSC	HS	PUC	Total
1	Andhra Pradesh	64	4	5	6	89		**168**
2	Arunachal Pradesh	17	2	0	0			**19**
3	Assam	84	19	3	0			**106**
4	Bihar	121	11	3	2			**137**
5	Chhattisgarh	51	8	0	2			**61**
6	Delhi	6	12	0	0			**18**
7	Goa	3	4	63	0	158		**228**
8	Gujarat	56	7	0	4			**67**
9	Haryana	63	7	2	0			**72**
10	Himachal Pradesh	32	6	4	0			**42**
11	Jammu & Kashmir	48	14	0	0			**62**
12	Jharkhand	47	7	1	0	114		**169**
13	Karnataka	88	35	301	83	13243	2346	**16096**
14	Kerala	45	50	25	27			**147**
15	Maharashtra	96	39	41	20			**196**

16	Madhya Pradesh	100	40	0	0			**140**
17	Manipur	17	0	6	1			**24**
18	Meghalaya	19	0	0	1			**20**
19	Mizoram	3	0	0	0			**3**
20	Nagaland	11	1	0	2			**14**
21	Odisha	69	5	0	5	1115	767	**1961**
22	Punjab	63	16	1	0	96		**176**
23	Rajasthan	112	22	1	9			**144**
24	Sikkim	8	1	0	0			**9**
25	Tamil Nadu	0	21	43	32			**96**
26	Tripura	13	0	0	1			**14**
27	Telangana	21	14	1	1			**37**
28	Uttar Pradesh	184	48	6	3			**241**
29	Uttarakhand	44	27	0	1			**72**
30	West Bengal	33	26	1	3	7		**70**
31	Andaman & Nicobar (UT)	3	1	0	0			**4**
32	Chandigarh (UT)	2	3	0	0			**5**
33	Dadra & Nagar Haveli (UT)	4	0	0	0			**4**
34	Daman & Diu (UT)	1	0	0	0			**1**
35	Lakshadweep (UT)	3	1	0	0			**4**
36	Puducherry (UT)	8	2	0	0			**10**
	Total	**1539**	**453**	**507**	**203**	**14822**	**3113**	**20637**

(b) Skill Training Programme

Academic year	No of participants trained
2020-2021	200 (online/off line)
2021-2022	706 (online/off line)
2022-2023	408 (online/off line)
2023-2024	285 (off line)
2024-2025	385 (Off line)
Total participants trained	1984

(G) TDC/SDC - Collaborations

1. **LabXchange Harvard University and Talent Development Center, IISc Challakere campus (soon to be launched)**

LabXchange is a free online platform from Harvard University dedicated to delivering expert-curated digital educational content and skill development tools for learners and educators worldwide. The content is meticulously curated by experts, ensuring that educators and learners have access to reliable, cutting-edge resources without the need to navigate the unverified and vast expanse of the internet. It offers a rich array of learning materials including videos, texts, images, quizzes, and virtual interactive labs with cutting-edge facilities, providing a great resource particularly for educators lacking access to advanced laboratories. Educators have the flexibility to organise content into tailored learning pathways that align with their syllabi, teaching goals, or styles, and then share these with their students. Worldwide, LabXchange is used by nearly 56 million educators and learners.

2. Team from ICER-Pune visited TDC, Challakere and would like to colloborate with the centerfor the follow-up training of teachers.

(H) Infrastructure / Laboratories installation in Progress

1. Parking work at SDC: Truss work is 90% completed. Fabric cloth work is pending. Expected date of completion is April 2025.
2. Fire structural facility: Building construction 95% completed.
3. Precision agriculture: Green house framework, electricity and water supply work in progress.
4. Astronomy and astrophotography laboratory work in progress
5. CC road work: Storm water drain work completed. DLC concreting 2 kilometres completed. PQC (cc pavement) and footpath work is pending. Expected date of completion is May 2025
6. Tender floated for construction of 24 single bed and 24 double bed residential quarters including water supply, sanitary installations, drainage, electrical and so on.

(I) Future Plans

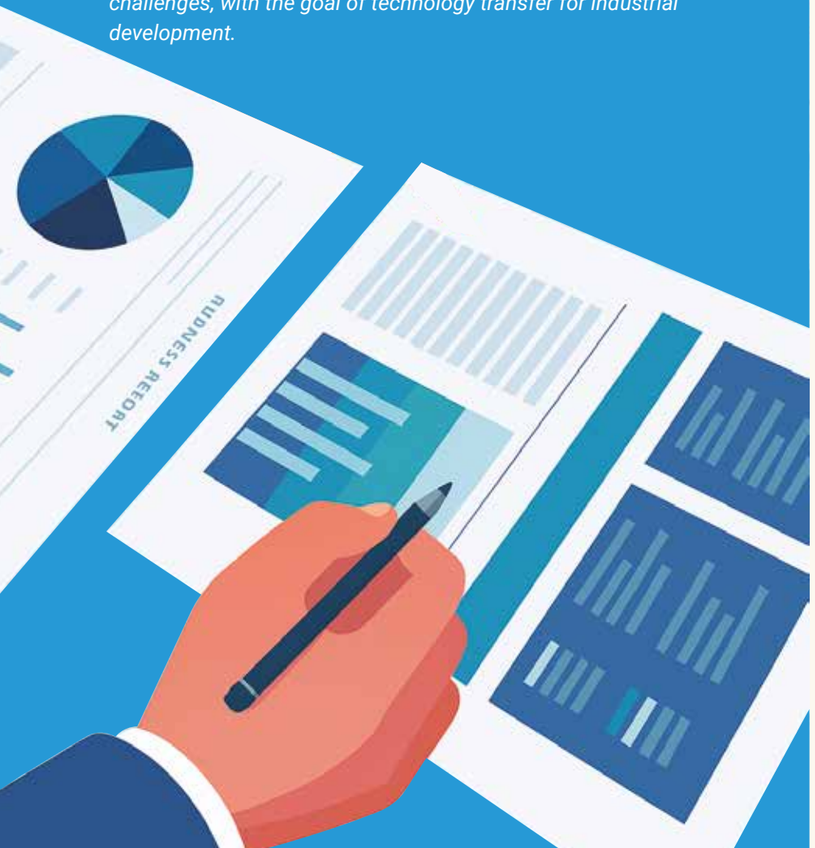
- Recently IISc TDC/SDC signed MoUs with the Governments of Punjab, Uttarakhand, Lakshadweep, for Teachers Training and Skill Training programmes.
- TDC/SDC programs have reached all the States and Union Territories in India.
- TDC will extend Teachers Training programmes to BSc and MSc teachers in the near future (Uttarakhand Government) including short training programs for high school and college students.

3.7.8

Centre for Scientific and Industrial Consultancy

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 goal of technology transfer for industrial development.



Chair:
AMBEDKAR DUKKIPATI

The ranges 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 1, 2024 to March 31, 2025, 265 consultancy project proposals costing INR 2,925.49 lakh were communicated to the clients. In the above said period 231 consultancy projects with an outlay of INR 2,394.95 lakh materialised.

Receipts from consultancy projects and consultancy test projects amounted to INR 2,394.95 lakh.

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Digital Campus and IT Services Office

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 digitalisation activities and services in the Institute.

Chair: ANIL KUMAR P S

Chief Information Security Officer: JOY KURI

Chief Information Technologist: SRINIVAS ANANDA RAO

During April 2024-March 2025, the activities of DIGITS have resulted in the following outcomes:

❖ Project ISTAR (Implementing SAP S/4 HANA ERP for Transforming Administration and Research):

- **Operation & Maintenance (O&M) Support Phase for both Wave-1 and Wave-2 SAP applications is now in a steady state.**
- **The Institute has planned for SAP version upgrade from v1709 to v2023. The Institute has signed a contract with SAP India on this. The upgrade will be taken up once the server infrastructure is ready.**
- **The existing server infrastructure is reaching its End of Life. The Institute is working with**
- **CtrlS Datacentres, the Institute's cloud services partner, on refreshing the server infrastructure**
- **Sourcing and Procurement:**
  - **New Validations for Purchase Orders:** GL Accounts validation implemented for proper expenditure classification. Benefit: Ensures budget accuracy and financial compliance.
  - **Revoke and Reject Options Disabled:** Enhanced process accuracy for Purchase Order creation. Benefit: Reduces errors and unauthorised modifications.
  - **User Interface Simplification:** End-to-end procurement processes are simplified, with simplified custom screens. Benefit: Increases user-friendliness and processing speed.
  - **Release Strategy Implementation:** Implemented for all newly created departments, including departments under the Division of Medical Sciences.
- **Finance**
  - **SBI e-Pay Report Update:** Enhanced as per the latest SBI format. Benefit: Simplifies transaction processing and aligns with the latest banking requirements.
  - **Payslip Summary Report Fix:** Logical issues that can create amount mismatches have been corrected. Benefit: Ensures accurate payroll calculations and reporting.
  - **Forex Form Auto-generation:** Now includes student details to simplify identification. Benefit: Speeds up processing for student-related forex transactions.
  - **Mandatory Business Area Field:** Ensures a clear distinction between transactions from different business areas (F&A and CSSP). Benefit: Enhances financial transparency and audit readiness.
  - **ZGSTR1 Report Enhancement:** Now captures HSN Code description and place of supply in the item-wise report. Benefit: Improves compliance with GST regulations and simplifies reconciliation.
  - **Vendor Master Data Issue Resolved:** Implemented SAP advice to fix errors for 35 vendors. Benefit: Reduces errors and improves transaction efficiency with vendors.
  - **MOE Fellowship Agency Code:** Introduced to smoothen scholarship payments starting April 2024. Benefit: Streamlines payment processing for MOE fellows
  - **Forex Forms for External Thesis Reviewers:** Auto-generation integrated with the "Payment of Honorarium" application. Benefit: Reduces manual paperwork and accelerates payment timelines.
  - **Bank Reconciliation Statement Template:** New template developed as per requirements from the Business. Benefit: Simplifies bank reconciliation and improves data accuracy.
- **Treasury Management**
  - **TDS and TCS Configuration:** Configured TDS on dividend posting for mutual funds and TCS for other investments. Benefit: Ensures compliance with tax regulations for various investment types.
  - **Investment Register Adjustment:** Fixed issues where treasury bills (CP/CD) gains or losses were reflected in the Interest column instead of Capital Gain/Loss. Benefit: Provides more accurate financial reporting.

◆ **Bank GL Account Configuration Change:** Modified configurations to distinguish between inflow and outflow of cash transactions, with inflows now mapped to Bank GL - XXXXX3. Benefit: Enhances clarity in cash flow reporting and simplifies reconciliation.

◆ **Accrued Distribution for INviTS:** Configured to improve financial tracking in the TRM module. Benefit: Supports seamless integration of investment data into the main financial ledger.

- **HR and Payroll**

◆ **Special Casual Leave for Differently Abled Employees:** Now allows an additional 4 days of leave annually. Benefit: Promotes inclusivity and support for differently-abled employees.

◆ **Rehire Option for S3/S4 Employees:** Streamlined rejoining process for relieved employees with the same PAN number. Benefit: Prevents duplicate records and facilitates smoother rehiring.

◆ **Child Education Allowance (CEA) Update:** Increased to Rs 33,750, with hostel subsidy allowance set at Rs 1,01,250 starting from the 2023-2024 academic year. Benefit: Provides greater financial support for employees with children.

◆ **Income Tax Slab Configuration:** Updates aligned with Union Budget 2024-2025, scheduled for completion by September. Benefit: Ensures accurate tax deductions and compliance.

◆ **Performance Management System (PMS):** End-to-end customisation completed and went live on April 3. Benefit: Enhances performance tracking and transparency.

◆ **HCM ESS Access for Temporary Employees:** Enabled access to pay details and Form 16 for S3 and S4 employees. Benefit: Empowers employees with real-time access to payroll data. The leave workflow for temporary employees is in development. Expected to launch by May. Benefit: Enables faster and error-free leave applications.

◆ **Resume on Duty Requirement:** Mandated for key leave types like Sabbatical, Childcare, and Maternity Leaves. Benefit: Ensures proper tracking and return processes.

◆ **Leave Workflow Updates:** HR case workflow included before HR Manager review for accuracy. Benefit: Reduces errors and improves leave application accuracy.

◆ **Vacation Leave Processing Enhancements:** System corrections implemented for May, June, and July. Benefit: Prevents bottlenecks during peak vacation months.

◆ **The Salary Budget report** It was not fetching the current contract start and end date. The logic for fetching the contract dates has been corrected.

- **Project System**

◆ **Issue Resolution for UC/SE:** Addressed and fixed various issues reported. Benefit: Enhances project tracking and smoothens project workflows.

- **Student Lifecycle Management and Student Financials**

◆ **Development of 15 Change Requests** for new requirements, raised by DIGITS, Academic Section and F&A teams, for Wave-2 SAP applications, began from March 2025.

◆ **Academic Structure Updates:** Newly modified programmes will be updated before the start of the academic year. Benefit: Ensures students and faculty have access to the latest course structures.

◆ **BTech and BSc Summary Sheet Alignment:** Standardised formats for easy reference. Benefit: Streamlines academic record handling.

◆ **UG/PG Transcript Optimisation:** Improved formatting as per business requirements. Benefit: Simplifies document processing and verification.

◆ **Student Summary Sheet Update:** Now displays ABC ID and blood group. Benefit: Enhances student record accuracy.

◆ **New Leave Type for Exchange Programmes:** Introduced “Joint Exchange Programmes” for better tracking. Benefit: Eases the processing of exchange student leaves.

◆ **Examiner Master Data Upload Application Enhancement:** The application was enhanced to incorporate new examiner data creation functionality. Benefit: Streamlines the process of adding and managing examiner details.

◆ **Display of Documents in Candidacy Confirmation Application**: Provision to display the documents uploaded by the Research Supervisor in the first attempt of the Comprehensive Examination. Benefit: Simplifies access to critical documents for academic verification.

◆ **CMGS Report Tile Availability:** The CMGS Report tile is made available to the Department Chair and DCC Chairs. Enhanced to display course grade approval status. Benefit: Improves visibility of academic progress and course status.

◆ **The annual progress report for the previous year was not submitted.** Benefit: Enforces compliance with academic timelines.

◆ **UG Student Summary Sheet Update:** Updated to include the students' leave details. Benefit: Allows for better tracking of student's leave history.

◆ **Course Creation Application Character Limit Increase:** Character limit for new courses extended to prevent incomplete titles. Benefit: Ensures complete and clear representation of course titles.

◆ **Course Instructor Feedback for Summer term:** Enabled for Summer Term. Benefit: Students can submit feedback for the Summer term now.

◆ **NAD Report Enhancement:** The First set of requirements from the Academic Section have been completed. Work in progress for the next set. Benefit: Ensures alignment with regulatory and academic standards.

◆ **Student Status Revocation Issue Fix:** Corrected a long-pending issue where student status remained inactive even after revocation. Benefit: Ensures accurate student status representation.

◆ **Senate Agenda Generation Automation:** Automated Senate Agenda generation. Benefit: Streamlines administrative tasks and reduces manual workload.

- **Hostel Management (Re-Fx)**

◆ **Student Guest Room Booking Application:** Enhanced for smoother guest house allocation. Benefit: Improves the booking experience for students and staff.

◆ **Mandatory Business Area Field in Re-Fx Transactions:** Ensures clarity of origin between F&A and CSSP. Benefit: Enhances financial transparency.

◆ **Bonafide Certificate Correction:** Resolved the room number display issue. Benefit: Prevents errors and confusion during documentation.

- **Sales and Distribution (SD)**

◆ **Separate Number Ranges for Cancelled Invoices and Credit Notes:** Business requested implementation to distinguish between the two different document types during processing. Benefit: Enhances financial clarity and simplifies auditing of transaction records.

◆ **Output Control for Cancelled Invoices:** Cancelled invoices now display “Credit Memo” in the header area. Benefit: Provides immediate visual distinction between tax invoices and cancelled invoices, reducing processing errors.

◆ **Credit Notes Upload to E-Invoice Portal:** All Credit Notes are now uploaded with document type CRN. Benefit: Streamlines reconciliation and ensures accurate reporting to the E-Invoice Portal.

◆ **E-Invoice Report Mapping for UOM:** Mapping for the Unit of Measurement (UOM) corrected to avoid discrepancies. Benefit: Enhances the accuracy of invoice data and prevents customer disputes.

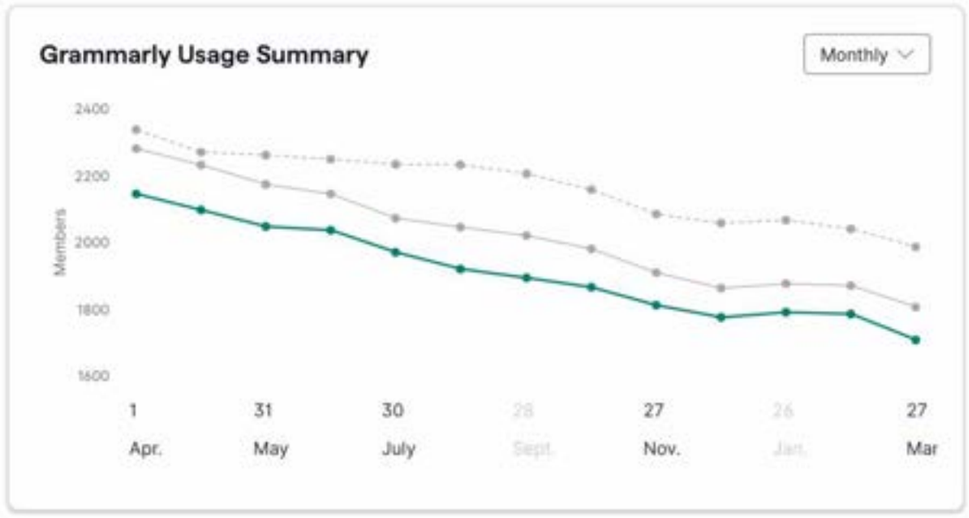
◆ **Proforma Invoice Generation for Scrap Sales Orders:** Configuration issues resolved to enable generation. Benefit: Simplifies the sales process and prevents

bottlenecks during scrap sales.

- **Adobe Products:**

  - The institute has bought licenses for Adobe Sign, Acrobat Pro DC and the Creative Cloud product/suite.
  - The Sign and Acrobat are assigned by default to all the faculty and admin officers and to others in specific cases.
  - The Adobe Sign plan is based on the number of transactions/documents per year, and the other two are user-based licenses.
  - As of now, Adobe Sign has around 800-plus users, including many admin assistants.
  - DIGITS has been managing the technical issue resolutions of the users and, wherever necessary, has been working with Adobe technical contacts.

- **Grammarly**



- Grammarly is an automated tool to Eliminate Grammatical Errors & Other Writing Issues, Improve Word Choice.
- The institute has licenses for Grammarly and is assigned to all the faculty, admin officers and PG/PhD students.
- Plug-in support for both Windows and Mac systems. https://digits.iisc.ac.in/wp-content/uploads/2020/10/FAQ-Grammarly1.2.pdf

- **Overleaf**

- Overleaf is a collaborative cloud-based LaTeX editor used for writing, editing, and publishing scientific documents.
- Institute has subscription to Overleaf Premium.
- This is used by the faculty and students.

Highlights for **April 2024-March 2025**

Security

1. Setup a team to improve the information security of the institute. The responsibility of the team includes:
   a) identifying system/software that enhances information security, perform testing and PoC, procure and implement the same.
   b) Conduct VAPT, identify and implement fixes.
   c) Proactively scanning the network and identifying and fixing vulnerabilities.
   d) Taking necessary action and replying to emails from Cert-In, NCCC and other agencies.
2. Implemented Azure Firewall for monitoring and managing all Azure environment traffic.
3. Conducted Cyber security awareness in the form of posters and phishing attack simulation as part of cyber security awareness month.
4. Integrated our Network as a node of the National Cyber Coordination Centre (NCCC) and have been taking corrective measures as recommended by them.
5. To enhance the security of the devices we have onboarded Microsoft Defender for Endpoint on 255 Desktops in administrative departments for near real-time telemetry, which is being constantly monitored, and corrective actions are taken in case of an alert.
6. Actively pushed for the enablement of MFA for every account. We are constantly monitoring the alerts, notifying the affected user, and taking corrective action, including enabling (or trying to) Multi-Factor Authentication (MFA) if not already set up.

Azure

1. A total of 143 VMs are managed in the Azure environment, with about 25 being added this year.
2. Upgraded Azure Application Gateway with HTTP/2 support.
3. Supported CeNSE in setting up the SEMulator3D server, enabling IISc to be a nodal institute for.
4. Performed cost optimisation.
5. Implemented changes on Azure to enable role-based authentication for the IISc mobile app.
6. Implemented Microsoft Monitoring Agent on Azure on all VMs.
7. The Azure environment is configured to enable role-based authentication for the Student ID card portal.

Email Support

1. **AD data sync with SAP data:**
   a) Now, temporary staff accounts are created based on SAP data only.
   b) SAP ID of all the Project staff updated.
   c) Department name and designation were updated
   d) Temporary staff account extensions are being done proactively based on SAP data.
   e) The team is now updating the newly created account details on SAP master data directly. This is done to avoid data discrepancy between the two.
2. **AD clean up:**
   a) Migrated over 300 staff/faculty accounts to the Alum domain.
   b) Migrated over 3000 student accounts to the Alum domain.
   c) Deleted over 1000 accounts.
   d) Deleted about 150 accounts of withdrawn/discontinued students.
   e) Moved 100+ accounts to vendor domain
   f) 146 CBR account migrated to the CBR domain.
   g) 222 FSID accounts identified and planned to be migrated.
   h) A total of 2500+ new accounts created.
3. Migrated Teams videos of all users from Stream Classic to OneDrive without outage or loss of data.
4. Microsoft reduced the storage size of the IISc tenant (OneDrive, SharePoint) from 14.5 PB to 500 TB, and timely action ensured that a major service outage was averted.
5. A co-pilot license was assigned to our tenant, currently assigned to two users. Also, Co-pilot GitHub is implemented and assigned to our developers.
6. 45TB of OneDrive space recovered by releasing space from an unlicensed account.

Network Support

1. The network team conducted a survey across the campus to build a BoM and an upgrade project request with the following objectives
   a. Upgrade the ageing Wi-Fi infrastructure in many departments
   b. Upgrade the complete network of the Civil Engineering department
   c. Extend Wi-Fi coverage to outdoor locations within the IISc Campus
   d. Upgrade the Core switch
   e. Upgrade the Distribution switches in the backbone network
   f. Building a robust WIPS (Wireless Intrusion Prevention System)

Upon approval, an OEM agnostic tender document that meets all project

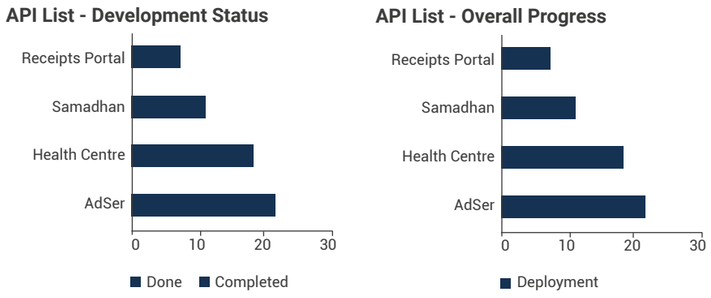
objectives was prepared and floated initially as a local tender for this tender on 25th October 2024. Due to a lack of participation, a GTE was requested, and once the GTE approval was received, it was floated again as a global tender on 10th January 2025. After following all the involved processes, the PO was released on 20th Mar 2025. The equipment delivery is ongoing. The project is expected to be completed in the next 3 months.

1. Tendering and implementation of the Wi-Fi and LAN network infrastructure in the IDS SmartX building is completed and working fine.
2. The implementation of the Wi-Fi and LAN network infrastructure in the 1000 rooms of the Boy Hostel and 500 rooms of the Girl Hostel building is completed
3. Upgraded distribution switches with dynamic routing and 10 Gbps uplink at Physics, Mathematics, and DESE departments.
4. Two new Sophos XG8050 series firewalls have been purchased to replace the old firewalls, enhancing network performance and security.
5. Whenever there is fibre damage, team has identified the issue and got it rectified at the earliest with minimum downtime
6. Isolation of Internet access for IISc Users, Guest users and Eduroam is successfully tested. Implementation is in progress.
7. As CentOS is no longer supported, we have successfully migrated all essential services (IDNS, EDNS, RADIUS) to Red Hat 9.7."
8. Browser-based authentication for accessing the Internet using the IISc email ID and password is being tested.

Portals/Websites and Applications **(New/Enhancements & Support)**

1. New Launches

- **Employee ID Card Portal:** A new portal launched to collect employees' personal details, photographs, and address proofs for printing & issuing ID cards.
- **Health Centre Website:** A newly designed website providing comprehensive information about the health centre facilities.
- **Student ID Card Portal:** A new portal has been developed to allow students to apply for ID cards online.
- **Search Programmes Portal:** A new portal that helps student applicants explore academic programmes offered by IISc based on their qualifications.
- **Document Verification Requests Portal:** A portal for receiving and processing requests related to the verification of academic documents.
- **Open Day Website:** The official website for Open Day 2025 has been updated and launched with new content and features.
- **Open Day Mobile App:** Mobile apps for Open Day 2025 have been launched for both Android and iOS platforms.
- **Thesis Examiners' Bank Account Portal:** A portal to collect bank account details from thesis examiners.
- **Insurance Portal (Students & Temporary Staff):** A new portal that allows married students and temporary staff to purchase insurance coverage for their spouses and children and make online payments.
- **Auditorium Booking Portal:** A portal that enables both internal and external users to view availability and book various auditoriums at IISc.
- **Project Management Portal for ODAA:** A dedicated portal to help the ODAA team create, monitor and manage project-related activities.
- **Mobile Application:** A new mobile app developed for students, staff and pensioners to access services such as AdSeR, Samadhan, HMIS, Receipts Portal, Campus Maps, and Directory.
    - Mobile app APIs : APIs for mobile applications has been developed, tested & deployed



1.1. Conference Websites Launches

- International Conference on Magnetic Materials and Applications (ICMAGMA 2025)
- The RISE for Healthy Ageing Longevity India Conference is a one-of-a-kind event bringing together leaders from academia, industry, clinical practice, and policy making from across the globe
- Entrepreneurship and Entrepreneurial Ecosystems in the Global Economy: Role of Returnee Entrepreneurs
- Modern Trends in Molecular Magnetism & Spins in Molecular Systems
- NDIN Design Education Meet 2024
- Longevity India Sci-Tech Industry Conclave
- Cyber-Physical Systems Symposium (CyPhySS 2024)
- IISc Sustainability Summit
- Summer School on Optics and Photonics

- SPCOM-2024 International Conference on Signal Processing and Communications
- 6th Biomembranes Symposium 2024
- The ISSS International Conference on Micro, Nano, and Smart Systems (IC-MNSS)
- Open Basic Education Workshop 2024
- This is the payment page of ODAA to receive donations for projects

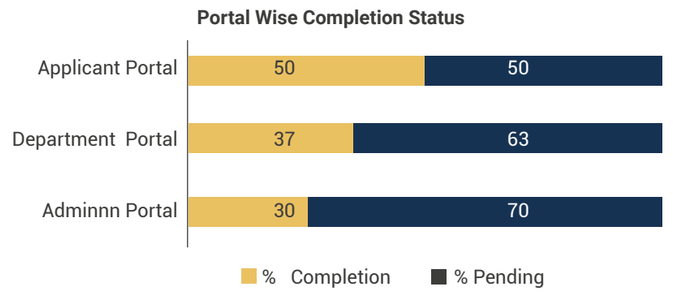
1.2. Other Websites & Portals

- Asian Engineering Deans' Summit 2024 - Disruptive Innovation in Engineering Education and Research
- HUL fellowship for women PhD students in IISc
- The department can nominate students for the various medals
- Official Transcripts, Educational Verification and Degree certificate/ Marksheet/ Duplicate Marksheet by Post
- Recruitment portal for medical school, to receive applications for various departments
- Institute NMR Facility (INF) - The Institute NMR facility houses eight NMR spectrometers, and details are available
- Application/Nomination for IISc Young Alum Medal - ODAA
- Nomination for IISc Distinguished Alumnus/Alumna Award - ODAA
- ODAA Travel Grant Support
- Information Security Office website

2. Enhancements

- **AdSeR Portal:** A new screen has been added to display user feedback with filtering options by email and SR number, along with pagination support.
- **Electricity Billing Portal:** Functionality introduced to enable sending bulk emails. New tariff structure implemented.
- **Medals Portal:** Replaced Active Directory login with a default username-password mechanism. Enhancements include updates to CGPA, credits, SR number, autofill features, dropdown options, file uploads and resolution of missing data in reports.
- **Samadhan Portal:** A new list was introduced, with users mapped accordingly to route complaints. Inventory-related issues were resolved, and additional information was added to the display grid for improved data visibility.
- **Receipts Portal:** Implemented a dynamic conference form. Integrated with the Auditorium Booking and Transcript Verification Request portals for better interoperability. Integrated several conference/events portals for registration.
- **AMS Portal (Legacy):** New features launched for regular session admissions. Portals for International Admissions and MTech Online Admissions have also been launched. The MTech selection process now includes functionality for managing multiple waiting list rounds.
- **ORG Portal (Research Grant Management):** Multiple enhancements implemented, including:
    - Support for selecting both faculty and students in grant calls
    - Archiving of closed schemes
    - Inclusion of multiple funding agencies
    - Unlimited text entry in the Additional Information field
    - Visitor tracking
    - Multiple submission deadlines
    - Improved document preservation during edits
- **Employee ID Card Portal:** Enhanced to capture additional inputs required for ID card printing.
- **Convocation Portal:** Introduced features allowing students to enter guest details and generate entry passes. The passes include QR codes that facilitate scanning and seat allocation in designated halls based on predefined categories upon arrival at IISc.
- **Amenities Portal:** Relaunched with Active Directory (AD) authentication and fixes for previously reported issues and security vulnerabilities.
- **Email Support Portal:** Enabled bulk UID generation for students and bulk email dispatch for sending credentials. Integrated with the AMS portal to fetch L3-approved student data automatically, reducing manual intervention in email ID creation.
- **DIGITS Website:** Redesigning of DIGITS website

3. Project Status: Admission Management Status



- APIs has been developed and are under testing
- Search Programme feature of Applicant portal has gone live
- UI/UX designs for applicant portal and admin portal has been reviewed by Committee. Review of department portal designs are in progress.
- Development of Applicant portal is in progress.

4. Receipts Portal: Event and Conference Websites Integrations

- **Conferences & Symposia:** Integrated with several national and international conferences such as IC-MNSS 2024, SPCOM-2024, Biomembranes Symposium, and iNCMDAO 2024, supporting event registration and fee collection.
- **Workshops & Winter Schools:** Includes integration with technical workshops and training programmes like the CeNSE Winter School, AFMM Microscopy Workshop, and Flow Cytometry workshops.
- **Design & Innovation Events:** Linked with events like NDIN Design Education Meet and conferences on entrepreneurship, innovation, and design ecosystems.
- **Science & Technology Summits:** Supports events like the IISc Sustainability Summit, Deep Science and Technology Industry Conclave, and Sci-Tech Industry Conclave.
- **Semiconductor & Engineering Events:** Integrated with specialised workshops and summits from CeNSE and Civil Engineering, including COSEIn 2025 and geosynthetics in dam engineering.

5. Azure Infrastructure

- **Firewall Implementation:** A network-level firewall has been successfully implemented across the entire Azure environment to enhance the security posture.
- **RHEL Subscription:** Red Hat Enterprise Linux (RHEL) subscription has been purchased and configured for all newly provisioned VMs starting from April 2024.
- **Database Credential Management:** Database credentials have been securely segregated and consistently configured as per best practices.
- **VM Provisioning:** Approximately 40 virtual machines have been provisioned and configured to support various application workloads.
- **VAPT Compliance:** All VAPT (Vulnerability Assessment and Penetration Testing) issues reported for Azure-hosted sites have been addressed and resolved.
- **Database Backups:** Database backup policies have been updated, and regular backups are now scheduled and configured as per the new policy framework.
- **Security Recommendations:** Defender for Cloud security recommendations are being reviewed and implemented daily to maintain compliance and reduce risk.
- • **DevOps Implementation:** DevOps pipelines and automation workflows have been successfully implemented for the AMS Application.

6. Health Centre ID Card Status:

Group	Relation	Total	Submitted	Pending for review	Corrections	To be Printed	Printed	Issued*
Group A	Self	580	328	3	22	4	299	0
Group A	Dependents	1398	643	11	60	10	562	0
Others	Self	320	208	5	36	0	167	0
Others	Dependents	527	282	14	101	0	167	0
Pensioners	Self	1606	1046	7	158	3	878	0
Pensioners	Dependents	1051	744	7	192	5	540	0

**Cards are being issued to staffs & Pensioners by Health Centre. The number of cards issued are yet to be received.*

ScholarOne, GSuite and SharePoint

- Organised Enhancement Discussion between the top management of Silver Chair (ScholarOne Thesis Processing SaaS provider) and IISc Thesis Stakeholders. The below enhancement was done.
- The auto-generated email to the Guide is sent when the Dean approves the thesis. The attachment includes:
  (i) Guidelines for Oral Examination
  (ii) List of Examiners who reviewed the thesis (Work in Progress)
  (iii) Review Reports
- Weekly Status Reports Generation
- The auto-generated email to the Guide is sent when the Dean approves the thesis. The attachment includes:
  - (i) List of Examiners who reviewed the thesis
  - (ii) Review Reports
- Technical Support to ScholarOne users
- Technical Support
  - G Suite
  - *No of new IDs created: 2624
  - *No of IDs deleted: 822
- **SharePoint:**
- **Intranet Site:** With the help of the Departments, the course details and others were updated in the departments' SharePoint pages and the same was linked to those with intranet site
- **Document Management System:** Running it and management access for various documents.

3.7.10

Office of Research Grants

The Office of Research Grants (ORG) was established at the Indian Institute of Science in 2020 to provide professional grant management support to the institute's researchers. ORG serves as the primary administrative contact for services and support related to sponsored projects at the Indian Institute of Science.

Grants Manager
ROHIT KUMAR HG

Grants Officer
RAMYA MOHAN
DEVI R KRISHNAN

Chair:
SANDEEP M
ESWARAPPA

Dissemination of funding opportunities
The ORG, in collaboration with DIGITS, has developed a comprehensive grant database portal (https://researchgrantsportal.iisc.ac.in) that compiles funding opportunities from around the world, covering various research areas relevant to the institute's researchers. ORG maintains and updates this database, which currently includes over 1,300 funding calls from national and international grant agencies. Institute researchers can access this portal using their IISc credentials.

The office regularly disseminates funding opportunities from national and international agencies via email. During FY 2024-25, more than 120 funding opportunities were communicated to the institute community through regular emails. Additionally, grant opportunities were compiled and shared electronically through the ORG monthly newsletter, "STREAM."

First two pages of STREAM Issue 50 November 2024

Support to faculty members
The office regularly assists faculty with grant submissions to national and international agencies. In FY 2024-25, ORG provided both pre and post-award support to a total of 75 projects, in addition to responding to many queries. This support includes assistance with grant submissions and the activation of award-winning projects.

Assistance in Grants Administration
ORG has streamlined the international grant submission process at the Institute. The office currently manages the following important registrations and certifications required for international grants submissions:

Sl. No.	Registrations / Certifications	Role of ORG
1	System for Award Management (SAM)	Registration and its annual renewal
2	Office of Research Integrity (ORI) certification	Annual report submission for renewal
3	Shastri Indo-Canadian Institute (SICI)	Annual membership renewal and report submission

ORG assists the faculty members in creating user accounts on the eRA commons portal required for NIH grant submissions. The office also coordinates between different administrative offices of the institute to facilitate the smooth and timely submission of grant proposals.

ORG has assisted in registering the institute on BioRRAP (Biological Research Regulatory Approval Portal), which is a centralised mechanism created to facilitate Biological Research Regulatory Approval process. The office may be contacted for any assistance in creating user IDs.

Facilitating Research Funding Programmes

The office plays a critical role in facilitating and managing research funding programmes at IISc. By collaborating with corporate and philanthropic partners, ORG ensures the seamless implementation of funding initiatives, from the formalisation of agreements and proposal calls to project monitoring and reporting.

CSR Funding from Syngene: ORG is coordinating four research projects funded by Syngene as part of their CSR initiative.

IISc BFI-Biome Programme:
The Blockchain For Impact (BFI) expressed interest in providing funding support for research projects in the field of biomedical sciences at IISc. To facilitate this initiative, the ORG initially supported the Office of Development and Alumni Affairs (ODAA) in formalising the Memorandum of Understanding (MoU) for the execution of the funding programme.

Following the execution of the MoU and the receipt of USD 300,000 (INR 2,47,97,131) from BFI, the programme was handed over to ORG for implementation of the first funding cycle. ORG invited proposals from institute researchers to submit their innovative project ideas and coordinated the internal review process of the submitted proposals. Total of three projects were selected for funding by the BFI, which are now being implemented.

Execution of MoUs
Establishing Memorandums of Understanding (MoUs) with various external agencies in research areas of mutual interest, in collaboration with the legal and administration departments at the institute, also falls within the scope of tasks performed by ORG. During 2023-24, the office supported the establishment of MoUs with two reputed organisations, in addition to facilitating activities related to two MoUs that were established in previous years.

MBBS/MPH internship programme
Since FY 2022–23, ORG has been coordinating the MBBS research internship programme with philanthropic support, which was extended to include MPH students in FY 2023–24. The objective of this programme is to provide clinical students with the opportunity to gain research experience in one of the participating laboratories on campus, fostering the development of physician-scientists in the country. A total of 48 students were selected under the guidance of 35 faculty members for FY 2024-25, and they stayed on campus for 4 to 8 weeks to complete their internships.

Picture taken during the initial discussions – Faculty members and representatives from ORG, ODAA, and BFI were present.

MoU signing ceremony of the collaboration between IISc and BFI

Events

Science Communication and Grant Writing Workshop
ORG successfully hosted an engaging Science Communication and Grant Writing Workshop aimed at enhancing the science communication and grant writing skills of IISc researchers. Held over three days (Feb 6–8, 2025), the workshop brought together PhD students, postdocs, and faculty members to explore key topics:

- **Day 1:** Writing scientific papers & understanding journals and editorial processes
- **Day 2:** Identifying grant opportunities & crafting compelling applications
- **Day 3:** Delivering impactful scientific presentations

The workshop was led by Andrew Moore, an expert trainer in science communication and former Programme Manager and Associate Editor at the European Molecular Biology Organisation (EMBO).

Meet 'n Greet
To foster networking and provide MBBS/MPH interns an opportunity to interact with esteemed faculty members, a 'Meet 'n Greet' event was organised on June 20, 2024. The event aimed to create a platform for meaningful dialogue, collaboration, and mentorship in an informal setting.

A total of **24 interns and eight faculty members** participated, engaging in lively discussions, knowledge sharing, and exchanging ideas on current trends, challenges, and opportunities in the field of medical and public health education and research. The informal interaction encouraged interns to seek guidance on career pathways and academic pursuits, while faculty members shared valuable insights and expertise, making the event a successful and enriching experience for all.

Lecture Series
To bring together all the students selected under the MBBS-MPH internship programme on one platform, a lecture series featuring pedagogical talks on diverse research topics was hosted. Last year, five lectures were conducted (listed below), each offering valuable insights into specific medically relevant issues.

Speaker	Title	Date of Lecture
Sandeep M. Eswarappa *Associate Professor, Biochemistry*	Evolution and medicine	July 04, 2024
Dipshikha Chakravortty *Professor, Microbiology and Cell Biology*	Right to live	July 11, 2024
Swaminathan S. *Inaugural Chair and Professor Dept. of Nephrology, Division of Medical Sciences*	Reflections on my personal and scientific journey	July 16, 2024
Ramray Bhat *Associate Professor, Developmental Biology & Genetics*	On ovarian cancer progression: metastasis, therapy and resistance	August 12, 2024
Umesh Srinivasan *Assistant Professor, Centre for Ecological Studies*	Climate change, habitat loss, and the future of Himalayan biodiversity	August 19, 2024

Talk by Prof Swaminathan S at Raman Building Conference Room

3.7.11

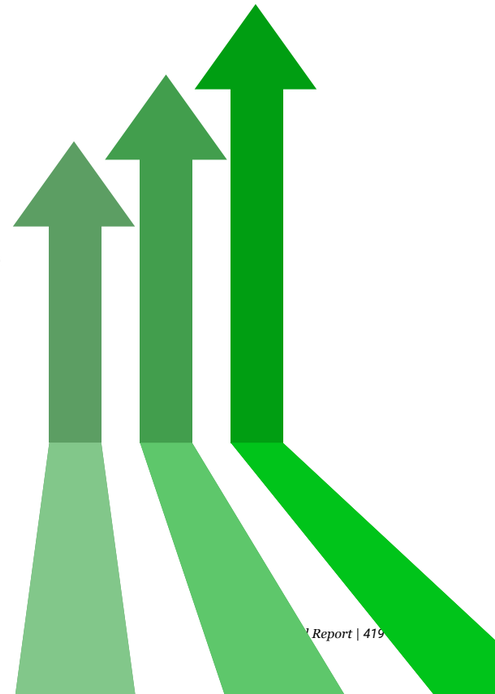
Office of Career Counselling and Placement

The Office of Career Counselling and Placement (OCCaP) Centralised the management of campus Placement & Internships. Several placement activities and events were organised to facilitate interaction between students and industries through special meetings (pre-placement talks, alumni connect meetings, etc) in IISc and helped students hone up their skills to meet industry requirements. 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.

A. Completion of Final Placements for Batch 2019-20
B. Connect with Batch 2020-21 & Batch 2021-22
C. Pre-Placement Offers Post Internship – Batch 2020-21
D. Final Placement Campus Season 2020-21
E. Special counselling for specific students
F. Internship Placements 2021-22
G. Special Attempts for PhD & Post Doc students
H. Technical and Soft Skills for students
I. Final Placement Campus Season 2021-22
J. Connect with Batch 2022-23
K. Internship placements Batch 2022-23
L. Final Placements Campus Season for 2022-23 (In-process)
M. Internship Placements for Batch 2023-24 (In-process)
N. Completed full-time placements for the 2022-23 batch
O. Organised a “Thanksgiving” event for the 2022-23 student placement coordinators
P. Established connections with the 2023-24 batch
Q. Completed internship placements for the 2023-24 batch
R. Pre-placement offer post internship for the 2023-24 Batch
S. Conclusion of Final Placements: Batch of 2023–24 (Graduating in 2024)
T. Internship placements for the 2024-25 batch (completed)
U. Ongoing Full-Time (Batch graduating in 2025) and Summer Placements (Batch graduating 2026)
    (1.) Final Placements (Batch graduating in 2025)
    (2.) Summer Internship Placements (Batch graduating in 2026)
V. Student Support Events and Industry Engagement

A. Completion of Final Placement 2019-20
Final placement for batch 2019-20 continued and closed in June 2020 for UG, MTech, MTech(Res), MDes, MMgmt and PhD students registered with OCCaP to seek placement support

B. Connect with batch 2020-21 & batch 2021-22
Students from batch 2020-21 were addressed in July/ August 2020 and students of batch 2021-22 were addressed in January/ February 2021. These interactive sessions with the students were to understand their inclination for campus placements, share information about placement process/ policies and to identify their needs for personal skills and those necessarily requiring additional attention.



C. Pre-Placement Offers Post Internship – Batch 2020-21 About 50% students from batch 2020-21 received direct pre-placement full time offers (PPO) in September 2021 who participated in internship season 2020.

D. Final Placement Campus Season 2020-21
Pre-Placement Talks (PPT's) for UG/Master/ PhD/ Post Doc students scheduled from August and continued till September.

- Pre-placement talks by companies were scheduled virtually in August and September
- Placement process, PPT, Test, Interviews conducted via virtual mode.
- Campus Placement interviews commenced from 10th September 2020.
- 180+ companies participated in campus hiring for full time placements.
- 294 students secured full time jobs with highest of 95.3 Lakh JPY as highest international offer and 61.2 LPA highest domestic offer

Final Placement	*2020-21***	*2019-20**	*2018-19*	*2017-18*	*2016-17*
Total Students Placed	294	238	269	235	207
Highest CTC (LPA)	95.3 L JPY (inter-national) & 61.2 L (domestic offer)	43.3	62.4 L (Inter-national) 43.3 (domesti c)	45	30
Average Annual CTC (LPA)	21.8	21.9	20	16.7	15
No. of students placed with >40 LPA	10	13	7	1	NA
No. of students placed with 30- 40 LPA	50	43	45	10	2
No. of students placed with 20-30 LPA	97	76	56	53	33
No. of Master students placed	261	192	231	194	198
No. of PhD/ Post Doc Students Placed	28	34	35	31	3
No. of UG Students Placed	5	12	3	10	6

** ** L – Lakh, JPY – Japanese Yen*
***2020-21 – placements commenced in mid-September 2020 and to continue till July 2021*
**Note: 2018-2020 MTech admission (batch 2019-20) was only 268 compared to 346/457 in the previous year*

E. Special counselling for specific students
Students who were finding their way difficult to get through the interviews and secure a job were addressed to understand their problem areas beyond technical domain and help them overcome the same to prepare for further interviews.

F. Internship Placement (Batch 2020-21)

- Internship placement for batch 2020-22 commenced in March 2022.
- Virtual internships for selected students for 8 weeks duration staring from June.
- Highest Stipend –1.25 L per month (PhD and Master programme)

G. Special Attempts for PhD & Post Doc students
Continuous meetings with PhD and Post Doc students to familiarise them with the prospective work opportunities available in industries. PhD/ Post Doc placement for final placement and internship open round the year.

H. Technical and Soft Skills

- Technical/ soft skills/ mentorship sessions(virtual) with industry leaders free of cost to students
- Student Mentorship sessions in association with Talent Acquisition leaders of industry to take them through various aspects like expectations of industry on a fresher, Future skills, creative problem solving, preparing a great CV, virtual interview, how to crack virtual interview etc.
- Technical & soft skill sessions by BT Leaders on - Big Data Technical, Cloud Computing, Women in Technology, Importance of Communication, Agile, DevOps etc.,

I. Final Placement Campus Season Batch 2021-22 (*In-process)
Pre-Placement Talks (PPT's) for UG/Master/ PhD/ Post Doc students scheduled from August-2021.

- Pre-placement talks by companies were scheduled virtually in August and September
- A special 1-credit course to improve students' communication skills was organised during the year. A couple of sessions of coding bootcamp was also facilitated during the year. These have been extremely useful in bridging the gap between students' capabilities and employers' expectations.
- Placement process, PPT, Test, Interviews conducted via virtual mode.
- Campus Placement interviews commenced from 10th October 2021.
- 150+ companies participated in campus hiring for full time placements.
- 356 Masters/UG, PhD students secured full time jobs with highest of 60.00 LPA domestic offer

Final Placement	**2021-22*	*2020-21*	*2019-20*	*2018-19*	*2017-18*	*2016-17*
Total Students Placed	356	294	238	269	235	207
Highest CTC (LPA)	60.00 LPA (Domestic Offer)	95.3 L JPY (international) & 61.2 L (domestic offer)	43.3	62.4 L (International) 43.3 (domestic)	45	30
Average Annual CTC (LPA)	23.2	21.8	21.9	20	16.7	15
No. of students placed with >40 LPA	8	10	13	7	1	NA
No. of students placed with 30- 40 LPA	73	50	43	45	10	2
No. of students placed with 20-30 LPA	154	97	76	56	53	33
No. of Master students placed	331	261	192	231	194	198
No. of PhD/ Post Doc Students Placed	18	28	34	35	31	3
No. of UG Students Placed	7	5	12	3	10	6

J. Connect with Batch 2022-23
Students from the batch of 2022-23 were addressed in July 2022. These interactive sessions with the students were to understand their inclination for campus placements, share information about the placement process/ policies, and identify their needs for personal skills and those requiring additional attention. Completed the pre-registration process for the full-time placements, and approximately 538 students registered, including PG, UG, PhD, and Post Doc.

K. Internship placements Batch 2022-23

- Internships open for UG/ Masters/PhD/Post Doc students
- Student meetings to take them through placement process and policies
- Batch 2023 internships commenced from March 2022
- 108 students secured internships
- Highest monthly stipend – 1.5 L

L. Final Placements Campus Season for 2022-23 (In-process)

- Placement activities for Students graduating in the academic year 2022-23 were initiated in September 2022 with interactive sessions with the students to understand their interest in campus placements, share information about the placement policies and procedures, identify their need for personal/inter-personal skills, and offer additional help to those requiring special attention.
- The pre-registration process for full-time placements has been completed, including UG, Masters, PhD students, and Post-Doctoral fellows. In addition, we organised periodic meetings with PhD students and Post Docs to familiarise them with work opportunities in the industry.
- This year, OCCaP prepared an attractive pamphlet of 12 departments to circulate to potential recruiters. Several recruiters were contacted, and many have responded positively with opportunities for our students.
- Some new recruiters such as Cerebras Systems, Capital One, Silicon Labs, Fujitsu Research of India, Pvt Ltd, British Petroleum, SAP Labs, Super Six Sports, IDFC, Infobell, and Humanetics have been added to our list of eminent recruiters from earlier years.
- Pre-Placement Talks (PPTs) for students were scheduled during September and November 2022. OCCaP continues to use an online Portal developed a few years ago for managing key processes of matching students' interests with companies' requirements.
- The full-time hiring process for the academic year started in October 2022.
- This year, a total of 412 full-time offers were made, and 379 UG, Masters, and PhD students secured jobs through OCCaP. The highest international CTC was 85.71 LPA, the highest domestic CTC was 66.79 LPA, the average CTC was 27.59 LPA, and the median CTC was 27.06 LPA. The placement process is still ongoing, and a few more students are expected to be placed through OCCaP in the coming months.

The below table displays the placements comparison between 2022-23 and 2021-22.

Final Placement Statistics	2022-23 (In-process)	2021-2022
Average Annual CTC (LPA)	27.59	23.2
No. of Masters students placed	346	331
No. of PhD Students Placed	30	16
Total Students Placed	379	356
Summer Internships	102	108

The below table depicts the 2022-23 Full-time placements statistics.

Final Placement Statistics	2022-23 (In-process)
Average Annual CTC (LPA)	27.59
No. of Students placed with >40 LPA	55
No. of students placed with 30- 40 LPA	102
No. of students placed with 20-30 LPA	101
No. of Masters students placed	346
No. of PhD Students Placed	30
Total Students Placed	**379**

M. Internship Placements for Batch 2023-24 (In-process)

- Internship activities for Students graduating in the academic year 2023-24 were initiated in January 2023.
- Pre-registration process for the internship placements has been completed, including UG, Masters, PhD students, and Post-Doctoral fellows.
- PPTs for students are scheduled from January 2023
- This year, a total of 131 internship offers have been made, and 125 UG, Masters, and PhD students secured internships through OCCaP. The highest domestic stipend was 1.5 lakhs/month, The internship placement process is still ongoing.

N. Completed full-time placements for the 2022-23 batch

- Placement activities for students graduating in the 2022-23 academic year began in September 2022 and concluded in August 2023. These activities supported UG, Masters, and PhD students registered with OCCaP for placement assistance.

The below table displays the placements comparison between 2022-23 and 2021-22.

Final Placement Statistics	2022-23	2021-22
Average Annual CTC (LPA)	27.5	23.2
No. of Masters students placed	352	331
No. of PhD Students Placed	36	16
Total Students Placed	391	356
Summer Internships	102	108

The below table depicts the 2022-23 Full-time placements statistics.

Final Placement Statistics	2022-23
Average Annual CTC (LPA)	27.5
No. of Students placed with >40 LPA	58
No. of students placed with 30- 40 LPA	102
No. of students placed with 20-30 LPA	101
No. of Masters students placed	352
No. of PhD Students Placed	36
Total Students Placed	391

O. Organised a "Thanksgiving" event for the 2022-23 student placement coordinators

- A Thanksgiving event was held in June 2023 to show appreciation to the student placement coordinators for their support and coordination during the 2022-23 placement season. Certificates were presented to all the coordinators, and their feedback was requested.

P. Established connections with the 2023-24 batch

- Students from the batch of 2023-24 were addressed in July 2023. These interactive sessions with the students were to understand their inclination for campus placements, share information about the placement process/ policies, and identify their needs for personal skills and those requiring additional attention. Completed the pre-registration process for the full-time placements, and approximately 790 students registered, including PG, UG, PhD, and Post Doc.

Q. Completed internship placements for the 2023-24 batch

- This year, a total of 140 internship offers have been

made, and 134 UG, Masters, and PhD students secured internships through OCCaP. The highest domestic stipend was 1.5 lakhs/month.

R. Pre-placement offer post internship for the 2023-24 Batch

- A total of 134 single internship offers were extended, with 35 students receiving pre-placement offers.

S. Completion of Final Placements: Batch of 2023–24 (Graduating in 2024)

- Placement activities for Students graduating in the academic year 2023-24 were initiated in September 2024 with interactive sessions with the students to understand their interest in campus placements, share information about the placement policies and procedures, identify their need for personal/inter-personal skills, and offer additional help to those requiring special attention.
- The pre-registration process for full-time placements has been completed, including UG, Masters, PhD students, and Post-Doctoral fellows.
- This year, OCCaP asked the student placement coordinators to prepare an attractive brochure of their respective departments to circulate to potential recruiters. Several recruiters were contacted, and many have responded positively with opportunities for our students.
- We have added new recruiters such as Total Environment, OLA, Technip Energies, Hawkins, Synopsis, Ashirvad, Air India, Nykaa, Dolby, Siemens EDA, Kotak Mahindra, Micron Technology (Taiwan), and Kotak Life to our esteemed list of recruiters from previous years.
- Pre-Placement Talks (PPTs) for students were scheduled during August and September 2023. In line with our commitment to providing comprehensive information, we introduced a new practice this year. After the pre-placement talk, a dedicated 30-minute slot was allocated for the student placement coordinators to present individual department details alongside the respective recruiters. This initiative aimed to give recruiters a deeper understanding of each department's strengths, achievements, and potential contributions to their organisations.
- The full-time hiring process for the academic year started in October 2023. OCCaP continues to use an online Portal developed a few years ago for managing key processes of matching students' interests with companies' requirements.
- This year, a total of 434 full-time offers have been made, and 413 UG, Masters, and PhD students secured jobs through OCCaP. The highest international CTC was 58.56 LPA, the highest domestic CTC was 65.40 LPA, the average CTC was 26.35 LPA, and the median CTC was 24.6 LPA. Final placement activities for the batch of 2023–24 began in August 2023 and concluded in July 2024.

The table below displays the placements comparison between 2023-24 and 2022-23.

Final Placement Statistics	2023-24	2021-2022
Average Annual CTC (LPA)	26.35	27.5
No. of Masters students placed	365	352
No. of PhD Students Placed	46	36
Total students placed	413	391
Summer Internships	143	102

The below table depicts the 2022-23 Full-time placements statistics.

Final Placement Statistics	2022-23
Average Annual CTC (LPA)	26.35
No. of Students placed with >40 LPA	50
No. of students placed with 30- 40 LPA	78
No. of students placed with 20-30 LPA	165
No. of Master students placed	365
No. of PhD Students Placed	46
Total Students Placed	413

T. Internship placements for the 2024-25 batch (completed)

- Internship activities for Students graduating in the academic year 2024-25 were initiated in January 2024.
- Pre-registration process for the internship placements has been completed, including UG, Masters, PhD students, and Post-Doctoral fellows.
- PPTs for students are scheduled from January 2024
- This year, a total of 159 internship offers (including 6 month offers to students graduating in 2024) have been made, and 157 UG, Masters, and PhD students secured internships through OCCaP. The highest domestic stipend was 2.0 lakhs/month.

U. Ongoing Full-Time (Batch graduating in 2025) and Summer Placements (Batch graduating in 2026)

The Placement Office facilitated full-time and internship placements across UG, Masters, PhD, and Post-Doctoral programmes. Activities began in August 2024 with prep sessions, industry talks, and recruiter engagements.

Final Placements (Batch graduating in 2025)

- A total of 480 full-time job offers were made to 459 students. 25 students secured 6-month internships.
  - **o Highest Annual CTC:** 54.8 LPA
  - **o Median Annual CTC:** 27 LPA

Summer Internships (Batch graduating in 2026)

- A total of 196 summer internship offers were made to 194 students (including 31 B.Tech)
  - **o Highest Monthly Stipend:** 2.5L
  - **o Median Monthly Stipend:** 60K

****50+ New Recruiters visited in 2024-25 during the full time and summer internship placements**

Final Placements (Batch graduating in 2025)

Full-time placement activities began in mid-August 2024 with pre-placement talks, followed by assessments and interviews. Final placement activities for the batch of 2024-25 began in August 2024 and are scheduled to conclude in July 2025. 25 students secured a 6-month internship. 431 Master students and 27 PhD students secured full time jobs.

Final Placement Statistics	2024-25 (ongoing)	2023-24 (completed)
Total Offers	480	434
Total Students	459	413
Number of Master students Placed	431	365
Number of PhD students Placed	27	46
Median Annual CTC (LPA)	27 LPA	24.6 LPA

Average Annual CTC (LPA)	28 LPA	26.4 LPA
No. of Students placed with >40 LPA	82	50
No. of students placed with > 30 and <= 40 LPA	87	78
No. of students placed with > 20 and <= 30 LPA	153	165

***Placement for 2024-25 is ongoing and scheduled to conclude by July 2025*
***Master students include – MTech, MDes, MMgmt, MTech (Res), MSc(Res)*

Summer Internships (Batch graduating in 2026)

Internship placements for Summer 2025 began with student addressal session and registration in January 2025, followed by recruitment processes starting February 2025 which is scheduled to conclude by May 2025. Total 194 students (including 31 BTech) secured three months internship offers.

Summer Internship (3 month)

Batch	2024-25 (batch graduating 2026)	2023-24 (batch graduating 2026)
Total Offers	196	148
Total Students	194	143
Bachelor of Science (Res)	3	4
BTech (Mathematics & Computing)	31	NA
Masters	158	135
PhD	2	4
Highest stipend (monthly)	2.5 L	2 L
Median stipend (monthly)	60 K	50 K

***Masters include MDes, MTech, MMgmt and MTech (res)*

V. Student Support Events and Industry Engagement

To enhance student preparedness and industry connectivity, OCCaP conducted the following programmes.

1. Industry sessions by Google, Microsoft, Amazon, and more.
2. Events like hackathons and talent quests led to additional job and internship offers.
3. Career readiness programmes included resume workshops and alumni talks

(1.) Industry Sessions & Workshops

- **Google –** Tech Session on "Future of Search" - open for all students
- **Microsoft –** Session on "Navigating the Landscape of Generative AI" - open for all students
- **Amazon Research –** Introduction to ML Research
  - o Two internships offered
- **Optum –** AI/ML Leadership Talk
  - o One PhD internship offered
- **Micron –** Free Coursera access for upskilling in tech domains
  - o 133 students received free subscriptions

(2.) Hiring Events

- **Startup AI Talent Quest Event** in partnership with ACCEL & NASSCOM
  - o 16 full-time job offers, and nine internships offered
- **Motive Hackathon –** Hiring Event
  - o Two full-time roles + two internships offered + one student won an iPad; all participants received goodies
- **Scale AI –** Specialised hiring drive for PhDs
  - o 35 PhD, one Research Associate, one Project Assistant received part time offers with an opportunity to make 4.0 Lakhs for a project of eight weeks)

(3.) Career Readiness Programmes

- Resume Workshops – Helped students draft impactful resumes
- Alumni Talk – "Industry Expectations for the Future Workforce"

3.7.12 *Foundation for Science, Innovation and Development*

PROJECTS SANCTIONED

During the period under review FSID got 110 projects sanctioned covering different departments of the Institute involving the participation of large number of faculty members

INDUSTRY R&D CENTRES IN FSID/IISc CAMPUS

I-HUB Centres

1. United Technologies Corporation India Private Limited (Pratt & Whitney R&D Centre)
2. Tata consultancy Services
3. I-HUB for Robotics and Autonomous Systems Innovation Foundation
4. IUDX Programme Unit
5. Garett motion Technologies Private Limited

Agreements/Mou

Agreements with the following organisations have been entered into during the period under review.

1. Karnataka Innovation and Technology Society
2. Jaitra Software Solutions
3. UHasselt
4. Himalaya Wellness Company
5. Ministry of Heavy Industry
6. Nexperia B.V
7. Karnataka State Police Housing & Infrastructure Development Corporation Limited
8. Accenture Solutions Private Limited
9. Tata Consulting Engineers Limited
10. Tata Steel Limited
11. Indian Airforce
12. Indian Army
13. Lexus Softmac
14. Bharat Serums And Vaccines Limited
15. Danfoss Industries Private Limited
16. Hindustan Aeronautics Limited
17. Visvesvaraya Jala Nigam Limited
18. Sonata Information Technology Limited
19. BASF India Limited
20. Petronet MHB Limited
21. Electronics City Industries Association (Elcia)
22. Honeywell Technology Solutions Lab Private Limited
23. Tejas Networks Limited
24. Fujitsu Limited
25. Daimler Truck Innovation Center India Pvt Ltd
26. Indian Space Research Organisation

Project and Programme MoU Pipeline

1. Hindalco Industries Limited
2. Space Applications Centre, ISRO
3. NRSC, ISRO
4. VSSC, ISRO
5. DFCCIL

Stem Cell

Companies (External) currently being incubated in FY 2024-25

Sl No	Incubation MM/YY	Company	Incubatee	Technology Area	Status	Impact Area
1	Mar/2025	Ecostrata Infra Private Limited	Nikhil, Nithin Nujum	Energy/ Sustainability	Early Stage	Construction Sector
2	Dec/2024	Visist AI Technologies Pvt Ltd	Suresh Kumar Chintada, Raghavan Seshadri	AI/ Computer Vision	Early Stage	SportsTech
3	Nov/2024	Voltanova Energy Private Limited	Jaicky Kumar, Deepak Mishra	ClimateTech	Early Stage	Energy
4	Jul/2024	BillionGradients Lab Private Limited (Interflow)	Tushar Shinde, Abhinash Khare	Artificial Intelligence	Early Stage	BFSI
5	Jul/2024	Apratima Biosolutions Pvt Ltd	Kavyashree Manjunath	Protein Engineering	Early Stage	Environment
6	Apr/2024	ABX3 PV Private Limited	Aditya Sadhanala, Sushobhan Avas-thi, Laxman Gouda, Satya Gangadhara Rao Vadaga, Praveen Chandrashekarapura Ramamurthy	Perovskite Solar Cells	Early Stage	Renewable Energy

Companies incubated under the Faculty Entrepreneurship Programme in FY 2024-25

Sl No	Incubation MM/YY	Company	Incubatee	Technology Area	Status	Impact Area
1	Mar/2025	MedrinZ Bio	Indranil Chakraborty, Chatterjee Kaushik	Orthopaedic implant	Early Stage	Healthcare
2	Aug/2024	Rejuvome Therapeutics Private Limited (RTPL)	Deepak Kumar Saini, Darshit Patel	Longevity	Early Stage	Healthcare
3	May/2024	Rescons Solutions Pvt Ltd	Pratibha Gupta, Govind Sharan Gupta	Metallurgy Software	Early Stage	Iron and Steel industries

Companies incubated under TBIs (CPDMED & InCENSE) in FY 2023-24

Sl No	Incubation MM/YY	Company	Incubatee	Technology Area	Status	Impact Area
CPDMED						
1	Apr/2024	Newttorr Pumps And Systems Pvt Ltd	Mallikarjun Shivappa Dandinawar, Aman Mallikarjun Dandinawar	PSA Oxygen Generators	Early Stage	Healthcare
InCENSE						
1	Aug/2024	Gyrfalcon IntelliEdge Solutions India Pvt Ltd	Lakshmi Vaidyanathan, Radha Durbha Mohan	IoT (Internet of Things)	Early Stage	Automation
2	Sep/2024	Meerkats Heatcrafters Private Limited	Sonali Saleel Tatke, Aashish Manocha	Nanotechnology	Early Stage	Electronics
3	Apr/2024	ABX3 PV Private Limited	Aditya Sadhanala, Sushobhan Avasthi, Laxman Gouda, Satya Gangadhara Rao Vadaga, Praveen Chandrashekarapura Ramamurthy	Perovskite Solar Cells	Early Stage	Renewable Energy

Startups Supported under SISF in FY 2024-25

S.No.	Name of the Startup	Technology Area	Impact Area
1	BPC Bioproducts Private Limited	Bio-based Materials	Packaging
2	Green Collar Agritech	AI & Analytics	Agriculture

Startups Supported under NIDHI SISF in FY 2024-25

S.No.	Name of the Startup	Investment amount	Remarks
1	BillionGradients Lab Private Limited	25 Lakhs	Fund Dibursed- Stuck with PFMS tech issue
2	Apratima Biosolutions Pvt Ltd	25 Lakhs	Yet to disburse the fund
3	Kristelle Dental Implant Systems Private Limited	25 Lakhs	Fund transferred- CCD
4	Botloka Private Limited	30 Lakhs	Fund transferred- CCD
5	Dfine Bio Innova-on Pvt Ltd	30 Lakhs	Fund transferred- CCD

Startups Supported under iDEX

Sl. No.	Name of the Startup	Name of Challenge	DOC/ISC/ Prime Details	Current Milestone
1	Prayasta 3D Innovations Pvt Ltd	(TCL)Designing thermal agile mannequin to measure comfort parameters in simulated high altitude environment	DISC 6 (TCL)	M1
2	Astrome Tech	4G/LTE Tactical LAN (IA)	DISC 1	M5
3	Astrome Tech	Four-Axis stabilised Antenna for C & Ku Band Operation (IN)	DISC 3	M3
4	Tsall Aerospsce Technologies Pvt Ltd	Caged Drone with TIC for Firefighting in Confined Spaces	DISC 7 #44	M3
5	Tsall Aerospsce Technologies Pvt Ltd	An integrated system for surveillance & reconnaissance, border mapping and targeting solutions	OC 6(Indian Army)	M2
6	Tsall Aerospsce Technologies Pvt Ltd	Autonomous Cargo Carrying Ariel Vehicle	0C 6 Indian Navy)	M0
7	Bellatrix Aerospace Pvt Ltd	Micro Propulsion Systems for cubesats	DISC 8 Ch: 35.2	M1
8	Bellatrix Aerospace Pvt Ltd	Hall Effect Plasma Thrusters for Spacecraft Orbit Corrections	DISC 8 Ch: 35.3	M1
9	Next Defence Pvt Ltd	DMAG (Drone Mounted Autonomous Gun)	OC 6(Indian Army)	M1
10	Astrome Tech	Customised Remote Modem with Ruggedised FPGA based platform with inbuilt Post quantum Encryption for VSAT baseband for Naval Platform	DISC VIII, Ch 31	M1
11	Agnit Semiconductors Pvt Ltd	Advanced Gallium Nitride Semiconductors	OC 7 - BEL	M1
12	Bellatrix Aerospace Pvt Ltd	Altitude Determination and Control System for CubeSats	DISC 8 Ch: 35.1	M1
13	Digantra Research and Technologies Pvt Ltd	Space Domain Awareness for Space Military	OC 7 (IAF)	M0

14	SpaceFields Pvt Ltd	Smoke Generator for Sarang Display Team	DISC X (Airforce) Ch:13	M0
15	SpaceFields Pvt Ltd	SparkType Ignitor Box and ignitors	DISC X Ch: 35	M0
16	Akashlabdhi Pvt Ltd	Developmentof IR Identifier Patches	DISC X Ch: 11	M0

Incubation Pipeline

STEM Cell has a healthy pipeline of proposals from prospective incubatees. The following are in advances stages of evaluation and discussion:

Domain	Product / Initial Offering
Healthcare	• Immunyfit Healthtech, • Aagamiseq Technologies Private Limited • Akylo Healthcare Private Ltd • OUI Medical Pvt Ltd • Aerobiosys Innovations Pvt Ltd • BabyCue Private Limited • Quixotix Bioprinting Private Limited
AI	• Sooru.AI
Spacetech	• QOM- Prof Aloke' startup, • Biosky
MedTech	• StrideAIde • OpenMedLabs • Periwinkle Labs
Nano / Semicondustor	• Chargeworks • NanoMatter
Sustainability	• TGP Bioplastics Pvt Ltd, • Tealaa Innovations Private Limited
Climate Tech	• Greenovate Solutions Pvt Ltd, • TechXEarthSpace
Longevity	• Ferry Lifesciences • Namita Rao- EIR • Ashwini – EIR
Others	• VedaCrunch

Others

1. 1. CSR grant of ~2 cr received from Honeywell for startup support.
2. 2. We have partnered with Zerodha to support startups in the areas of climate tech, sustainability, health tech, and longevity. The total funding commitment is 4 crore over two years, with 2 crore disbursed in FY 2024–25.
3. We have also received CSR grants from companies such as Harting, Merlinhawk, and AMD, amounting to approximately 60 lakhs.
4. We have secured a commitment of 15 crore from SIDBI to invest in incubated startups and those supported under the iDEX programme. While the Investment Committee meetings have been completed, the CCD agreement is currently pending finalisation by SIDBI.
5. Started disbursement under NIDHI SSP
6. Agreement with EXIM Bank being inked for 2cr support to startups with Scale up potential. We disbursed the funding completely.
7. The first cycle of SISF funding has been fully utilised, and a new application has been submitted under FSID for the second round of funding.
8. Opex under AIM has been exhausted, while Capex is being allocated to the Bio Lab as in-kind support. Equipment procurement is in progress, pending a transition to a new payment module.

Startups Success Stories/ Investment

Name of the Start-up	Amount received(in Rupees)	VC/ Investor
AGNIT Semiconductors pvt ltd	100,000,000	Angel Investors
Azooka Labs pvt ltd	20,500,000	IKP, Friends & Family
Dfine Bioinnovations pvt ltd	3,100,000	Director Capital
Digantara Research and Tech Pvt Ltd	982,885,080	Karan Bhagat, Yatin Shah, Kalari Capital, GB-VIII Opportunity, Campus Fund, Peak XV, Athmanirbhar VC, Naman Finance Investment
Green Collar Agritech Solutions pvt ltd	4,195,000	SISF, Technology Business Incubator, Honeywell CSR
Lab to market Innovations pvt ltd	59,084,980	HNI
Morphing machines pvt ltd	236,707,398	Speciale Invest, IvyCap Ventures, Navam Capital, Golden Sparrow Ventures, IIMA Ventures, DeVC
Mynvax Pvt Ltd	469,300,000	Accel,1 Crowd,Kotak,Inviga healtcare,Baldota
Nabhdrishti Aerospace pvt ltd	8,001,810	Angel investors (Vanita & Lildhar)
Papyrus Diagnostics pvt ltd	1,000,876	C-CAMP
QPiAi India pvt ltd	382,380,084	SIDBI VC,Younest, SBS Bottelbrush, Sahasrar Capital private limited, Progressive silicon systems, Investt trust
Simyog Technology private limited	199,989,521	Ideaspring Capital Future, MV Coretech Fund1, 1Funds trust 2, MV Coretech fund
Spacefields pvt ltd	88,751,000	Angels (Series 2 CCD)
Ykrita Lifesciences pvt ltd	144,500,000	Angel investors

9. Product Accelerator `Samriddhi' funded by MHI in ongoing with 7 companies and 8 products (Multiple faculty members from Mech Engg, EE, Aero and Materials)
10. Product Innovation Centre (PIC) has been established for developing an axial pump for ADA (R N Govardhan)

Nidhi Prayas Activity

Sl no.	Prayasee Name	Company Name	Project name	Status
Fund cycle 2021-2022				
1	Subham Sourabh		Electric filter bottle	Completed
2	Vinay A N	Fluxlink India Pvt Ltd	Link Robot	Completed
3	Pratyush Bhadra	Fiacre Telematics Pvt Ltd	CabStop	Completed
4	Hemang Kumar Jayant	HEM Dimensions Private Limited	Metal and Polymer Additive Manufacturing	Completed
5	Divya Acharya	Dfine bioinnovations Pvt Ltd		Completed commercialise
6	Apurwa Masook	SpaceFields Pvt Ltd	Dual-Use Solid Rocket Motors/ Boosters	Completed
7	Dr Abhilash M N	Guerin Technologies Private Limited	Ultra-Compact and Lightweight Space Deployable Communication Antenna	Completed
8	Shadab Ahmad Ansari		Drone Mid-Air Payload/Battery Transfer Mechanism	Completed
9	Bharath Anantha Srinivas	Technovos Machinery Private Limited	GaadE-Electric Vehicle for Commercial application	Completed
10	Pawan Kumar	Yenveez Private Limited	Yenveez HIIT Equipment	Completed
Fund cycle 2022-2023				
11	Ratheesh M. Yogananda	HEEDJETBOARDS PRIVATE LIMITED	Electric Jetboards	Completed
12	Dattaguru Umesh Prabhu	HONNAVAR TECHSOLUTIONS LLP	Tactile Hearing Aid	In Progress
13	Suraj Kesri	Wegro Green Labs Pvt Ltd	Wegro	In Progress
14	Anjali S Patil		Universal Auto Disbursing Machine -UADM. IoT-based Smart Containers for FMCG Industries Promoting Circularity, Carbon Neutrality & Mitigating Plastic Pollution	In Progress
15	Deval Karia		LifeBox Heart: An active heart preservation system for extending out-of-body viable time during transport for transplant	In Progress
Fund cycle 2024-2025				
16	Arjun Bangalore Srivatsa		Indigenous Micro Gas Turbines for UAVs	Project commenced
17	Onkar Chopra	ALGOBOTIX PRIVATE LIMITED	Agri-Mergix (A plug and play automation solution for precision agriculture using drones)	Project commenced
18	Nithin N	Ecostrata Infra Pvt Ltd	NOVACRET AAC MIX	Project commenced
19	Dhritiman Mallick	Vyuhaa Med Data Private Limited	EDGE Enabled Hardware system for Cervical Cancer Processing	Project commenced
20	Dr B E Amita Rani	MACOF INNOVATIONS PVT LTD	Food hygiene test to prevent chronic health diseases	Project commenced
21	Saranya Gunasekaran	ReNewLiv Ecoventures Private Limited	Transforming Agricultural Residues into High Value Bio-composites for Sustainable Bio-plastics in Biomedical Applications	Project commenced

Product Development Project

Sl no.	Year	Company	Product area	Status
1	2021	NSoft (India) Services Pvt Ltd	Manhole Desilting Machine	Completed

Other Activities

- Secured CSR grant of 10 Lakhs from RingCentral
- Conducted a SPACE session with Multiple Special Steel Pvt Ltd (MSSPL), Bengaluru
- Organised Falling Walls Labs – India Edition
- The Nidhi-Prayas Monitoring Committee convened to evaluate applications and successfully selected six Prayasees for support.
- Letter of Intent received to support NxG programme
- Expression of interest received for technology licensing

Upcoming/Pipeline:

- There are 6 companies which are in pipeline for collaboration with FSID
- Falling walls 2025 is being scheduled

Visibility & Outreach:

- FSID showcased at IMTEX 2025 – International Expo

TARGETED RESEARCH (SEED)

STI hub training and outreach programmes

To interact with local entrepreneurs and work on technologies related to agriculture and produce, many sessions were conducted. We are now working on some products/ areas indicated in these events as the need of the local community.

Awareness Programme	Role of "Farmer Produce Organisations (FPO's) in Shaping Farmers into Entrepreneurs"	08-06-2024	151	23	174
Entrepreneurship Development Programme	Entrepreneurship Development Programme	06-11-2024 to 11-11-2024	22	06	28

New Technologies Development
Based on the baseline data, interactions and field-level observations, potential technologies developed at iisc and other research institutions were screened for applicability.

Selection criteria included:
(a) alignment with existing traditional occupations, (b) low-cost and low-tech feasibility, (c) potential for income generation, and (d) scalability within the rural context. Technologies identified included:

1. A biotechnology-based water purification unit to improve aquaculture productivity developed by Prof Sreenivasan Ramaswami (CST). A demo unit is now operation at Challakere campus with livestock. Timeline for completion of this experiment is November 2025.
2. A keratin extraction system to add value to waste wool from sheep rearing. Prof. Kaushik Chatterjee from Bioengineering department overseeing the research with SEED team.
3. Small-scale banana and sisal fiber extraction machines. Prototypes designs have been created.
4. Improved charcoal kilns and biomass briquette production systems. Methodologies are being developed for small farm scale production.
5. Thermal and solar fruits and vegetable dehydrators. SEED team working on developing new protocols with improved products of higher nutritional values.

These innovations are now under testing/ development.

1. School science demonstration initiative
To foster scientific temperament from an early age, the SEED/ STI hub team conducted hands-on science demonstrations in high schools located in villages such as Siddeswaranadurga, Rekhalagere Lambani Hatti, and Nayakanahatti. These sessions were aligned with the Karnataka state curriculum and included simple experiments in physics, chemistry, biology, and environmental science. Using low-cost materials and local examples, the goal was to bridge the gap between textbook learning and real-world application, while addressing challenges related to low literacy and numeracy among rural students.

Sl #	Name of School	Type	Date of Demo	# Students Attended	# of SC Students	# of ST Students
1.	Shree Venkateswara Rural High School, Neralagunte,Challakere Talluk	Govt Aided	12-08-2024	124	35	64
2.	Heggere Tayamma Girls Govt High School, Challakere Talluk	Govt Girls HS	13-08-2024	150	40	48
3.	Sri Radakrishna Rural High School, Challakere, Gosikere	Govt Aided	11-09-2024	88	22	24
4.	Shri Valmiki High School ,Devara Marikunte	Govt Aided	11-09-2024	104	27	42
5.	Govt High School, Abbenahalli	Govt	12-09-2024	138	33	85
6.	Govt High School, N Devarahally	Govt	18-09-2024	135	52	02
7.	Govt High School, Thimmapianahalli	Govt	18-09-2024	140	80	35
8.	Adarsha Vidyalaya, Challakere	Govt	10-12-2024	154	50	53
9.	BMGHS, Challakere	Govt	10-12-2024	140	34	30
10.	Government High School, Kaparahally	Govt	10-12-2024	47	15	10
11.	Government High School, R Lambani Hatti	Govt	10-12-2024	85	45	08
12.	Government High School, P Mahadevapura.	Govt	12-12-2024	77	25	20
13.	Government High School, Siddeshwarana Durgha.	Govt	12-12-2024	112	12	10
Total				**1494**	**470**	**431**

Developing affordable Student Science Kit-
SEED team is working on educational tool kit designed to:
- Encourage hands-on science learning in rural schools
- Be cost-effective and easy to use for students and teachers alike
- Spark interest in STEM careers through locally relevant experiments

V Programme Office Status Report
V Large Strategic Programmes Status Reportexperiments

Sl no.	Programme Name	Ministry/Corporate	Status	Remarks
01	Gallium Nitride Ecosystem Enabling Centre & Incubator (GEECI)	MeitY	Ongoing	• FAB D-line installation completed and formal inauguration of the facility to be scheduled soon. • Manpower ◆ COO for the GEECI programme onboarded in July 2024. ◆ Overall manpower currently around 40. • MoU with MeitY signed for year 2 (after installation of the D-line) and based on PRSG review in January 2025, the Governing Board for GEECI being expanded with 4 additional experts from Academia and Industry

				• (in addition to the 4-member board currently in place) • Commercial production commenced on the D-Line. Revenue of INR 1 crore in 2024-25, onboarding of 5-6 customers and initiation of 1 EIR Programme
02	Centre of Data for Public Good (CDPG)	MHOUA/ MeitY	Ongoing	• The IUDX programme was subsumed under a larger initiative (Data for Public Good).. • The scope of this initiative now includes creating an infrastructure for data for public goods beyond smart cities (which was the original mandate for IUDX. • In 2024-25 this has extended to Agriculture data and Geo-spatial data.
03	Quantum Research Park @ FSID	KITS (GOK)	Ongoing	• GoK has announced QuRP Phase 2 with a budget of Rs. 48 crore for 3.5 years commencing in the last quarter of 2025. • QuRP has set up an Equipment Cluster featuring high-value equipment such as lasers and cryostats. • Enabled access to the equipment for academic institutions, startups, and industry players to support quantum R&D. • Q-Daksha Summer Internship Programme 2024. • Provided access to the Equipment Cluster and collaborative opportunities with IQTI members. Two startups, GDQLABS and Avinya SQ, were selected under this programme 2025)
04	Research collaboration with National Payments Corporation of India (NPCI)	NPCI	Ongoing	• Year 1 programmes (8 research projects, 2 training projects and establishment of 1 CoE) – have been completed and signed off. • Year 2 funding of INR 2.87 crores received and projects for year 2 commenced. • Discussions currently underway for a Research Fellowship to be jointly managed by IISc & NPCI for creating the next generation research team at NPCI.
05	Longitudinal Study in collaboration with Siemens Healthineers Private Limited (SHPL))	SHPL	Ongoing	• Research programme is ongoing (longitudinal study). Release of second tranche of funding expected in May 2025 (invoice has been raised and submitted to SHPL) in May 2025.
06	Multiple Research Programmes with Accenture	Accenture	Ongoing	• All projects with the first 3 year funding (September 1, 2021 to August 31, 2023) have been completed. • Extension of the Research Programme extend till August 31, 2026. During this extension the contract has been transitioned from SID to FSID • Accenture released an addition research grant of INR 3 crores in September 2024.Q-Daksha Summer Internship Programme 2024. • New research projects in areas of initiated: ◆ AI-ML (Perturbation Sensitivity & Healthcare), ◆ AI based Multi-omics research (Oncological research), ◆ Quantum sensing (Healthcare Domian) ◆ AI for corrosion prognosis using hyperspectral imaging (Petrochemicals & Chemical Engineering) ◆ MoF based CO2 Adsorption for tackling climate change) • Discussions underway for initiating research in edge computing in intelligent satellite systems (space technology)
07	Indian Opensource Software Platform for an end-to-end 5G network (IOS-5G)	MeitY (DoT)	Ongoing	The Objectives of the programme are: • Create an Indian Open-Source Mobile Computer Network (IOS MCN) platform. • Create an Open-Source, 3GPP, and ORAN Compliant Mobile Communication software platform (IOS-MCN) • Provide a commercial grade, common and open software platform to enable vendors to rapidly use, customise, make derivative works from and thereby create Mobile Communication (5G and beyond) products and services. • Provide deep technical support to the industry in using IOS-MCN platform ◆ Onboard members to the Project to facilitate proliferation, usage and enhancements to the IOS MCN platform ◆ Evolve a sustainable model for the Project to consistently contribute to the open-source Telecom ecosystem. • This project is being jointly implemented in collaboration with CDAC Thiruvananthapuram & FITT, Delhil (a Section 8 company founded by IIT Delhi) • Total project fuding of INR 20 crores (IISc – INR 8.64 crores) – Project duration from August 2023 to August 2025.

3.7.13 *Centre for Brain Research*

The Centre for Brain Research (CBR) is dedicated to innovative research focused on brain aging and age-related neurological disorders, including Alzheimer's and Parkinson's diseases. Its primary objectives are to preserve cognitive health as people age and to contribute to minimising the impact of neurodegenerative conditions. These goals are pursued through cutting-edge interdisciplinary research aimed at early diagnosis, prevention, delay of disease onset, and effective management using evidence-based health interventions. To complement its research efforts, CBR explores creative avenues for outreach, public engagement, and capacity building to strengthen its mission.

Director:
KVS HARI

Celebrating CBR's First Decade

August 12, 2024, marked the completion of a decade since CBR was registered as a Society under the Karnataka Societies Registration Act of 1960 with a generous gift from the Pratiksha Trust. A celebratory event was organised at CBR on August 19, 2024. Abhay Karandikar, Secretary, Department of Science & Technology, Government of India kindly graced the occasion as the Chief Guest of honour, in the esteemed company of G Rangarajan (Director, IISc, and Chair, CBR Governing Board), Anurag Kumar (Former Director, IISc), Vijayalakshmi Ravindranath (Founding Director, CBR), Y Narahari (Former Director, CBR, and Member, CBR Governing Board), and other dignitaries. Kris Gopalakrishnan (Co-founder, Pratiksha Trust, and Chair, IISc Council) participated in the event virtually and offered kind felicitations. To commemorate the milestone, Karandikar planted a sapling and formally inaugurated the cardiac autonomic nervous system testing laboratory (funded by SoftwareAG) at CBR. He acknowledged that CBR's efforts in planning for the welfare of the aging population are an important contribution to science and technology and encouraged the CBR fraternity to continue striving for global excellence in aging neuroscience.

Flagship Research Projects

Community-based longitudinal studies are vital for a comprehensive understanding of dementia and aging-related disorders. India's rural-urban diversity offers a unique opportunity to explore the associated risk and protective factors. Through the Srinivaspura Aging Neuro Senescence and COGnition (CBR-SANSCOG) study and the Tata Longitudinal Study of Aging (CBR-TLSA), the Centre spearheads longitudinal, multimodal assessments of healthy aging in rural and urban populations. These efforts result in valuable datasets—spanning clinical, cognitive, imaging, biochemical, and genetic domains—that would support targeted strategies to prevent or delay neurodegenerative diseases, especially in rapidly aging, low- and middle-income settings like India.

1. **CBR-Srinivaspura Aging, Neuro Senescence and Cognition (CBR-SANSCOG) Study:**
   CBR-SANSCOG, funded by the Pratiksha Trust, is a large-scale, prospective cohort study focused on aging in a rural Indian population (target n = 10,000) from villages in Srinivaspura taluk, Kolar district, Karnataka. As CBR's flagship initiative, the study aims to map trajectories of healthy and pathological aging and identify risk and protective factors for dementia and related disorders. It adopts a multidisciplinary, multimodal approach, incorporating clinical, neurocognitive, biochemical, genetic, and neuroimaging assessments with long-term follow-up. Since its launch in 2018, the study has engaged over 12,000 consenting individuals across 209 villages, completing more than 10,000 baseline clinical assessments and 4,600 follow-up assessments. This unique rural cohort provides an invaluable resource for understanding brain aging in underrepresented populations and developing context-specific strategies for dementia prevention.

2. **Tata Longitudinal Study of Aging (CBR-TLSA):**
   CBR-TLSA is a long-term cohort study of older adults in Bangalore, launched in 2015 with support from Tata Education Trusts. The study aims to track 1,000 participants over time to identify factors influencing cognitive aging and the risk of disorders like Alzheimer's disease. Over the years, there has been continued engagement with around 1,670 consenting individuals resulting in those many baseline clinical assessments and over 3,200 follow-up assessments. Now in its second phase, CBR-TLSA has recently completed a one-year pilot study (n=123) entailing a multimodal lifestyle-based non-pharmacological intervention, modeled on the Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) study. Preliminary findings point to a strong association between the intervention and positive changes in cognitive and metabolic parameters.

3. **GenomeIndia:**
   GenomeIndia is a pan-India initiative involving 20 premier research institutions across the country. Funded by the Department of Biotechnology, Government of India, and coordinated by CBR, the study aims to create a comprehensive national resource of genetic variations in the Indian population that will facilitate future genetic studies and help understand the genetic basis of complex and rare inherited disorders. The whole genome sequencing of 10,074 individuals has been completed thus achieving the WGS target of the project. The final joint variant callset, after all quality checks, comprises population-level genetic data from 9,768 individuals representing 83 populations across the country. The dataset has revealed 129.97 million variants, that captures unprecedented genetic diversity of the country and sheds light on population-specific signatures. 9.19% of these variations are novel when assessed against world datasets. This reference dataset will also facilitate association studies for complex disease phenotypes such as cardiometabolic traits. Following a publication in Nature Genetics, that provides a descriptive outline of GenomeIndia, the flagship paper is being composed.

4. **YLOPD Study:**
   The Young and Late-Onset Parkinson's Disease (YLOPD) study is a longitudinal research initiative on Parkinson's disease (PD), funded by the SKAN Research Trust and carried out in partnership with NIMHANS. The study aims to recruit 1,000 individuals with young-onset and late-onset PD, conducting periodic follow-ups to elucidate the disease's natural progression. The main objective is to identify common and rare genetic risk factors for YOPD and LOPD within Indian populations. CBR has sequenced and analysed nearly 200 samples to date. The project seeks to assess the extent of population-shared and population-specific PD risk loci and conduct a meta-analysis of our dataset in conjunction with other genomic PD datasets from India. In parallel, animal models of PD are being investigated to gain insight into mechanisms underlying the neurocircuitry of non-motor symptoms of the disease.

Other Initiatives

To advance its mission, CBR strategically invests in a range of innovative initiatives and embarks on partnerships with like-minded organisations. The examples below showcase key efforts in 2024-25, each designed to meaningfully support and enhance CBR's ongoing endeavours.

1. **External Grants:**
   In pursuit of hypothesis-driven research questions focused on healthy and/or pathological brain aging, CBR researchers successfully secured competitive grants and fellowships from premier funding agencies, including the Indian Council of Medical Research (ICMR), Department of Biotechnology (DBT), Department of Science & Technology (DST), Anusandhan National Research Foundation (ANRF), US-India Educational Foundation (USIEF), and PRASHO Foundation.

2. **Collaborations:**
   CBR entered into memoranda of understanding with several esteemed academic institutions, research organisations, and industry partners to facilitate knowledge exchange and foster collaboration in areas strongly aligned with its mandate. Notable examples include the UK Dementia Research Institute (UK DRI), Gates Ventures, Siemens Healthineers, and S-VYASA Deemed-to-be University.

3. **Infrastructure Development:**
   Following rigorous scrutiny, CBR successfully secured the ISO 20387:2018 certification from the Quality Accreditation Institute (QAI), confirming that its biobank meets international standards for competence, impartiality, and consistency across structural, resource, process, and quality management requirements. CBR also launched state-of-the-art electroencephalography (EEG) and echocardiography (Echo) laboratories. These facilities will play a vital role in generating multimodal data for longitudinal cohort studies on aging, offering deeper insights into brain health and cognitive decline over time.

4. **Capacity-building:**
   CBR conducted various programmes aimed at building capacity in aging brain research. These include the second edition of the sought-after CBRAIN internship programme which culminated in a poster symposium, technical workshops on topics aligned with CBR's mandate (such as genomics, brain health, and the potential of dementia biomarkers and AI in aging brain research) involving lectures and panel discussions by global experts, the inaugural lecture of the CBR-Distinguished Visitor Programme by Rema Raman (University of Southern California), and the sixth Sharvaree Gokhale Memorial

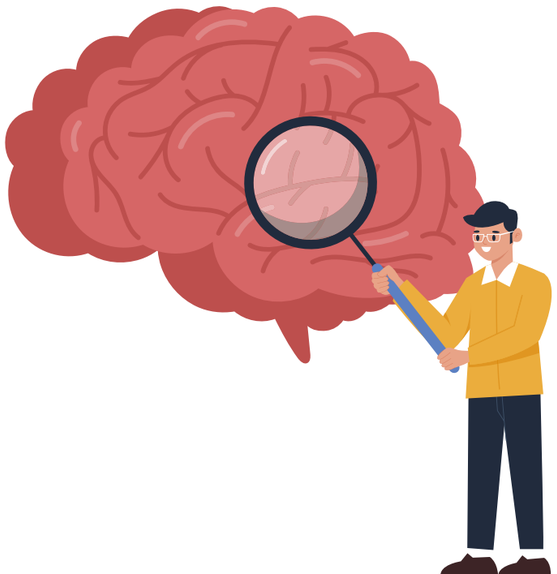
Lecture by Siddharthan Chandran (Director, UK Dementia Research Institute).

5. **Engagement with Clinicians and Researchers:**
CBR participated (as one of the sponsors) in a medical conference organised by Shri Atal Bihari Vajpayee Medical College, Bengaluru, attended by over 2500 medical students from across India. CBR partnered with Dementia India Alliance to co-organise the inaugural edition of DemCon, an international conference that brought together over 900 participants including dementia caregivers and families, researchers, technologists, NGOs, and policymakers. CBR hosted an exhibitor booth at the 50th edition of ICASSP (IEEE International Conference on Acoustics, Speech, and Signal Processing) to raise awareness about its research projects and to highlight the critical role of signal processing techniques in advancing CBR's research, particularly in areas such as EEG, MRI, gait and balance, speech and hearing assessments.

6. **Outreach and Community Awareness:**
With the aim of enhancing public awareness about the aging brain, cognitive health, and allied scientific topics, CBR orchestrated engaging events and exhibits to commemorate occasions such as World Alzheimer's Day and IISc Open Day. Throughout the year, CBR welcomed visits from curious young minds, including school students from Assam, Meghalaya, West Bengal, as well as students and faculty from institutes of higher learning such as IIT Madras, Indian School of Business Mohali, and various engineering colleges across Karnataka. Besides organising an antimicrobial resistance awareness event, CBR partnered with organisations like Parikrma Humanity Foundation and Science Gallery Bengaluru to co-create immersive educational experiences and foster dialogue between scientists and the public.

Publications

Based on interesting findings emerging from research projects, 35 papers (research articles, reviews, and comments) were published in peer-reviewed journals and several manuscripts have been accepted for publication. The journals include *Alzheimer's Research & Therapy, BMJ Public Health, Brain Communications, Journal of Biological Chemistry, Journal of Neurology, Life Science Alliance, The Lancet Neurology, Nature Genetics, and Scientific Reports.*



3.7.14

Karnataka State Council for Science and Technology

The Karnataka State Council for Science and Technology (KSCST) was established in the year 1975 as the first state S&T council in the country to utilise the scientific and technical expertise of many scientists, technologists and engineers in the state to improve the living standards of people and to provide solutions through Science & Technology (S&T) interventions. Education, water, energy, housing, geospatial technologies, and natural resource management are some of the sectors identified by KSCST to pursue research, development and dissemination of ideas, products, services and technologies with the support of State and Central governments.

Secretary:
ASHOK M RAICHUR

Some of the earlier success stories arising from the activities of KSCST include: Design of novel biogas plants, solar collectors, solar ponds, gasifiers, alternate building technologies, design of high-efficiency cooking stoves (ASTRA Ole), setting up of rural energy centers, innovative use of sisal plant and so on. The recent major initiatives of KSCST for societal benefits include a geospatial action plan for informed decision-making, rainwater harvesting, rejuvenation of traditional water harvesting systems, Karnataka geoportal, village mapping, students and faculty project programmes, Patent cell, SC/ST cell, watershed management and digital mapping of heritage sites and museums, renewable energy-related activities, implementation of a virtual classroom in high schools and S&T outreach activities. KSCST provides support to the State Government in the formulation of S&T-based policies and to both Central and State Governments in scientific surveys, project implementation, evaluation, coordination and monitoring, organisation of scientific meets and awareness campaigns. Apart from playing a catalytic role in the implementation of sustainable technologies to society-centric problems/issues, KSCST has also been promoting research, development and innovation in universities and institutions.

VISION: Application of S&T for the management of resources, improvement of the environment, quality of life and socio-economic conditions of the people of Karnataka.

MISSION: Coordinate R&D activities to generate knowledge for scientifically based interventions, develop and popularise appropriate technologies for adaptation by the civil society to overcome local-specific problems and inspire and improve human resources of the S&T sectors in the state.

Major Programmes:

Health & Nutrition Initiatives

- **Sickle Cell Anaemia Project:** A Command Center was inaugurated at OMI Lab, IISc, Bengaluru on 11 November 2024, by IOCL, IISc, and KSCST. Local folk dance was organised with the Chandana Project for awareness. A state-level awareness and screening camp was held at HD Kote on 18 January 2025.
- **Establishing SHGs / FPOs enterprises to address malnutrition and provide rural livelihood in Yadgir District, Karnataka (Yadgir):** Trial production of four fortified food variants is complete. Commercial production is underway. Patent applied, third-party inspection completed, and FSSAI certification obtained.
- **Establishment of Non-Timber Forest Products Collection Enterprises (NTFPCE) Processing Centers (Mysuru & Koppa):** Honey and Shikakai processing plant and machineries installed & inspected. Tenders for further installations were published.

Intellectual Property & Innovation

- **Patent Information Centre:** Held 37 IPR-related programmes. Trained IP Coordinators across

Government colleges. Established 10 IPR cells. Initiated GI research on Raniele, Ranimenasu Ranibennuru Kambali and Hoysala stone Art, Coordinated Women Scientist Scheme (WISE KIRAN), and drafted the state IPR policy.

Spatial Planning and GIS

- **NRDMS Centers:** Provided GIS data to district officials daily. Supported 2024 elections and district-level projects like Jal Jeevan, Disaster Management. Held training on GIS, Drone, 3D Laser and so on to district NRDMS officials during July 2024.
- **Village Info System (VIS):** Webmap completed for Ragihalli village showing assets, land use, and infrastructure.

Digital Heritage & Museums

- **Karnataka Digital Museum:** Formed a Project Advisory Committee. Tenders for 3D laser scanners published. 3D laser scanning and digital documentation of antiquities done at Government Museum, Hassan. Submitted digital data to DAMH under Karnataka Digital Heritage project.

Water Technology & RWH

- Conducted RWH awareness programmes reaching around 6,477 people. Prepared DPRs. Held three RWH trainings with BWSSB support. Maintained RWH theme park activities.

Student Project Programme (SPP)

- Held State-Level Project Exhibition at Sharnbasva University. 48 projects recommended for awards. 7,349 proposals received under 48th SPP series, evaluations are under progress by experts from IISc, NAL, CMTI experts.

Science Outreach Activities and popularisation

- IISc research scholars conducted hands-on science experiments for Classes 8th –10th at KREIS schools.
- National Space Day: Celebrated in 5 districts, 2800+ students benefitted.
- Meghalaya & Assam Students Visit: Organised science tours of Bengaluru's R&D institutions.
- Mathematics Workshops: Held state-level and district-level training for teachers and students.
- National Mathematics Day: Celebrated across 31 districts.
- Children's Day with science activities: Bengaluru.
- National Science Day – JN Tata Auditorium, IISc; Shri NS Boseraju Hon'ble Minister of Minor irrigation and Science & Technology, GoK inaugurated the NSD 2025. 750 students attended.
- Painting and Essay Competition – theme: “Empowering Youth in Science for Vikasit Bharat".
- Webinars as part of KSCST Golden Jubilee activities – Topics: STI Eco System, Application of Nanotechnology and Materials Engineering, Water Technologies and IPR.

Regional Centre – Kalaburagi

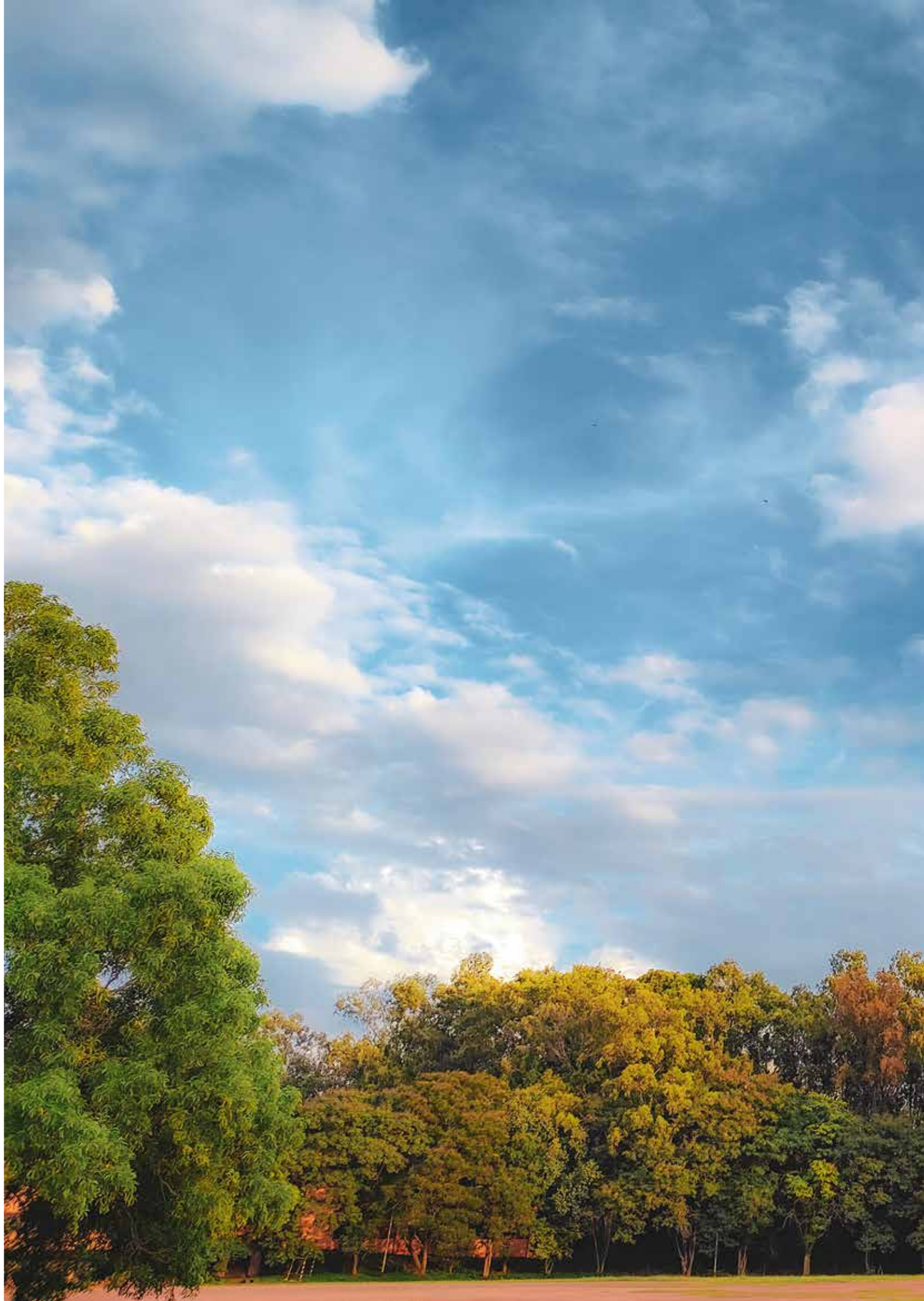
- Under the KSCST Regional Centre, Kalaburagi, various training programmes were organised to address region-specific problems through Science, Technology, and Innovation (STI) in the Kalyana Karnataka Region.

Digital Learning & CSR Initiatives

- **‘Vidwath – AURA’ Project:** Developed AR-based e-learning platform for high school students; hosted in GitHub.
- **Scientific Audit of KREIS:** Assessed schools' infrastructure and innovation; report submitted.
- **ICT Project with HAL - CSR:** National Productivity Council completed the impact assessment and submitted the report.

Special Recognition

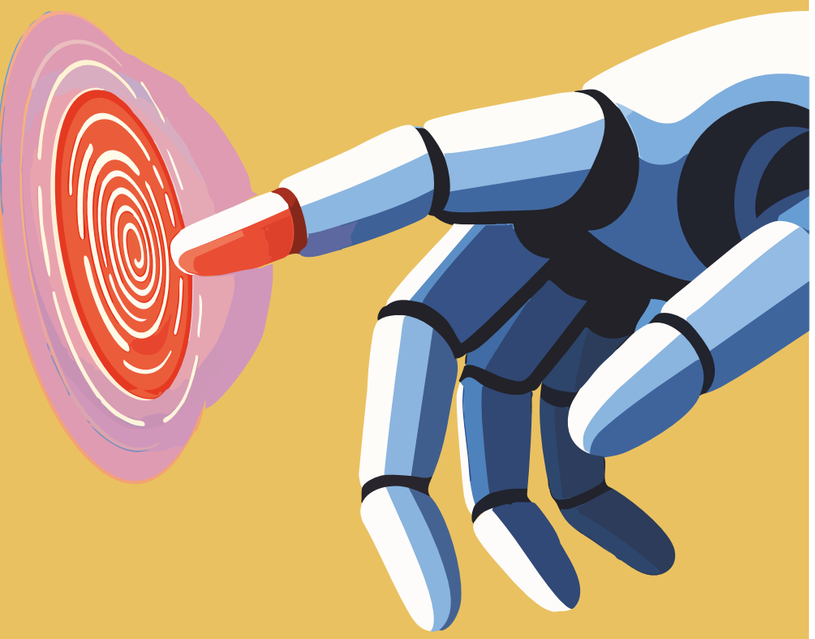
- State Scientists and Engineers Awards were presented on 26 September 2024 at JN Tata Auditorium, IISc, by Hon'ble Chief Minister Shri Siddaramaiah. Bharat Ratna Prof CNR Rao, Minister Shri NS Boseraju, Prof G Rangarajan, and other dignitaries graced the event.



3.7.15 *AI and Robotics Technology Park*

ARTPARK Innovation Challenge 2024
The ARTPARK Innovation Challenge 2024 was designed to provide various modes of support to various types of teams: Researchers/innovators affiliated with institutions can avail of grants; Startup investments; and unaffiliated/ unincorporated teams could join ARTPARK as Innovators-in-Residence. Through this challenge we also select for our prestigious Startup@ARTPARK programmes based on stage and fit.

Up to Rs 2 crore per year, per team/startup | Mentoring & training | Connects to deep-tech facilities, researchers, investors



Technologies: Robotics, Autonomous Systems, AI, Indic language AI, Communications & Network technology
Domains: Industrial Automation, Mobility, Agriculture, Health

Winners:
- Charukeshi Healthcare Pvt Ltd
- Floaid MedTECH Pvt Ltd
- Hyflex Pvt Ltd
- Red Black Trust
- SpaCyPhy Tech Pvt Ltd
- StrideAide Pvt Ltd
- Techno Yantra Pvt Ltd
- Vyshvasys Aerospace Pvt Ltd
- Zenteiq AiTech Innovations Pvt Ltd

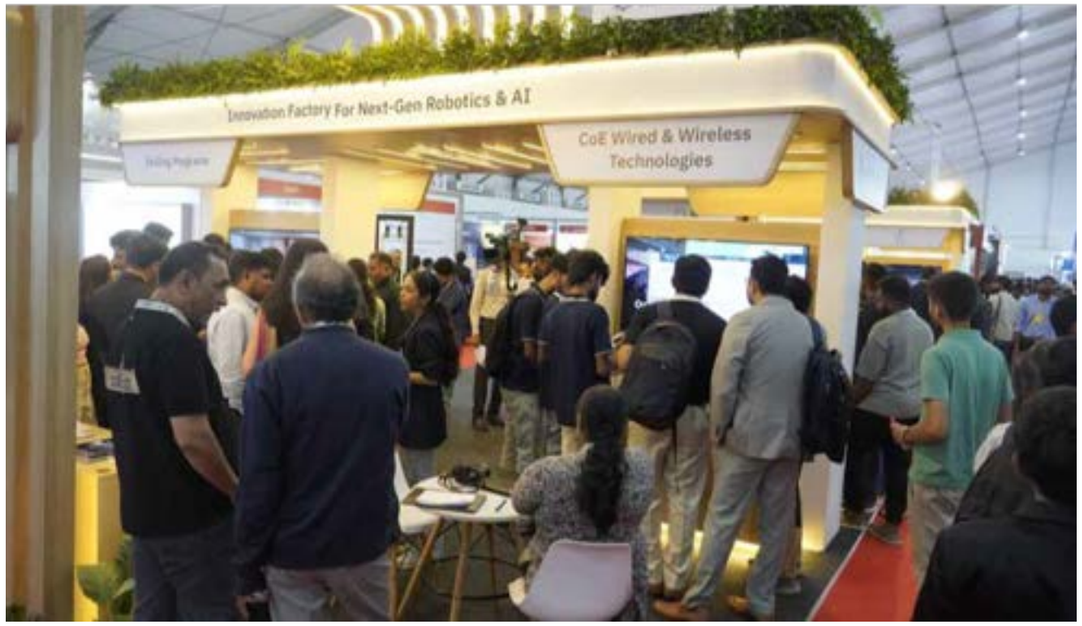
Executive Director:
BHARADWAJ AMRUTUR

Hosted the National Workshop on Technology Innovations in Cyber Physical Systems 5.0 (TIPS), organised by DST India

We were honoured to host the 5th Workshop for Technology Innovations in Cyber-Physical Systems (TIPS 5.0), organised by India DST, on 11-12 November at the JN Tata Auditorium, IISc.

This two-day workshop brought together 23 Technology Innovation Hubs from across India, each showcasing pioneering deep-tech products and startups. The workshop also included an investor pitch session, where startups presented to VCs, igniting exciting funding opportunities.

The event featured an inspiring evening talk by Vijay Chandru, sharing insights into his 'Audacious Journey' of building deep tech startups, followed by Anmol Garg (aka Corporate Babaji) with a humorous take on entrepreneurship and passion.



ARTPARK Honoured as an Ecosystem Enabler and Winner of the Most Innovative Display Award at Bengaluru Tech Summit 2024

3 days, 50,000+ attendees, 100+ startups showcases, innovative product launches, inspiring talks and panel discussions from some of the key changemakers of this country, and endless opportunities for networking.

We participated along with startups Comrado Aerospace, Yaanendriya, Flo Mobility, NxtQube, Sakar Robotics and Vaydyn. We also showcased our efforts and initiatives in One Health, Gen AI 5G Communications and Skilling.

ROSCon India 2024 - 2nd edition

ARTPARK-IISc, in collaboration with Acceleration Robotics and Rigbetel Labs, successfully hosted the second edition of ROSCon India 2024 at the JN Tata Auditorium, Indian Institute of Science (IISc), Bengaluru. Over the course of three vibrant days, the event brought together the country's thriving robotics community — from researchers and developers to startups and industry leaders. With hands-on workshops, expert talks, a dedicated startup showcase, engaging panel discussions, and invaluable networking opportunities, ROSCon India 2024 created a platform for meaningful collaboration and knowledge exchange. The event saw participation from 900+ attendees and 20+ expert speakers, making it one of India's largest gatherings dedicated to advancing the adoption of ROS (Robot Operating System) in the region.

4.0

Undergraduate *Programme*

4.0

Bachelor of Science (Research) and BTech (Mathematics and Computing) Programmes

Dean:
PRABAL KUMAR MAITI

The Undergraduate Science Programme, launched in 2011, has seen 10 batches of students graduate with a four-year Bachelor of Science (Research) degree and nine batches with a Master of Science degree.

The academic year 2024–25 marked the 13th anniversary of the Bachelor of Science (Research) programme and the 3rd anniversary of the BTech (Mathematics and Computing) programme. In July 2024, the tenth batch graduated with a four-year Bachelor's degree and the ninth batch with a Master's degree. Fifty to sixty percent of students in each batch opted to continue for a fifth year to pursue a Master of Science degree.

Since its inception, the UG programme has gained increasing popularity and has become one of the most sought-after undergraduate programmes among scientifically inclined, bright, and energetic students across the country. Admission cut-off ranks in qualifying examinations continue to remain high, reflecting the programme's growing reputation.

In the academic year 2024–25, 98 students were admitted to the Bachelor of Science (Research) programme and 66 to the BTech (Mathematics and Computing) programme. The 10% supernumerary quota for women in the Bachelor of Science (Research) programme and 20% in the BTech (Mathematics and Computing) programme significantly contributed to the improvement of gender diversity. The percentage of women admitted was 15% in the Bachelor of Science (Research) programme and 21% in the BTech (Mathematics and Computing) programme. The gender ratio is expected to improve further in future years. Several fellowships were also instituted exclusively for women students through private donors.

CAREER PATHS OF OUTGOING STUDENTS

In each batch, around fifty to sixty percent of students opt to continue for the Master's programme. Of the remaining, a large proportion pursue PhD or Master's programmes at top universities and institutes both in India and abroad. Students graduating in the upcoming convocation have already received admission offers from leading institutions, underscoring the strong reputation the UG programme has built over just 13 years. A small number of students have secured employment in reputed multinational companies, while a few others have gained admission to top management programmes in India.

CO-CURRICULAR ACTIVITIES

UG students actively participate in several co-curricular activities alongside academics. PRAVEGA, the annual national science, technology, and cultural fest organised by UG students, showcases their talents and leadership. The UG iGEM team won the coveted gold medal at the international Genetically Engineered Machines (iGEM) 2024 competition held in Paris in the Software and AI track and the Silver Medal in the Foundational Advance track.

Other highlights include the UG magazine, QUARKS, which displays their literary creativity; SAMANWAY, the Institute's industry outreach initiative where UG students play a major organisational role; and cultural events such as RANGMANCH and RHYTHMICA, which showcase dramatic and dance talents, respectively. The annual UG sports meet, "Eclipse", also witnessed enthusiastic participation and was a resounding success.

5.0

Awards and *Distinctions*

Name	Division	Department	Awards
Sandeep M Eswarappa	Division of Biological Sciences	BC	Prof Rita Mulherkar Lecture Award from Indian Society for Cell Biology
Sandeep M Eswarappa	Division of Biological Sciences	BC	Sir CV Raman Young Scientist Award from the Karnataka Government
Sandeep M Eswarappa	Division of Biological Sciences	BC	Vishishta Seva Puraskar from Mysore Medical College
Sandeep M Eswarappa	Division of Biological Sciences	BC	Elected member of the Guha Research Conference
Prabeer Barpanda	Division of Chemical Sciences	MRC	SMC Bronze Medal 2024
Prabeer Barpanda	Division of Chemical Sciences	MRC	Fellow, International Association of Advanced Materials
Bikramjit Basu	Division of Chemical Sciences	MRC	Outstanding Professor, Academy of Scientific and Innovation Research, GOI
Bikramjit Basu	Division of Chemical Sciences	MRC	Distinguished Biomaterials Scientist, Society for Biomaterials and Artificial Organs India
Arvind Ayyer	Division of Physical and Mathematical Sciences	MA	Fellow of National Academy of Sciences, India (NASI)
Subhojoy Gupta	Division of Physical and Mathematical Sciences	MA	Associateship of the Indian Academy of Sciences was renewed for an additional 3-year period
Thirupathi Gudi	Division of Physical and Mathematical Sciences	MA	Fellow of National Science Academy, Prayagraj
Thirupathi Gudi	Division of Physical and Mathematical Sciences	MA	Fellow of Indian Academy of Sciences Bengaluru
Akshay Singh	Division of Physical and Mathematical Sciences	PHY	Paired Early Career Fellowship in Applied Research (PECFAR), Indo-German Science and Technology Centre (IGSTC)
Akshay Singh	Division of Physical and Mathematical Sciences	PHY	Associate, Indian Academy of Sciences
Vijay Balakrishna Shenoy	Division of Physical and Mathematical Sciences	PHY	JC Bose National Fellowship
Prateek Sharma	Division of Physical and Mathematical Sciences	PHY	Invitation and support to attend a summer programme at Aspen Center for Physics, Aug-Sep, 24
Rajeev Kumar Jain	Division of Physical and Mathematical Sciences	PHY	IISc Research Award 2024
Rajeev Kumar Jain	Division of Physical and Mathematical Sciences	PHY	Associate Editor of Physical Review D of American Physical Society
Rajeev Kumar Jain	Division of Physical and Mathematical Sciences	PHY	Axis Bank Centre conference travel grant

Name	Division	Department	Awards
Sebabrata Mukherjee	Division of Physical and Mathematical Sciences	PHY	Infosys Young Investigator award
Ranjan Laha	Division of Physical and Mathematical Sciences	CHEP	2024 ICTP prize
Ranjan Laha	Division of Physical and Mathematical Sciences	CHEP	IPA Buti Foundation Award for Excellence in Theoretical Physics, Astrophysics and Biophysics - 2024
Anant	Division of Physical and Mathematical Sciences	CHEP	Member, Governing Council, Inter University Centre for Accelerator Physics, New Delhi
Aninda Sinha	Division of Physical and Mathematical Sciences	CHEP	Fellow, Indian Academy of Sciences
Justin David	Division of Physical and Mathematical Sciences	CHEP	Elected to the Mathematical Physics commission of the IUPAP
Justin David	Division of Physical and Mathematical Sciences	CHEP	Associate editorship of EPJC extended for another 3 years (2024-2027)
Bhavana Kanukurthi	Division of EECS	CSA	Distinguished PC Member, Eurocrypt Programme Committee
Gugan Thoppe	Division of EECS	CSA	Elevated to IEEE Senior Member
Gugan Thoppe	Division of EECS	CSA	Selected to the ACM India Eminent Speaker Programme (ESP) Panel
Siddharth Barman	Division of EECS	CSA	Received the ACM India Early Career Researcher (ECR) 2023 Award
Vijay Natarajan	Division of EECS	CSA	Humboldt Ambassador Scientist, Alexander von Humboldt Foundation
Vijay Natarajan	Division of EECS	CSA	Best Short Paper Honorable Mention Award, IEEE Visualisation Conference, 2024
Arpita Patra	Division of EECS	CSA	Prof SK Chatterjee Award for Outstanding Woman Researcher or Industry Leader
Shalabh Bhatnagar	Division of EECS	CSA	Fellow, IEEE
Shalabh Bhatnagar	Division of EECS	CSA	Fellow, AAIA
Chiranjib Bhattacharyya	Division of EECS	CSA	Fellow of Asia Pacific Artificial Intelligence Association
Kausik Majumdar	Division of EECS	ECE	IISc Research Award
Debdeep Sarkar	Division of EECS	ECE	Inducted as Young Associate of Indian National Academy of Engineers, 2024
Debdeep Sarkar	Division of EECS	ECE	Received International Travel Support (ITS), ANRF (Formerly SERB), India, 2024 for participating in IEEE APSURSI 2024

Name	Division	Department	Awards
Debdeep Sarkar	Division of EECS	ECE	Received Young Professionals Excellence Award in Wireless, Antennas and Microwaves Symposium, 2024
Dipshikha Chakravortty	Division of Biological Sciences	MCB	TWAS Fellowship
Omkar Subbaram Jois Narasipura	Division of Mechanical Sciences	AE	Eminent Engineers Award by The Institution of Engineers
Ananth Govind Rajan	Division of Mechanical Sciences	CE	Associate, Indian Academy of Sciences (IASc)
Ananth Govind Rajan	Division of Mechanical Sciences	CE	Young Engineers Award, Institution of Engineers India (IEI)
Ananth Govind Rajan	Division of Mechanical Sciences	CE	Guest Editor, ACS Engineering Au, for a special issue on Materials Design
Ananth Govind Rajan	Division of Mechanical Sciences	CE	Guest Editor, Journal of the Indian Institute of Science, for a special issue on Advances in Atomic-Scale Modelling of Materials and Molecules
Narendra Dixit	Division of Mechanical Sciences	CE	Alumni Award for Excellence in Research in Engineering, IISc
Narendra Dixit	Division of Mechanical Sciences	CE	Fellowship of Indian Academy of Sciences
Narendra Dixit	Division of Mechanical Sciences	CE	Academic Editorship of PLoS Computational Biology
Balachandra Suri	Division of Mechanical Sciences	ME	Predictive framework for flow reversals in turbulence is Editor
Ashok M Raichur	Division of Mechanical Sciences	MAT ENG	Distinguished Professional, AICTE
Ashok M Raichur	Division of Mechanical Sciences	MAT ENG	Adjunct Professor, MNIT Jaipur
Sai Gautam Gopalakrishnan	Division of Mechanical Sciences	MAT ENG	Young Metallurgist (Environment) Award 2023, Ministry of Steel
Sai Gautam Gopalakrishnan	Division of Mechanical Sciences	MAT ENG	Emerging Investigator, Journal of Materials Chemistry A, 2024
Sai Gautam Gopalakrishnan	Division of Mechanical Sciences	MAT ENG	Prof Priti Shankar Teaching Award (2023)
Sai Gautam Gopalakrishnan	Division of Mechanical Sciences	MAT ENG	Young Battery Research Award, Battery Society of India (2023)
Govind S Gupta	Division of Mechanical Sciences	MAT ENG	Keynote speaker in various conferences
Govind S Gupta	Division of Mechanical Sciences	MAT ENG	Academic expert to USTB, Beijing
Govind S Gupta	Division of Mechanical Sciences	MAT ENG	Member of Editorial board of Carbon Neutrality Frontiers Journal

Name	Division	Department	Awards
Prosenjit Das	Division of Mechanical Sciences	MAT ENG	Paired Early Career Fellowship in Applied Research (PECFAR), IGSTC, 2024
Nagesh Kumar Dasika	Division of Mechanical Sciences	CIE	Edward M Curtis Visiting Professorship, Lyles School of Civil and Construction Engineering, Purdue University, West Lafayette, USA, (Aug 2024 to May 2025)
Anbazhagan P	Division of Mechanical Sciences	CIE	Thiranmigu Poriyalar (Efficient Engineer)
Tejas Murthy	Division of Mechanical Sciences	CIE	Edward Curtis visiting professorship
Sreenivasan Ramaswami	Division of Mechanical Sciences	CST	IEI Young Engineers Award 2023-24 by The Institution of Engineers (India) in recognition of contributions in the field of Environmental Engineering
Pavan Nukala	Division of Interdisciplinary Sciences	CeNSE	IISc Award for excellence in teaching
Pavan Nukala	Division of Interdisciplinary Sciences	CeNSE	CeNSE award for excellence in teaching
Sreetosh Goswami	Division of Interdisciplinary Sciences	CeNSE	Young Scientist Award at the National Physicists Conclave (2024)
Sreetosh Goswami	Division of Interdisciplinary Sciences	CeNSE	Young Associate of the Indian Academy of Sciences
Nikhil Gandasi	Division of Biological Sciences	DGB	Avadhesha Surolia Research and Innovation Award
Jayant R Haritsa	Division of Interdisciplinary Sciences	CDS	Public Interest Director, National Clearing Limited
Jayant R Haritsa	Division of Interdisciplinary Sciences	CDS	Member, Technical Advisory Board, Microsoft Research India
Venkatesh Babu Radhakrishnan	Division of Interdisciplinary Sciences	CDS	Elevated to AAAI Senior Member
Venkatesh Babu Radhakrishnan	Division of Interdisciplinary Sciences	CDS	Recognised as top cited chapter author by Springer Nature

Name	Division	Department	Awards
Venkatesh Babu Radhakrishnan	Division of Interdisciplinary Sciences	CDS	Associate Editor, IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) [Impact factor: 20.8]
Venkatesh Babu Radhakrishnan	Division of Interdisciplinary Sciences	CDS	Action Editor, TMLR
Ravindranath Hanumanthappa Aladakatti	Division of Biological Sciences	CAF	Best recognition Award for paper presentation in Asian Conference on Science, Technology and Medicine (ACSTM), 2024
Ravindranath Hanumanthappa Aladakatti	Division of Biological Sciences	CAF	Nominated as a NAAC Assessor Member, National Assessment and Accreditation Council (NAAC), University Grants Commission (UGC)
Anoop Thomas	Division of Chemical Sciences	IPC	Young Scientist award of the Asian and Oceanian Photochemistry association
Debasis Das	Division of Chemical Sciences	IPC	Graeme Hanson AsBIC Early Career Researcher Award
Debasis Das	Division of Chemical Sciences	IPC	IISc Awards for Excellence in Teaching
Debasis Das	Division of Chemical Sciences	IPC	IISc Research Award
Partha Sarathi Mukherjee	Division of Chemical Sciences	IPC	JC Bose National Fellowship
Partha Sarathi Mukherjee	Division of Chemical Sciences	IPC	Appointed as Editorial Advisory Board Member of Aggregate, a journal of the Wiley-VCH
Santanu Mukherjee	Division of Chemical Sciences	OC	SYNLETT Best Paper Award 2023
Rachit Agarwal	Division of Interdisciplinary Sciences	BE	Editorial board member for the Journal of Biomedical Materials Research Part A, August 2024
Rachit Agarwal	Division of Interdisciplinary Sciences	BSSE	Organisation of Pharmaceutical Producers of India (OPPI) Young Scientist Award, 2024
Ajay Tijore	Division of Interdisciplinary Sciences	BE	EMBO Travel Grant for an invited talk at EMBO Mechano-Genomics conference 2024, Italy
Rohini Balakrishnan	Division of Biological Sciences	CES	Elected Councillor, International Society for Neuroethology
Awadhesh Narayan	Division of Chemical Sciences	SSCU	Indian National Science Academy Young Associate, 2024

6.0

Students

6.1
Admissions and On Roll

ADMISSIONS 2024-25:

1. **AUGUST 2024-25 ADMISSIONS (PG/ RESEARCH PROGRAMMES)**

In the August 2024-25 admission cycle, 1509 students were admitted under various programmes.

- Regular PhD: 397
- PhD/MTech (Res) under External Registration Programme (ERP): 28
- PhD under Quality Improvement Programme (QIP): 3
- Continuation/Upgradation/ Transfer: 25
- Integrated PhD: 66
- Regular MTech (Res): 53
- Regular MTech (GATE & CFTI)/MDes/MMgt: 665
- 1-Year MEngg: 15
- Joint MTech: 2
- MTech Sponsored Category: 32
- MSc Programmes: 72
- MTech (Online): 151

SC/ST Category Distribution (Postgraduate/Research Programmes):

- **SC/ST: 260 students:** 97 in Research Programmes (PhD and MTech (Res)), 13 in Integrated PhD, 134 in Master's Programmes (MTech/MDes/ MMgt/ MSc/ MEngg) and 16 in MSc programme.

2. **UNDERGRADUATE ADMISSIONS (2024-25):**

A total of 164 students were admitted to undergraduate programmes:

- Four-Year BSc (Research): 98
- BTech: 66

SC/ST Category Distribution (Undergraduate):

- SC/ST: 25 students: 17 for BSc (Research), and 8 for BTech.

3. **MID-YEAR 2024-25 ADMISSIONS (RESEARCH PROGRAMME)**

In the Mid-Year admission cycle of 2024-25, 117 students were admitted:

- Regular PhD: 110
- PhD under External Registration Programme (ERP): 7

SC/ST Category Distribution (Mid-Year Admissions):

- SC/ST: 25 students

6.2
Students On Roll

The total number of students on roll at the institution is 5621. The breakdown of students by programme is as follows:

Programme	Number of Students
BSc (Research)	414
BTech	175
MDes	50
MMgt	31
MTech	1325
MTech (Research)	134
MS	93
PhD	2500
MTech (Online)	347
MEngg	15
MSc	143
Integrated PhD	392
MTech (Joint)	2

6.3
Scholarships/ Fellowships

The students participating in research and course programmes are granted scholarships at the Institute ranging from 5,000/- to 1,00,000/- depending on the programme/agency. 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.

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 newsletter of the students, is one of its main activities.

6.6
Hostels

The Students Hostel consists of 18 men and 5 women hostel blocks. A total of 4,359 (3089 men and 1270 women) are provided accommodation in the Hostel blocks.

Five dining halls (3 vegetarian and 2 Composite) provide a variety of food items in clean and hygienic conditions for all the boarders.

The hostels and dining halls are managed by the Council of Wardens/ Hostel Office.

6.7
Award of Medals

Recommendations for the award of Medals for the year 2023-24

Sl no.	Name of the medal	Frequency	Department	Discipline	Name	Remarks
Name of the Medal: MTech Programmes						
1.	Dr N Narayanamurti Medal	Alternate Year	AE	AE	Aswathi Krishna	-
1.	Mrs Sabita Chaudhuri Memorial Medal	Alternate Year	AE	AE	-	-
2.	Prof NR Kuloor Memorial Medal	Yearly	CH	CH	-	No recommendation. The number of students is less than five
3.	Prof NS Lakshmana Rao Medal	Yearly	CE	CE	Arshika Tomar	-
4.	The Computer Society of India (Bangalore Chapter) Medal	Yearly	CSA	CS	Dhruva Kashyap	-
5.	The KK Malik Medal	Yearly	MTE	MT	Syed Abdur Rahman	-
6.	SV Sastry Memorial Medal	Yearly	ME	ME	-	Awarded for the AY 2023-24 in the last convocation
7.	The Alumni Medal	Yearly	EC/ED	MV	Ashwin Rajesh	-
8.	Prof ISN Murthy Medal	Yearly	EE/EC	SP	Aditya C	-
9.	The NR Khambhati Memorial Medal	Yearly	RBCCPS	RAS	Suraj Kumar	-
10.	The NR Khambhati Memorial Medal	Yearly	EE	EE	-	Awarded for the AY 2023-24 in the last convocation

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Sl no.	Name of the medal	Frequency	Department	Discipline	Name	Remarks
11.	Prof SVC Aiya Medal	Yearly	EC	EC	Vinay U Pai	-
12.	Motorola Medal	Yearly	CDS	CDS	Sundaresan G	-
13.	The DESE Design Medal	Yearly	ESE	ESE	Sachin Thomas	-
14.	Dr Bhailalbhai P Sutharand Narmadaben					
15.	B Suthar Memorial Medal	Yearly	ESE	EPD	Vibhore Jain	-
16.	Prof Sargur N Srihari Medal	Yearly	EECS division	AI	Hamvir Dev	-
17.	Nikhil Memorial Medal	Yearly	CAOS	CL	-	No recommendation. The number of students is less than five
18.	Prof K N Krishnaswamy Medal	Yearly	CEaS	ER	Aayushi Kochar	
19.	Prof R Vasudevan Medal	Yearly	CeNSE	SemT	Vaishakh U	
20.	Mr Dheeshijith V G Medal	Yearly	DM	SM	Patel Dishank Sureshkumar	
21.	JC Roy & Mukti Roy Memorial Medal	Yearly	IAP	QT	Aman Tyagi	
22.	HR Babu Seetharam Medal	Yearly	IAP	IN	-	No recommendation. The graduating batch of students do not qualify based on CGPA as well as project grades
23.	The Institute Medal	Yearly	BE	BE	Sayantani Garai	-
MDes Programme						
24.	The Institute Medal	Yearly	DM	MDes	Sanika Subodh Bhide	
MMgt Programme						
25.	Prof BG Raghavendra Memorial Medal	Yearly	MG	MMgt	Somwanshi Nikhil Chhotu	

Sl no.	Name of the medal	Frequency	Department	Discipline	Name	Remarks
PhD Programme						
26.	Prof AK Rao Medal	Alternate	AE	AE	Jangala Ramesh Babu	
	Prof Chintakindi V Joga Rao Medal	Alternate	AE	AE	-	-
27.	Prof NR Kuloor Memorial Medal	Yearly	CH	CH	Bhanjan Debnath	-
28.	Prof BK Subba Rao Medal	Yearly	ME	ME	Shubham Sharma	
29.	Prof KP Abraham Medal	Yearly	MTE	MT	Telpande Swanand Prashant	-
30	Kudli Srinivasa Murthy Memorial Medal	Yearly	DCCC	CC	-	No recommendation. The number of students is less than five
31.	The Alumni Medal (Research)	Yearly	CS	CS	Koti Nishat Saipanmuluk	
32.	The Seshagiri Kaikini Medal	Yearly	EC	EC	V Arvind Rameshwar	-
33.	Prof DJ Badkas Medal	Yearly	EE	EE	Anwesha Mukhopadhyay	-
34.	Prof NS Govinda Rao Medal	Alternate	CE	CE	Kalore Shubham Arun	
35.	Prof KTS Iyengar Medal	Alternate	CE	CE	-	-
36.	MAA Communications Medal	Yearly	DM	DM	Sanketh Tonannavar	
37.	Lt Col Balan Krishnan Memorial Medal	Yearly	CNS	NS	Surya SP	-
38.	Prof Giri Memorial Medal	Yearly	BC	BC	Urbi Roy	-
39.	Mrs CV Hanumantha Rao Medal	Yearly	DBG	DBG	Rishi Kumar Mishra	
40.	Thippur Family Medal	Yearly	BCD	BCD	-	No recommendation. The number of students is less than five

Sl no.	Name of the medal	Frequency	Department	Discipline	Name	Remarks
	The Shamrao Kaikini Medal	Yearly	CES	CES	-	The committee has decided to reject the medal nominations as there are only four eligible students which is less than the minimum requirement of five.
	The M Sreenivasaya Medal	Yearly	MCB	MC	Mayashree Das	-
	Prof BH Iyer Medal	Yearly	MBU	MB	Nayanika Sengupta	-
	Dr JC Ghosh Medal (Physical Chemistry)	Yearly	IPC	PC	Deep Mukherjee	
	Prof S Soundarajan Medal (Inorganic Chemistry)	Yearly	IPC	IC	Satyam Jena	
	The Guha Research Medal	Yearly	OC	OC	Jagabandhu Sahoo	-
	The Toulouse Medal	Yearly	SSCU	SS	Debasish Mondal	
	The Martin Forster Medal	Yearly	MA	MA	Poornendu Kumar	-
	Prof Anil Kumar Memorial Medal					
	(Experimental Physics)	Yearly	PH	EP	Shashank Kumar Ojha	-
	Kumari L A Meera Memorial Medal (Theoretical Physics)	Yearly	PH	TP	Nilanjandev Bhaumik	
	The Indian Economic Association Medal	Yearly	MG	MG	Vikrant Lokeshwar	-
	Sir Vithal N Chandavarkar Memorial Medal	Yearly	CDS	CDS	P Naveen	
	The Sudborough Medal	Yearly	MRC	MR	NH Gowtham	-

Sl no.	Name of the medal	Frequency	Department	Discipline	Name	Remarks
	Dr Srinivasa Rao Krishnamurthy Medal	Yearly	IAP	IN	Prakash Joshi	-
	Amulya and Vimala Reddy Medal	Yearly	CST	ST	Priyanka Tripathi	-
	The Roddam Family Medal	Yearly	CAOS	AS	Nikumbh Akshaya Chandrakant	-
	Tag Corporation Medal	Yearly	ESE	ESE	Tutan Debnath	-
	The Institute Medal	Yearly	CEaS	ER	Jyotirmoy Paul	-
	Revati and Satya Nadham Atluri Medal	Yearly	CeNSE	NE	Lathia Rutvik Vasudevbhai	
	The Institute Medal	Yearly	ICER	ER	Shirish Kumar Sharma	-
	The Institute Medal	Yearly	BE	BE	Anil Vishnu G K	-
	Prof Pandurangan Medal	Yearly	MA (IMI)	IMI	-	No recommendation. The number of students is less than five
	The Institute Medal	Yearly	ICWaR	WR	-	No recommendation. The number of students is less than five
	Durgam and Subha Chakrapani Family Trust Gold Medal	Yearly	RBCCPS	CPS	-	No recommendation. The number of students is less than five
	The Institute medal	Yearly	CHEP	HE	Rhitaja Sengupta	
MTech (Research) Programme						
	Mrs Sabita Chaudhuri Memorial Medal (Research)	Alternate	AE	AE	-	No recommendation. The number of students is less than five
	NASAS Medal	Alternate	AE	AE	-	-
	The Institute Medal	Yearly	CH	CH	Shiv Kumar	-

Sl no.	Name of the medal	Frequency	Department	Discipline	Name	Remarks
	ME Department Alumni Medal	Yearly	ME	ME	Chandan Kumar Sah	
	Dr Karra Narasimhamurthy Memorial Medal	Yearly	MTE	MT	-	No recommendation. The number of students is less than five
	Dr M N S Swamy Medal	Yearly	CS	CS	Lonkar Aditya Abhay	-
	Prof F M Mowdawalla Medal	Yearly	EC	EC	-	No recommendation.
	There were seven candidates in contention, but the Department did not find any of them worthy of a medal.					
	The Hay Medal	Yearly	EE	EE	Vishwabandhu Uttam	
	The PS Narayana Medal	Yearly	CE	CE	-	No recommendation. The number of students is less than five
	Subramanian Rajalakshmi Medal	Alternate	CDS	CDS	Vinod Jacob Matthew	-
	NetApp Medal	Alternate	CDS	CDS	-	-
	The Institute Medal	Yearly	CAOS	AS	-	No recommendation. The number of students is less than five
	The Institute Medal	Yearly	ESE	ESE	-	No recommendation. The number of students is less than five
	The Institute Medal	Yearly	IAP	IN	Bache Sivacharangoud	
	The Institute Medal	Yearly	DM	DM	-	No recommendation. The number of students is less than five
	The Institute Medal	Yearly	RBCCPS	CPS	-	No recommendation. The number of students is less than five
	The Institute Medal	Yearly	CEaS	ER	-	No recommendation. The number of students is less than five
	The Institute Medal	Yearly	CST	ST	-	No recommendation. The number of students is less than five
Integrated PhD (MS Level)						
	Prof PL Bhatnagar Medal		Mathematical Sciences	Karambir Das		
	Dr RK Maller Memorial Medal		Biological Sciences	Swati Ghosh		
	Dr A Nagaraja Rao Medal		Chemical Sciences	Gautam Kumar Singh		
	Kumari L A Meera Memorial Medal		Physical Sciences	Ranju		
MSc Programme						
	Prof Krothapalli Ravindranath Medal		Life Sciences	Mahima Manjunath Bhat		
	Rajarshi Bhattacharya					
	Memorial Medal		Chemical Sciences	-	-	

6.8

External Registration Programme (No. of Students Joined in Academic Year 2024-25)

i) AUGUST 2024-25 ADMISSIONS

Sl No	Name of the Organisation (Selected Applicants)	Dept	No. Joined
	Government Organisation		
1	Combat Aircraft System Development and Integration Centre, CASDIC, DRDO, Khaggdasapura Road, CV Raman Nagar, Karnataka-560093	CDS	2
2	DEFENCE RESEARCH AND DEVELOPMENT ORGANISATION DSR, LRDE, DRDO COMPLEX, C V RAMAN NAGAR, Karnataka-560093	ECE	1
3	CENTRE FOR AIRBORNE SYSTEMS, Belur, Yemlur Post, Karnataka-560037	ECE	1
4	U R Rao Satellite Center, Old Airport Road, Vimanapura Karnataka-560017	ECE	1
5	DEFENCE RESEARCH AND DEVELOPMENT RESEARCH CENTRE IMARAT, VIGNYANA KANCHA POST, Telangana-500069	AE	1
6	Indian Space Research Organisation, O/o Scientific Secretary, ISRO Headquarters, Antariksh Bhawan, New BEL Road Karnataka-560094	AE	1
7	Aircraft Research and Design Centre-HAL, HAL Vimanapura, Marathahalli, Karnataka-560037	ME	1
8	CSIR-National Aerospace Laboratories, HAL Old Airport Rd, Kodihalli, Karnataka-560017	MT	1
9	Aeronautical Development Establishment, Karnataka-560075	CDS	2
	TOTAL		**11**
	Private Organisation		
10	GlobalFoundries Engineering Private Limited, 9th Floor, Block N1 (Balsa), Manyata Embassy Business Park, Nagawara, Outer Ring Road, Karnataka-560045	ECE	2
11	Airbus India Private Limited, 4th Floor, Xylem, Plot No, 4 & 4A, Whitefield Rd, Dyavasandra, Industrial Area, Mahadevapura, Karnataka-560048	AE	1
12	GE Healthcare,John F Welch Technology Centre, Whitefield Karnataka-560066	CDS	1
13	Wabtec India Industrial Pvt Ltd, ITC Green, 6th Floor, Southwest Tower, No. 18, maruthisevanagar, Banaswadi main road Karnataka-560005	ICER	1
14	Texas Instruments, 66/3, Bagmane Tech Park Rd, Karnataka-560093	ESE	1
15	Samsung Semiconductor India Research and Development, Bagmane Goldstone Building, Outer Ring Road, Mahadevapura Karnataka-560048	ESE	1
16	Advanced Micro Devices, Prestige Technostar, Doddanakundi Industrial Area 2, Phase 1, Karnataka-560048	CSA	1
17	Cisco Systems (India) Pvt Ltd, SEZ Unit, Cessna Business Park, Kadubeesanahalli Village, Karnataka-560087	CSA	1
18	Advanced Micro Devices AMD, Plot #102 &103, Karnataka-560066	CSA	1
19	Tata Consultancy Services Gopalan Global Axis Block-H, Rd Number 9, Opp Satya Sai Hospital, KIADB Export Promotion Industrial Area, Whitefield, Karnataka-560066	ECE	1
20	Samsung R and D Institute Bangalore, 560037	ECE	1
21	TATA Consultancy Services Limited, Sahyadri Park II, Phase 3, Rajiv Gandhi Infotech Park, Hinjawadi, Maharashtra-411057	DM	1
22	Mercedes Benz Research and Development India Pvt Ltd, Karnataka-560066	CPS	1
23	Mercedes-Benz Research and Development India, Bengaluru, 560037	CPS	1
	TOTAL		**15**
	Educational Institution		
24	Garden City University, Kithaganur Main Rd, Battarahalli, 560049	DBG	1
25	GIET University, AT-Gunupur, PO/PS- Gunupur, Rayagada Orissa-765022	MT	1
	TOTAL		**2**
	GRAND TOTAL		**28**

ii) MID-YEAR 2024-25 ADMISSIONS

Sl No	Name of the Organisation (Selected Applicants)	Dept	No. Joined
	Government R&D Organisation		
1	Central Manufacturing Technology Institute TUMKUR ROAD, Karnataka-560022	ESE	1
2	Hindustan Aeronautics Limited, Aircraft Research and Design Centre, Design Complex, Marathahalli Post, Karnataka-560037	ICER	1
3	Aeronautical Development Agency, PB 1718, Vimanapura Post, Karnataka-560017	CPS	1
	TOTAL		**3**
	Private R&D Organisation		
1	IBM- International Business Machines Corporation Manyata Embassy Business Park, 8th Floor, G2, Outer Ring Road, Rachenahalli and Nagawara Villages Karnataka-560077	CDS	1
2	Tata Consultancy Services Limited HMMQ+8FH, Phase 3, Hinjawadi Rajiv Gandhi Infotech Park, Hinjawadi, Pimpri-Chinchwad, Maharashtra-411057	ME	1
3	Global foundries Engineering Private Limited, 10th Floor, N1 Block, Manyata Embassy Business Park, Nagavara, Karnataka-560045	CENSE	1
	TOTAL		**3**
	Educational Institution		
1	Maharani Lakshmi Ammanni College For Women Malleshwaram 18 th cross, Karnataka-560012	MRC	1
	TOTAL		**1**
	GRAND TOTAL		**7**

6.9 *Placements*

The Office of Career Counseling and Placement (OCCaP) coordinated campus placements for full time and internship opportunities for the year 2024–25. A wide range of placement activities, industry interaction events, and student development programmes were conducted to support students across different programmes.

Placement Preparation and Pre-Placement Activities
Placement activities commenced in August 2024 with a series of interactive sessions with students to:

- Share placement policies and timelines
- A registration process for full-time placements was completed for all student categories — UG, Master's, PhD, and Post-Doctoral Fellows.

A. Conclusion of final placements: batch of 2023–24 (graduating in 2024)
Final placement activities for the batch of 2023–24 began in August 2023 and concluded in July 2024. 13 students secured a six-month internship. 365 Master's students and 46 PhD students secured full time jobs.

B. Ongoing full-time placements: batch of 2024–25 (graduating in 2025)
Full-time placement activities began in mid-August 2024 with pre-placement talks, followed by assessments and interviews. Final placement activities for the batch of 2024-25 began in August 2024 and are scheduled to conclude in July 2025. A total of 25 students secured a six-month internship. 431 Master students and 27 PhD students secured full time jobs.

C. Summer internship placements: batch of 2025–26 (graduating in 2026)
Internship placements for Summer 2025 began with student addressal session and registration in January 2025, followed by recruitment processes starting February 2025 which is scheduled to conclude by May 2025. A total of 194 students (including 31 BTech) secured three-month internship offers.

Please find below the placement statistics

CAMPUS PLACEMENTS

FULL TIME PLACEMENTS

Batch	2024-25	2023-24
Total Offers	480	434
Total Students	459	413
Highest CTC (Annual)	54.8 LPA	65.4 LPA
Median CTC (Annual)	27 LPA	24.6 LPA

SUMMER INTERNSHIP

Batch	2024-25	2023-24
Total Offers	196	148
Total Students	194	143
Highest stipend (monthly)	2.5 L	2 L
Median stipend (monthly)	60 K	50 K

50+ new recruiters visited in 2024-25 during the full time and summer internship placements

D. Student support events and industry engagement
To enhance student preparedness and industry connectivity, OCCaP conducted the following programmes.

(a) Industry Sessions and Workshops

- **Google –** Tech Session on "Future of Search" - open for all students
- **Microsoft –** Session on "Navigating the Landscape of Generative AI" - open for all students
- **Amazon Research –** Introduction to ML Research
  - 2 internships offered
- **Optum – AI/ML Leadership Talk**
  - 1 PhD internship offered
- **Micron –** Free Coursera access for upskilling in tech domains
  - 133 students received free subscriptions
- **Startup AI Talent Quest –** Event in partnership with ACCEL & NASSCOM
  - 16 full-time job offers, and 9 internships offered
- **Motive Hackathon –** Hiring Event
  - 2 full-time roles + 2 internships offered +1 student won an iPad; all participants received goodies
- **Scale AI** – Specialised hiring drive for PhDs
  - 35 PhD, 1 Research Associate, 1 Project Assistant received part time offers with an opportunity to make Rs 4 lakhs for a project of 8 weeks)

(b) Career Readiness Programme

- **Resume Workshops** – Helped students draft impactful resumes
- **Alumni Talk** – "Industry Expectations for the Future Workforce"

6.10
Awards and Distinction Conferred on Students

Student Name	Department	Award
Swati Ghosh	BC	Hindustan Unilever Women in STEM fellowship
Saubhik Som	BC	EMBO Travel Fellowship to attend a conference in Ireland
Debraj Manna	BC	Selected for early career leadership programme, Genetics Society of America, USA
Debraj Manna	BC	Best Oral Presentation Award, RNA meeting, IIT Guwahati
Debraj Manna	BC	Best poster presentation award, annual SBC meeting, MS University, Baroda
Debraj Manna	BC	Awarded the Presidential membership of Genetics Society of America
Micky Anand	BC	AICBC 2024 best presentation award
Abhinav Banerjee	BC	TNQ inspiring science award 2024
Abhinav Banerjee	BC	T R Bhaskaran Memorial Prize for excellence in academic research
Daivik Banerjee	MRC	Rajarshi Bhattacharya Memorial medal for best M.Sc. student
Subhendu Mishra	MRC	Best poster presentation award in International Conference on 60 Years of DFT: Advancements in Theory and Computation organised at IIT Mandi from July 21 to 26, 2024
Pooja Gakhad	MRC	Awarded SERB DST international travel grant for attending the 20th International Conference on Density Functional Theory and its Applications in Paris, France, in August 2024
Ashutosh Srivastava	MRC	Awarded foreign travel grant by the Council of Science and Industrial Research (CSIR), New Delhi, for attending the MRS spring meeting, 2024 in the USA
Alankar Dutta	PHY	Max Planck Postdoctoral Fellowship, MPA Garching
Bhoomija Chaurasia	PHY	Best poster award, WOPI Asia conference 2024, IIT Bombay
Avinash Tetarwal	PHY	Best poster award, Photonics 2024 conference, IIT Kharagpur
Ahmadullah Zahed	CHEP	Indian Physics Association, Rahul Basul memorial best thesis prize for high energy physics between
Venkata Naga Sreenivasulu Karnati	CSA	Dr MNS Swamy Medal for Best MTech (Research) Thesis 2023
Ankur Naskar	CSA	DST-ANRF Overseas Visiting Doctoral Fellowship at Purdue University
Nibedita Roy	CSA	ACM-W Travel Award
Vishali S	CSA	Axis Bank PhD Fellowship
Amritendu Dhar Shekhar	CSA	PMRF
Soumya Kanti Saha	CSA	TCS Research Scholar, 2024-2028
Bhavish Raj Gopal	CSA	Bhavish Raj Gopal has received Google travel grant to attend ACM CCS, 2024
Bhavish Raj Gopal	CSA	Bhavish Raj Gopal
Dhruva Kashyap	CSA	CSI Medal for the Best MTech (CSE) student
Pravin Nair	EE	Best Thesis Award (EE)
Arghya Sinha	EE	Outstanding TA Award (EE)
Kamisetti N V Prasad	EE	Best paper award at IEEE INTELEC 2024 for paper titled, “Analysis of Overvoltage Across Blanking Capacitor Due to Junction Capacitance of Sensing Diode in Desat Protection of SiC MOSFET”
Anupam Verma	EE	Best paper award at IEEE SeFet 2024 for paper titled, “Predictive DC-Bus Voltage Control of Switched Reluctance Generator Above Its Base Speed”
Anupam Verma	EE	Best paper of the track award at IEEE IC2E3 2024 for paper titled, “Comparison of Optimised Single-Pulse and Modified Single-Pulse Modes of Operation of Switched Reluctance Generator”
Aditya Raj	EE	Best paper award at IEEE PIICON 2024 for paper titled, “Performance Evaluation of Radial Electromagnetic Bearings using Measured Magnetic Characteristics of Core Materials over Wide Frequency Range”
Samrat Das	EE	Best paper award at IEEE PEDES 2024 for paper titled, “Experimental studies on speed-dependent vibrations of a 30,000 rpm switched reluctance machine”
Anwesha Mukhopadhyay	EE	IEEE Industry Application Society (IAS) CMD Student Thesis Contest 2024, PhD category, 3rd prize winner for the PhD dissertation
Anwesha Mukhopadhyay	EE	Grid India Power Systems Award (GIPSA), 2024-25 for PhD thesis
Roja Peri	EE	Best WiE Paper Award, IEEE Intelec 2024
Harshada Vijay Ahire	EE	Best Paper Award, IEEE PEDES 2024
Debarpan Bhattacharya	EE	TCS Fellowship

Student Name	Department	Award
Atli Lemma Gebretsadik	ECE	Best Student Paper Award in WAMS 2024 for his paper entitled "A Three-Ray Path Loss Model with Polarisation Effects for Indoor Single-Input Single-Output Millimeter-Wave Channel Modelling Applications"
Keerthipriya S	ECE	Selected as an awardee for the 2024 cycle of the IEEE AP-S (Antennas and Propagation Society) Fellowship Programme. She will receive USD 5000 to support her research on antennas and RF chain design for precision cosmology
Anand Kumar	ECE	Received SERB ITS (International Travel Scheme) support to present the work entitled "FDTD Modelling of Non-reciprocal RF Circuits using Modified Telegrapher Equations" in the International Microwave Symposium (IMS), Washington DC, USA
Anand Kumar	ECE	IEEE Microwave Theory and Technology Society Graduate Fellowship in the 2024 cycle (Up to 12 Fellowships in the amount of USD 6000 are granted by the IEEE MTT-S each year to assist students pursuing a graduate degree in microwave engineering)
Raju Malleboina	ECE	Best Paper Award in the Antenna, Communication and Networking track of the multidisciplinary conference IEEE CONECCT 2024 organised by the IEEE Bangalore section from 12-24 July 2024, and held at the Indian Institute of Science, Bengaluru, India (Jointly with Atli Lemma Gebretsadik)
Atli Lemma Gebretsadik	ECE	Best Paper Award in the Antenna, Communication and Networking track of the multidisciplinary conference IEEE CONECCT 2024 organised by the IEEE Bangalore section from 12-24 July 2024, and held at the Indian Institute of Science, Bengaluru, India (Jointly with Raju Malleboina)
Raju Malleboina	ECE	Best Paper Award in the Session on Metasurfaces and Associated Technologies of the IEEE Space, Aerospace and Defence Conference (SPACE), Bengaluru, India, 22-23 July, 2024 (Paper authored by UG interns Dheeraj G and Sateesh S Badadal from RVCE)
Sathisha Ramachandrapura	ECE	SPIE Photonics West - Best Paper Award in Optical Communications Track
Yashvanth L	ECE	Best Poster award at PMRF annual symposium
Anubhab Chowdhury	ECE	Best presentation award at the EECS Research Students Symposium

Student Name	Department	Award
Samarth S T	ESE	VLSID conference student fellowship
Abhinava De	ESE	VLSID conference student fellowship
Dipasree Hajra	MCB	Prestigious Saroj Chandrashekhar Award for excellence in Bioscience and Biotechnology (2024)
R Raghavendra	CE	Reliance Foundation PG Scholarship
Piyush Sharma	CE	2nd Prize, Mechanical Sciences Research Symposium Poster Session
Ankit Kumar Verma	CE	NTU India Connect Fellowship
Dr Kousika A	CE	National Post Doctoral Fellowship
Dr Srimayee Mukherji	CE	Poster Presentation Prize, MD@60 Conference
Arjun Sreedhar	ME	Post-Doctoral Fellowship from Johns Hopkins University, USA
Hasna Sabreen H	MAT ENG	Brij Seth Award for Best MTech thesis in Materials
Saquib Sarosh	CST	International Travel Support (ITS) from the Anusandhan National Research Foundation (ANFR) of the Science and Engineering Research Board (SERB) for attending 19th IWA LET conference, 24-28 June 2024, Essen, Germany.
Keerthi N S	CST	Best poster award, 1st DAE-BRNS International Conference on Recent Developments in Biofilms and Biofouling Control (BBC-2024)
Sanket Jugade	CeNSE	Cense Annual Student Symposium 2024 Best Oral Presentation Award
Deya Ganguly	CeNSE	Photonic 2024 best poster award
Meetu Singh	DGB	Travel/Poster prize
Aishwarya M A	DGB	PMR Fellowship
Priyadarshini V	DGB	PMR Fellowship
Jogendra Nath Kundu	CDS	IKDD Doctoral Dissertation in Data Science Award - Runner up award 2023
Jogendra Nath Kundu	CDS	ACM India 2023 Doctoral Dissertation Award - Honorable Mention award.
Rishubh Parihar	CDS	Prof Satish Dhawan Research Award 2024.
Jogendra Nath Kundu	CDS	Winner: IUPRAI-Doctoral Dissertation Award for 2023
Sravanti Addepalli	CDS	Winner: IUPRAI-Doctoral Dissertation Award for 2024
Sravanti Addepalli	CDS	Winner: IKKD Doctoral Dissertation Award in Data Science 2024
Abhipsa Basu	CDS	Qualcomm Innovation Fellowship 2024

Student Name	Department	Award
Priyanka Gupta	CNS	Neelam Roy Research Award for Women in Biological Sciences
Dipangkali Sarma	IPC	Best poster prize at the MOLEC 2024 conference, held in Aarhus, Denmark
Pooja Singh	IPC	PMRF
Harsh Baliyan	IPC	RSC and ACS Best Poster Prize at ETPP-24, IISER Mohali
Subha Biswas	IPC	RSC and ACS Best Poster Prize at ETPP-24, IISER Mohali
Subha Biswas	IPC	Best oral presentation, IPC day 2024
Subha Biswas	IPC	Vasudevan-Soundararajan Prize for best student seminar
Kavya S Mony	IPC	Vasudevan-Soundararajan Prize for best student seminar
Tabish Iqbal	IPC	Winner of the National Bio Entrepreneurship Competition (NBEC) 2024, C-CAMP Bangalore
Velpandi R	IPC	Best Student Seminar Award, IPC
Tabish Iqbal	IPC	Best Poster Award at the SABIC 2024 conference, Kolkata
Rahul Mondal	IPC	Best poster award at Internation conference on Modern Trends in Inorganic Chemistry
Medha Aggarwal	IPC	Dr A Nagaraja Rao Medal for best performance in Int PhD courses
Subhajit Mondal	OC	Best Poster Award at the Emerging Trends in Catalysis and Synthesis (ETCS-2024), IIT Kharagpur
Pankaj Roy	OC	Oral Presentation Awards at J-NOST Conference, IIT Gandhinagar
Pankaj Roy	OC	ACS-JOC Best Poster Award at the 7th International Symposium on C-H Activation (ISCHA-2024), in IIT Bombay
Pradeep Gupta	ICER	Best PhD Thesis Award
Madhumita P	BE	Reliance Post Graduate Scholarship 2023-25
Yeswanth C Kalapala	BE	Best poster award in Phage therapy, Viruses of Microbes 2024, Australia
Rashmita Luha	BE	HUL Women Fellowship
Amanda Ben	CES	Best talk award at the Student Conference on Conservation Science 2024
Avik Banerjee	CES	ASAB travel support to attend ECBB 2024 conference in University of Zurich, Switzerland
Avik Banerjee	CES	ISBE travel grant to attend ISBE 2024, Melbourne, Australia.
V P Gokul	CES	ABS Developing Nations Research Grant Award
Kanika Rawat	CES	ISBE - Travel Grant Award

Student Name	Department	Award
Ananta Kant Rai	RBCCPS	IEEE Computer Society Richard E. Merwin Student Scholarship
Ananta Kant Rai	RBCCPS	Student Support to Attend European Control Conference 2024
Laxmikant Pai Angle	RBCCPS	Outstanding Service at CNI, IISc
Prashanth S	RBCCPS	CNI MTech Fellowship
Sukalyan Deb	CNS	OHBM 2024 Travel Award
Navneet Shahi	CNS	Awarded full scholarship including airfare to attend a conference titled, Bridging Diverse Perspectives on the Mechanistic Basis of Foraging at HHMI, Janelia Research Campus (February 2024)
Navneet Shahi	CNS	Awarded SERB travel award to attend and present a poster at Cold Spring Harbor Meeting on neural circuits, New York (September 2024).
Navneet Shahi	CNS	Received registration waiver and travel assistance to attend the EMBO Meeting on Neuropeptides and Behavioural Flexibility to be held at NISER, Bhubaneshwar (December,2024).
Monmita Bhar	CNS	Selected to participate in the Genetics Society of America (GSA) early career per-review training programme that involved training in peer review and reviewing multiple manuscripts for the Journal Genetics and G3 (2024).
Monmita Bhar	CNS	Awarded registration waiver and selected for an oral presentation at the biennial TAGC conference hosted by the Genetics Society of America (GSA) in Washington DC, USA (March 2024).
Monmita Bhar	CNS	Selected to give an oral presentation at the 10th Asia Pacific Worm Meeting to held in Bangalore from (June 2024).
Monmita Bhar	CNS	Talk was selected for a best talk prize at the 2nd CNS Annual symposium at CNS, IISc, Bangalore (August 2024).
Aritra Das	CNS	Lt Col Balan Krishnan Memorial Medal (Institute Medal for best thesis at CNS)
Srishty Aggarwal	CNS	DST Award for Lindau Meeting
SP Surya	CNS	FENS travel award

7.0

Events

Institute Colloquium

1. Institute colloquium titled “Mathematics of Micro-structures: Multi-scale Analysis and Theory of Homogenisation” delivered by Nandakumaran AK, Department of Mathematics, IISc,, on 25 September 2024 at the Faculty Hall, Main Building.

2. Institute Colloquium titled “Topological Descriptors and Scalar Field Visualisation” delivered by Vijay Natarajan, Department of Computer Science and Automation, IISc,, on 23 October 2024 at the Faculty Hall, Main Building.

3. Institute Colloquium titled “Biology of brain tumours: mechanisms, signatures, and targets” delivered by Kumar Somasundaram, Department of Microbiology and Cell Biology, IISc,, on 26 November 2024 at the Faculty Hall, Main Building.

4. Institute Colloquium titled “Transformative strategies for the synthesis of complex natural products: Two decades of our continuing exploration” delivered by Kavirayani R Prasad, Department of Organic Chemistry, IISc,, on 22 January 2025 at the Faculty Hall, Main Building.

5. Institute Colloquium titled “Future of Mobility - Transition to Low Carbon Fuels & Technologies” delivered by RV Ravikrishna, Department of Mechanical Engineering, IISc,, on 19 February 2025 at the Faculty Hall, Main Building.

6. Institute Colloquium titled “Modelling Traveler Choices to Improve Transportation Systems” delivered by Abdul Rawoof Pinjari, Centre for infrastructure, Sustainable Transportation and Urban Planning (CiSTUP) and the department of Civil Engineering, IISc,, on 26 March 2025 at the Faculty Hall, Main Building.

Lectures

1. Institute lecture titled “What is the turbulence problem, and when may we regard it as solved?” delivered by KR Sreenivasan, Satish Dhawan Visiting Professor, Indian Institute of Science, University Professor and Eugene Kleiner Chair for Innovation, New York University on 3 May 2024 at Faculty Hall, Main Building.

2. Prof Roddam Narasimha Endowment Lecture titled “Transforming India into Aviation Power - Role of LCA programme” delivered by Kota Harinarayana, Chairman, Design division, Aeronautical Society of India, Chairman, Board of Governors, IIT (BHU) on 16 July 2024 at the Faculty Hall, Main Building.

3. Prof N R Kuloor Memorial Lecture titled “Movement of Neutral Molecules under Electric Fields and Relevance to Rechargeable Batteries” delivered by Nitash P Balsara, Chemical and Biomolecular Engineering Department, University of California, Berkeley, and Materials Sciences Division, Lawrence Berkeley National Laboratory, University of California, Berkeley on 6 August 2024 at the Faculty Hall, Main Building.

4. Institute Lecture titled “Secure and Resilient CPS for Smart Living: A Unified Data Science Approach” delivered by Sajal Das, Curators' Distinguished Professor and Daniel St Clair Endowed Chair, Department of Computer Science, Missouri University of Science and Technology, Rolla, USA, Infosys Visiting Chair Professor, IISc,, on 13 August 2024 at the Faculty Hall, Main Building.

5. Institute Lecture titled “On Some Quantum Internet Information Rates” delivered by Emina Soljanin, Distinguished Professor of Electrical and Computer Engineering, Rutgers, on 28 August 2024 at the Faculty Hall, Main Building.

6. Distinguished Lecture titled “Indian Agriculture: Achievements, Lessons, and Way Forward Towards a Sustainable Food System” delivered by Ramesh Chand, Member, NITI Aayog, Government of India, and Chair, Institute of Economic Growth, New Delhi on 27 September 2024 at the Faculty Hall, Main Building

7. Lecture on Constitution Day titled “Birds eye view of the Indian Constitution” delivered by Veeresh R Budihal, BA, LLB, PGDMLE, NLSIU on 26 November 2024 at the Faculty Hall, Main Building.

8. Prof CNR Rao Endowment Lecture titled “Non-mutual feelings, odd mechanics, and singular structures in nonequilibrium matter” delivered by Sriram Ramaswamy, Honorary Professor, Department of Physics, IISc, on 12 December 2024 at the Faculty Hall, Main Building.

9. Institute Lecture titled “A study of hydrological extremes from space” delivered by Venkataraman Laxmi, John L Newcomb Professor of Engineering, University of Virginia, Satish Dhawan Visiting Professor, Indian Institute of Science on 13 January 2025 at the Faculty Hall, Main Building

10. Institute Lecture titled “Searching for Dark Matter with the Universe's Highest-Energy Light” delivered by Prof. Tracy Slatyer Department of Physics, MIT on 16 January 2025 at the Faculty Hall, Main Building

11. Morris Travers Memorial Lecture titled “Why We Die: The New Science of Aging and the Quest for Immortality” delivered by Dr Venkatraman Ramakrishnan, Nobel Laureate, and Former President of Royal Society MRC Laboratory of Molecular Biology Cambridge, UK on 15 January 2025 at the AV Rama Rao Auditorium, Chemical Sciences Building, IISc.

12. Institute Lecture titled "On Teasing Out Causal Relationships in Travel Behaviour Analysis" delivered by Dr Chandra Bhat, University Distinguished Professor, The University of Texas at Austin, Satish Dhawan Visiting Chair Professor, IISc, on 05 February 2025 at the Faculty Hall, Main Building.

WORKSHOPS AND SEMINARS

Division of Biological Sciences

- RNA-Based Therapeutics, Short online course, Nov 2024 (BC)
- Immunocon 2024 Conference, Oct 2024 (DBG)
- Cryo-electron microscopy and 3D image processing (CEM3DIP), Conference, June 2024 (MBU)
- Food, Climate, and Health, Course, International, June 2024 (CES)
- Stem for Girls Programme, Workshop, Dec 2024 (CES)
- 10th Asia Pacific Worm Meeting, Conference June 2024 (CNS)
- EMBO Meeting on Neuropeptides and Behavioural Flexibility, Conference, June 2024 (CNS)
- 6th Bangalore Cognition Workshop (BCW24), Workshop, June 2024 (CNS)
- 1st Workshop on the Neuroscience of Consciousness, Workshop, June 2024 (CNS)
- Brain Cognition Workshop, June 2024 (CNS)

Division of Chemical Sciences

- The Symposium on Polaritonics for Next Generation Materials, European Materials Research Society (E-MRS) Spring Meeting. Strasbourg, France, May 2024 (IPC)
- IPC Inhouse Symposium, May 2024 (IPC)

Division of Physical and Mathematical Sciences

- Engineered 2D Quantum Materials, July 2024 (IAP)
- Second Meru combinatorics conference, June 2024 (MA)
- Discrete Integrable Systems, Workshop, Oct 2024 (MA)
- NCM workshop on Finite element analysis for variational problems, Workshop, July 2024 (MA)
- Engineered 2D Quantum Materials, Workshop, July 2024 (PHY)
- Local organiser of Frontiers in Particle Physics, Aug 2024 (CHEP)
- Frontiers in Particle Physics, Aug 2024 (CHEP)

Division of Electrical, Electronics and Computer Sciences

- AIML Workshop for Stanford Students, Sept 2024 (CSA)
- Bangalore Crypto Day, 2024 (CSA)
- Frontiers of Geometric Algorithms, 2024 (CSA)
- Art of Computing, 2024 (CSA)
- Winter School on Theory CS, 2024 (CSA)
- Frontiers of Geometric Algorithms, Workshop, 2024 (CSA)
- Theory CS Winter School, 2024 (CSA)
- Symposium on Emerging Worlds and AI, 2024 (CSA)
- Game Theory, Mechanism Design, and Artificial Intelligence Symposium, 2024 (CSA)
- Bangalore Crypto Day, July 2025 (CSA)
- Graph Theory and Related Algorithms, Aug 2024 (CSA)
- EECS Research Students Symposium, April 2024 (ECE)
- Theory and Practice of Multi-Party Computation Workshop (TPMPC 2025), Mar 2025 (CSA)
- International Conference on Signal Processing and Communications, July 2024 (ECE)
- Summer School of Photonics, July 2024 (ECE)
- Workshop on Intelligent Computing and Systems at the Edge (ICE), January 1 2024-25, (ESE)

Division of Mechanical Sciences

- Workshop on drone building and drone computing, Mar 2024-25 (AE)
- Analysis and Design of Composite Structures course taught at IISc-CCE 1 January – 31 May 2024 (AE)
- Analysis and Design of Composite Structures course taught at IISc-CCE, Aug 2024 – Dec 2024 (AE)
- AICTE Faculty Development Programme, 2024 (CE)

Division of Interdisciplinary Sciences

- Superconductivity and Nonreciprocity, Oct 2024 (CeNSE)
- Indian Conference on Vision, Graphics and Image Processing (ICVGIP), Dec 2024 (CDS)
- International Conference on Computer Vision and Image Processing (CVIP), Dec 2024 (CDS)
- Rotating Machinery Boot Camp-Pumps & Compressors, July-Sept 2024 (ICER)
- Rotating Machinery Boot Camp-Pumps & Compressors, Sept 2024 (ICER)
- Bioengineering-Plaksha University joint symposium, Oct 2024 (BE)
- IEEE International Conference on Signal Processing and Communications (SPCOM), July 2024 (RBCCPS)
- Cyber-Physical Systems Symposium (CyPhySS-2024), July 2024 (RBCCPS)

8.0

Other *Units*

8.1

Centre for Campus Management and Development (CCMD)

Estate Management is done by the Centre for Campus Management and Development (CCMD), which looks after maintenance of all the buildings, infrastructural needs, electrical requirements, 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 CCMD.

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 breakdowns in generators, transformers, high tension wires, low tension wires, water supply, and sanitation are addressed within 24 hours.

CCMD also looks after the Sewage Treatment Plant (STP), which recycles the sewage water to be used for gardens and flush tanks. A 24-hour maintenance and service centre is available along with staff to attend to minor complaints.

During the year 2024-25, the works completed, work in progress and new initiatives are as follows:

Works completed from April 1 2024 to March 31 2025

Sl no	Description of Works	Cost (Rs. in lakhs)	Area in Sq Mtrs
1	Upgradation of Cricket, Hockey and Football grounds in Gymkhana Premises at IISc	1770.72	
2	Repairing of 12.5MVA CGL make power Transformer	55.12	
3	Supply, Installation, Testing and Commissioning of Audio-Video system, Stage lighting and Curtains in TATA Auditorium (NSSC).	367.32	
4	Construction of Research Park (iHUB)	9771.43	
5	Providing Additional Classroom for PP School at IISc	19.72	
6	Renovation And Upgradation Of Newly Allotted Rooms From Old IPC Department (D-00, D-002, D-003 & C-008) For Department Of Mathematics	19.59	
7	Augmentation of power supply to the New BSL and Old CAF building	31.28	
9	Renovation works at Central Stores	37.82	
10	Renovation works for Open Circuit Wind Tunnel Building	61.21	
11	Reconstruction of damaged boundary wall and Raising of boundary wall with Solid Block Masonry at different stretches: From NSSC Auditorium gate to CBR gate, from HMT road to Main gate, near KV school, from Post office gate to Maramma circle gate, Security office gate to TPS pump house near Sadashiv Nagar police station and Fabrication and Chain Link fencing at 66KV IISc	195.79	
12	Renovation and Upgradation of Newly Allotted GATE office	59.69	
13	The Work of Providing Galvanized Sheet Roofing With Necessary M S Supports and other allied Work at ICWaR	15.22	
14	The work of providing replacement of Managalore concrete tiles, Waterproofing and other allied works at CPDM Department	17.08	
15	Construction of Light Weight Roofed Steel Structure for Facilitating Badminton Courts	70.34	
16	Upgradation of CCE Hall	24.00	
17	Renovation of Student Amenities Center (SAC) Gymkhana Premises	72.92	
18	Repairs, Re-surfacing of existing bituminous roads at IISc, Bangalore	372.41	

Works in-Progress during the year 2024-2025

Sl no.	Description of Works	Cost Rs (in lakhs)
1	Work of Construction, Supply, erection, testing and commissioning of 100 KLD capacity combined sewage/effluent treatment plant (CSETP) at Chemical science building, IISc, including Comprehensive operation and maintenance of CSETP for the period of 3 years after defect liability period of 1 year	184.15
2	Water Supply System Rehabilitation works for Smart Pumping Station (Phase II)	914.66
3	Proposed Second Floor For Annex Building Of CSA Department at IISc	250.69
4	Supply Installation Testing and Commissioning of Compact Substation for new buildings in IISc	535.23
5	Reconstruction of damaged boundary wall and Raising of boundary wall with Solid Block Masonry at different stretches: From NSSC Auditorium gate to CBR gate, from HMT road to Main gate, near KV school, from Post office gate to Maramma circle gate, Security office gate to TPS pump house near Sadashiv Nagar police station and Fabrication and Chain Link fencing at 66KV IISc	195.79
6	Construction of Modern Indoor Sports Complex at Gymkhana	11058.40
7	Supply Installation Testing and Commissioning of Compact Substation for new buildings in IISc Bangalore	535.23
8	Construction of 15 Passenger Lift and Associated RCC Deck slab and shaft work for IAP Annex Building	41.41

Sl no.	Description of Works	Cost Rs (in lakhs)
10	Renovation And Upgradation Of Newly Allotted Rooms From Old IPC Department (D-001, D-002, D-003 & C-008) For Department Of Mathematics	19.59
11	Augmentation of power supply to the New BSL and Old CAF Building	31.28
12	Construction of Additional Wing at Chemical Engineering Department at IISc	395.70
13	External Painting, laying of damaged plinth protection concrete water proofing treatment for arresting leakage from RCC Water tanks and roof of Old D Type Qtrs 40 Nos in IISc campus	43.30
14	External Repairs and External painting for old E Type quarters 32 Nos in IISc campus	42.42
15	Construction Of UTM, CMM Labs And Alternation Of Existing Rooms and Labs At New CST Building IISc	78.58
16	Construction of New Toilet Block, Providing and Laying Granite Stone Flooring Paver Blocks False Ceiling Waterproofing and Painting works and Electrical Renovation works etc at Centre for Cryogenic Technology CCT at IISc	44.85
17	Providing Terrace Floor Puff Shed, Additional water tank, water supply from existing tank, Lab Platforms, Aluminum Partition, waterproofing, other allied works including Electrical works at CAF Department at IISc	30.12
18	Renovation And Upgradation Of Newly Allotted Left Wing Of Ground Floor including Electrical work At ICWaR Department	29.92
19	Painting and other allied works including Electrical works for newly alloted OCCAP office in left and Right wing at old IPC Building at IISc	51.78
20	Repairs, Re-surfacing of existing bituminous roads at IISc	372.41
21	Renovation Of Medium Voltage Power Electronics Laboratory Near High Voltage Building IISc	110.58
22	The Work Of Renovation And Upgradation Of Washrooms Including Electrical Work At Ground Floor And First Floor Of SERC Department at IISc	29.74
23	Design, Supply, Installation of 12.5 MVA Power Transformer and associated works in 66 KV Main Receiving Station (MRS) at IISc	385.09
24	Extension of existing Tennis Court and provision of new acrylic cushion replacing old clay court	75.75

New Works Commenced during the year 2024-2025

Sl no.	Description of Works	Cost Rs (in lakhs)
1	Construction of 15 Passenger Lift and Associated RCC Deck slab and shaft work for IAP Annex Building	41.41
2	Renovation And Upgradation Of Newly Allotted Rooms From Old IPC Department (D-001, D-002, D-003 & C-008) For Department Of Mathematics	19.59
3	Augmentation of power supply to the New BSL and Old CAF building	31.28
4	Construction of Additional Wing at Chemical Engineering Department at IISc	395.70
5	External Painting, laying of damaged plinth protection concrete water proofing treatment for arresting leakage from RCC Water tanks and roof of Old D Type Qtrs 40 Nos in IISc campus	43.30
6	External Repairs and External painting for old E Type quarters 32 Nos in IISc campus	42.42
7	Construction Of UTM, CMM Labs And Alternation Of Existing Rooms and Labs At New CST Building IISc	78.58
8	Construction of New Toilet Block, Providing and Laying Granite Stone Flooring Paver Blocks False Ceiling Waterproofing and Painting works and Electrical Renovation works etc at Centre for Cryogenic Technology CCT at IISc	44.85
9	Providing Terrace Floor Puff Shed, Additional water tank, water supply from existing tank, Lab Platforms, Aluminum Partition, waterproofing, other allied works including Electrical works at CAF Department at IISc	30.12
10	Renovation And Upgradation Of Newly Allotted Left Wing Of Ground Floor including Electrical work At ICWaR Department	29.92
11	Painting and other allied works including Electrical works for newly alloted OCCAP office in left and Right wing at old IPC Building at IISc	51.78
12	Repairs, Re-surfacing of existing bituminous roads at IISc	372.41
13	Renovation Of Medium Voltage Power Electronics Laboratory Near High Voltage Building IISc	110.58
14	The Work Of Renovation And Upgradation Of Washrooms Including Electrical Work At Ground Floor And First Floor Of SERC Department at IISc	29.74
15	Design, Supply, Installation of 12.5 MVA Power Transformer and associated works in 66 KV Main Receiving Station (MRS) at IISc	385.09
16	Extension of existing Tennis Court and provision of new acrylic cushion replacing old clay court	75.75

8.2
Official Language Unit

Chair: Rajeev Ranjan

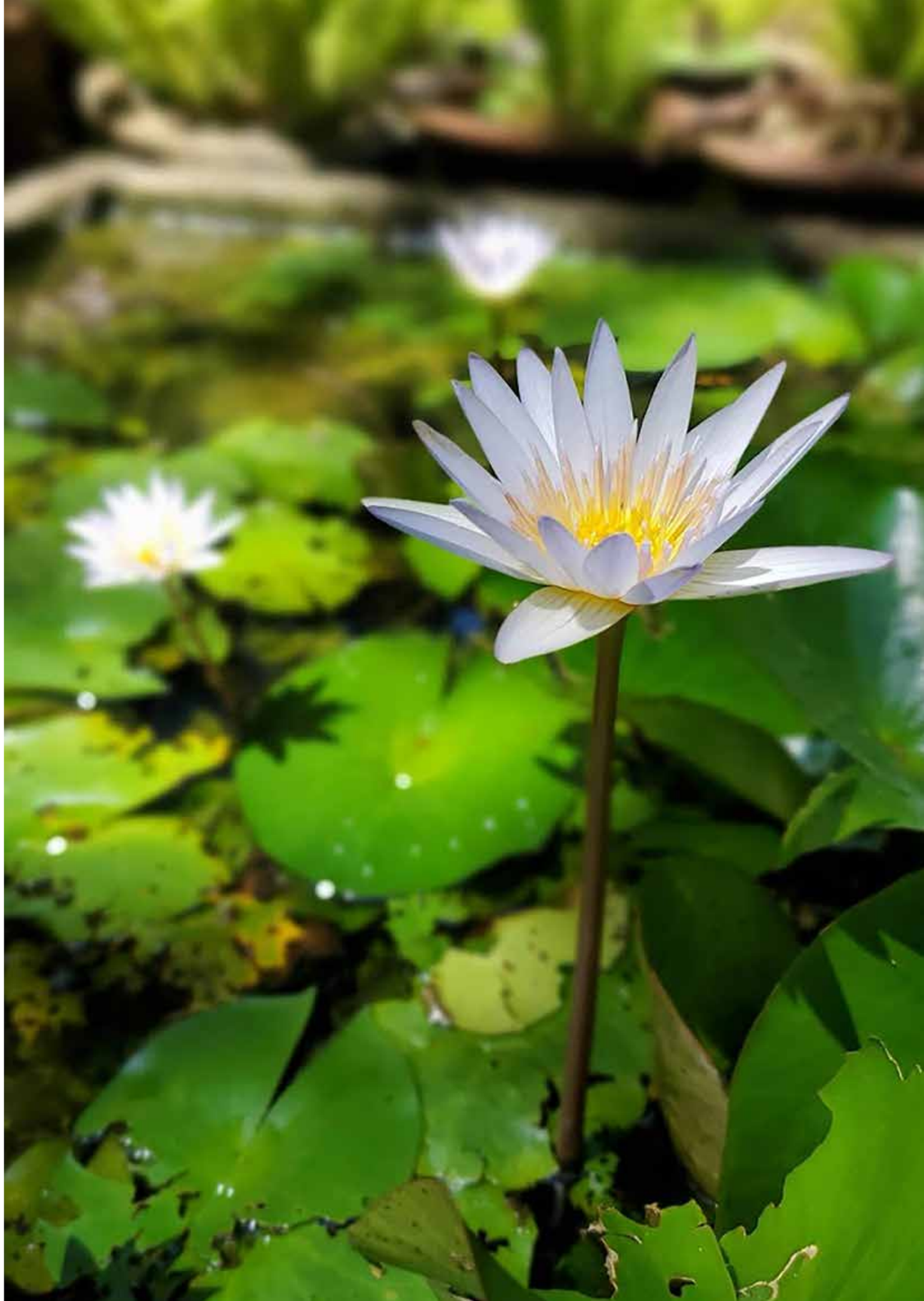
Hindi Workshop:

The Institute regularly organises Hindi Workshops on various aspects of the use of Hindi in Central Government Offices and conversation sessions for the benefit of the Institute staff. Staff from different Sections/Units of the Institute takes part in these workshops and are utilising the same in their offices. This year's workshop and discussion was organised and P Krishna, trustee of the Krishnamurti Foundation India (KFI), was invited at the campus. Various aspects of Science and Spirituality were discussed on an interactive basis. The workshop was highly appreciated by one and all.

Translation:
Hindi translation of other administrative manuals, forms and routine correspondence.

8.3
Public Information Office

The Institute adopted the Right to Information Act, 2005 in the year 2006. The Institute disseminates information through its website, which is accessible to the public. During the year, the public has made around 461 requests seeking information and prompt action has been taken and the applicants have been informed accordingly.



9.0

Campus *Facilities*

9.1
Health Centre

The Health Centre of the Indian Institute of Science, Bangalore, provides healthcare services to the campus community, comprising staff and students. A large number of staff members and their families reside on campus. Although small in relative terms, the Health Centre is well-equipped to perform a range of clinical investigations, offers outpatient care, and provides inpatient treatment.

The Health Centre provides Primary Health Care to the following categories:

- Staff and their dependents
- Students
- Pensioners and their spouses
- Family pensioners

The Health Centre offers round-the-clock outpatient, inpatient, and emergency care. Special care is available in the following specialties:

- General Medicine
- Gynaecology
- Dermatology
- Ophthalmology
- Cardiology
- Paediatrics
- Psychiatry

Consultants attend to cases referred by Medical Officers and Area Medical Officers on an appointment basis, as per their allocated time slots.

Facilities and Services

- **Dental Unit:** Provides preventive dental care, managed by a qualified dentist.
- **Physiotherapy Unit:** Fully equipped and operated by a qualified physiotherapist.
- **Pharmacy:** Stores and dispenses most required medications. It is fully computerised and procures medicines through a rate contract.
- **Clinical Laboratory:** Computerised and conducts both routine and special investigations.
  - Operating Hours:
    Monday to Saturday:
    8 am to 4 pm
    Sundays and Holidays:
    9 am to 4 pm
- **Operation Theatre:** Surgeries are performed under general, spinal, and local anaesthesia, depending on the case.
- **Radiology Department:**
  - Operates from 8 am to 8 pm
  - Routine X-rays and ultrasounds are conducted.
  - An Ultrasound Unit is operated daily by a Consultant Radiologist.
- **Emergency Care:**
  - Two emergency beds for day care
  - Ten general beds for inpatient cases
  - 24-hour ambulance service for outside referrals
  - A Night Duty Doctor is available for emergencies, particularly for students.

Staff Strength

- 4 permanent experienced doctors
- 5 Authorised Medical Officers handling outpatient, inpatient, and emergency care
- 6 Area Medical Officers serving staff residing outside the campus

Medicines and Prescriptions

- Most outpatient medications are dispensed directly at the Health Centre.
- For pensioners, unstocked medicines are prescribed for external purchase.
- For serving employees, such medicines are procured from M/s Emami Frank Ross Ltd and dispensed.
- Ayurvedic Healthcare is also available through recognised Ayurvedic practitioners on referral.

Student Medical Coverage

- Students are covered under the Student Medical Care Scheme.
  - Up to Rs 5,000/- per annum can be reimbursed for medical claims.
  - For major illnesses, inpatient treatment during 2024–2025 is covered under Group Medical Insurance up to Rs 3 lakhs per annum.

Staff and Pensioner Health Scheme

- Permanent staff and pensioners are members of the Contributory Health Service Scheme (CHSS).
- Staff and their dependents, pensioners and their spouses, and family pensioners are covered under Group Medical.

Insurance

- **Coverage:**
  Inpatient treatment for major illness is insured up to Rs 5 lakhs per family per annum.
  - Insurance Provider:
    M/s Go Digit Insurance Ltd, valid from 1.08.2024 to 31.07.2025.
  - Cashless treatment is available PAN-India at recognised hospitals under this scheme.

Administration

- The Health Centre Office handles all administrative work and correspondence related to healthcare services.

- Timings of Health Centre
  (i) 8 am to 2 pm
  (5 Doctors)
  (ii) 2 pm to 8 pm
  (2 Doctors)
  (iii) 8 pm to 8 am
  (1 Doctor)

- Ambulance / Nursing (24/7)
  No - 080 2293 2390/2006
- Reception No - 080 2293 2227

9.2
Recreational Facilities

9.2.1 Gymkhana

The Gymkhana at IISc serves as the central hub for student and official sports and cultural activities.

Facilities

The Gymkhana offers a wide array of facilities for both outdoor and indoor games, including:

- A well-equipped gymnasium
- Indoor badminton complex
- Billiards, carrom, and table tennis
- New football and hockey turf grounds
- Synthetic and clay tennis courts
- Swimming pool
- Volleyball and basketball courts

Beyond traditional sports, the Gymkhana supports various clubs, providing them with necessary facilities. These include:

- Frisbee
- Kung fu
- Kho-kho
- Kabaddi
- Throwball
- Handball

In addition, the Gymkhana supports numerous other clubs, fostering a diverse range of interests including:

- Nature club
- Dance club
- Aerobics club
- Yoga club
- Dramatic club
- Literary club
- Fine arts club
- Music club
- Fashion club
- Photographic club

In total, there are approximately 35 sports and cultural clubs operating under the Gymkhana.

Coaching Classes and Other Features

The Gymkhana also supports coaching classes in a variety of activities, such as:

- Badminton
- Tennis
- Swimming
- Kalaripayyatu
- Kung fu
- Football
- Table tennis
- Cricket
- Aerobics
- Yoga
- Zumba
- Dance

All sports grounds are equipped with floodlights.

The Raja Ramanna Student's Activity Centre (SAC) has undergone renovation and is available for cultural activities and other student activities. Additionally, the KV IISc ground is accessible for outdoor games from 4 pm to 10.30 pm, and the ground opposite SBI bank is also available for outdoor games, featuring cricket practice nets and box cricket.

Sports and Cultural Activities Conducted

The Gymkhana is a vibrant centre for numerous sports and cultural events:

- Sports clubs regularly organise annual intra/inter-college tournaments.
- The Rhythmica club hosts annual cultural events like "KHAYAL" and "BANDISH."
- Annual Gymkhana Sports meets include SPECTRUM, ECLIPSE, IDCC, Champions League, Freedom run, and Gandhi Jayanti sports meet.
- The Gymkhana assists in organising various intra-departmental and inter-college sports meets.
- The annual GSAC election has been conducted to elect student representatives who are the leaders of student-led activities.
- Workshops on Yoga and self-defence for women were also conducted.

IISc students achieved notable success in 2024, securing 2nd position in the Inter Institute Cultural Meet and 3rd position in the Inter Institute Sports Meet.

New Upgradation Works

Several new construction and upgrade projects are underway at the Gymkhana:

- Construction of a new indoor sports complex is ongoing within the Gymkhana premises.
- The existing clay tennis court is proposed to be converted into a hard synthetic court with new fencing and lighting.
- The indoor badminton court surface is proposed to be fitted with new HOVA mats.

9.2.2 Faculty Club

The Faculty Club serves as a hub for various recreational, social, and cultural activities exclusive to the club members at the Institute. It is a designated space where members can engage in leisurely pursuits and foster connections with fellow colleagues. Within the club, there is a library housing a collection of books and magazines carefully curated to provide a tranquil reading experience for members. To enhance the reading options available, new books have been added to captivate and stimulate the interests of avid readers among the club's members. This allows individuals to indulge in intellectual exploration and personal enrichment within the cosy lounge setting.

Recognising the importance of physical well-being, the Faculty Club offers a range of amenities to cater to the diverse interests of its members. These include recreational activities such as caroms, billiards, and table tennis, which provide opportunities for friendly competition and leisurely enjoyment. Additionally, there are television facilities for entertainment and relaxation. For those seeking a more active lifestyle, the club also provides a gym with various exercise equipment, encouraging members to maintain their fitness levels while enjoying the convenience and comfort of the club's premises.

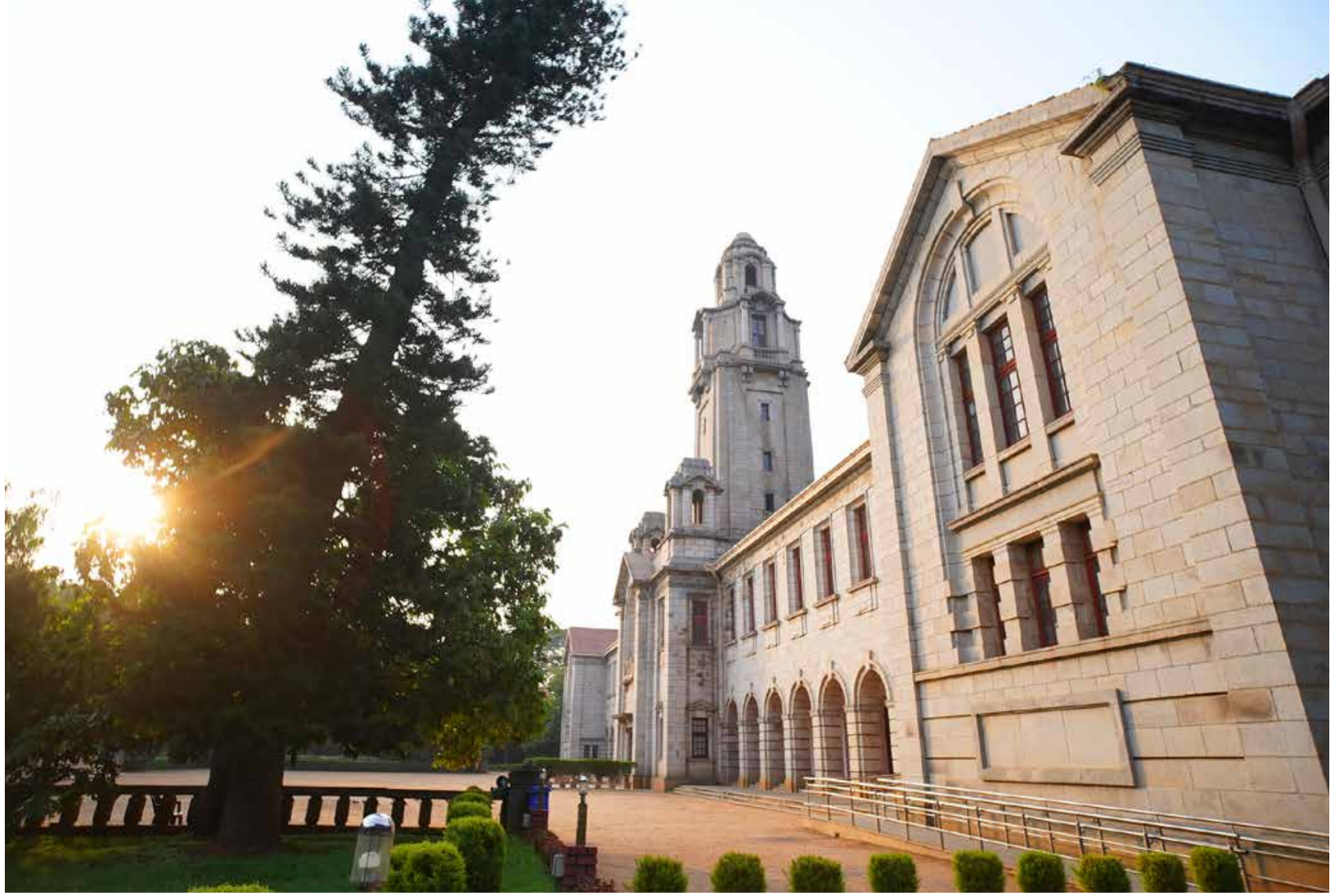
Catering to the dietary needs and preferences of its members, the Faculty Club offers dining facilities that serve fresh and wholesome vegetarian meals on a daily basis. These meals are carefully prepared to provide nourishment and ensure a balanced diet for the faculty and club members. During working hours, the club also offers tea, coffee, and different snacks, creating a pleasant and inviting environment for conversations and discussions. This not only fosters a peaceful atmosphere but also provides an opportunity for club members to engage in scholarly exchanges and share their research ideas, contributing to a collaborative and intellectually stimulating environment.

As part of its commitment to fostering a sense of community and celebration, the Faculty Club organises several annual events. One such event is the New Year Lunch, a cherished tradition that brings together all IISc Club members and their families. This festive occasion allows families and children to gather, enjoy a meal, and celebrate the beginning of a new year together. Additionally, retiring club members are regularly honoured and recognised for their contributions through a special high-tea event. This gathering, often graced by the presence of the Institute Director, provides an opportunity to express gratitude and appreciation for the valuable service and dedication of the retiring members. This year, the Faculty Club started a summer camp for the children of the members. The camp was conducted for a month-long activity in the summer holidays, which gave ample opportunities for the children to learn many skills, including dance, music, arts and crafts, exploring nature, watching birds and plants, visiting the library, gymkhana, etc. The camp was concluded with a valedictory function showcasing the talents of the children and the campus community.

In order to ensure transparency and accountability, the Faculty Club's financial accounts undergo a rigorous audit process. An external auditor from an agency is entrusted with reviewing the club's financial records for the 2024-2025 period. This comprehensive audit serves to ensure that the club's finances

are properly managed and adhere to established accounting practices, instilling confidence among club members and promoting responsible financial stewardship.

Recognising the need for improved facilities and infrastructure, the Faculty Club has put forth a proposal to the Institute administration. The proposal seeks to create a new building equipped with ultra-modern kitchen facilities and enhanced amenities that will benefit the club's members. This year, the entire Faculty Club building got a facelift with major maintenance works and painting. By providing better facilities, the club aims to offer an elevated experience and meet the evolving needs and expectations of its discerning membership. This endeavour underscores the commitment of the Faculty Club to continuously improve and provide a conducive environment that promotes the well-being and satisfaction of its members.



9.2.3 Tata Memorial Club

The Tata Memorial Club (TMC) serves as a vibrant hub for recreational, cultural, and educational activities for the staff and community of the Institute.

The Club provides space and facilities for a variety of indoor and outdoor games, and regularly organises training in various dance forms, musical instruments, yoga, meditation, and sloka chanting for members, students, and their dependents.

Tuition classes are conducted with the support of student volunteers for the children of needy families, and the Club also provides essential engineering and medical textbooks for such children. TMC maintains a well-stocked library and offers a gym facility to the TMC Institute community. Regular blood donation camps are organised in collaboration with the Students' Council, the Lions Club, and the Red Cross Society.

Sports tournaments such as cricket, carrom, badminton, and table tennis are conducted for staff members.

In the year 2024–25, TMC successfully organised a Retirement Function in July, a Blood Donation Camp in August, and a grand Dasara celebration in October.

For the first time, an auction-based cricket tournament and a treasure hunt event were introduced, both receiving enthusiastic participation.

TMC also celebrated Karnataka Rajyotsava with a vibrant cultural event and distributed prizes to all winners, runners-up, and participants of various games and activities.

Additionally, TMC introduced Bookoholics, a new initiative under the library programme where book enthusiasts come together for reading sessions and discussions.

Guitar classes were also launched this year, which have been well-received by young music lovers in the community.

9.3
Auditoria

9.3.1 National Science Seminar Complex

The magnificent National Science Seminar Complex, situated in the IISc Campus, is the first of its kind in India. The complex is open for seminars, symposia, workshops and conferences organised by recognised scientific societies, educational institutions and professional bodies. The total built up area measures around 5750 sq. Meters.

This is fully air-conditioned complex, houses the JN Tata Auditorium with a seating capacity of 750 and 3 mini seminar halls, Hall- A with 120 seating capacity, Hall- B with 90 and Hall- C with 60 seating capacity. It is having an Exhibition ground to conduct poster sessions and exhibitions. Interactive concourses at the basement and ground level with excellent light and sound facilities are part of the seminar complex. The dining area at basement is available for catering 250.

9.3.2 Prof Satish Dhawan Auditorium

Located on the first floor of the Centre for Scientific and Industrial Consultancy (CSIC), this is a medium sized auditorium, which is having a seating capacity of 250. It is having fixed seats and a dais suitable for conferences and the complex is open for seminars, symposia, workshops and conferences organised by recognised scientific societies, educational institutions and professional bodies. It is fully air-conditioned and is adequately equipped with sound, lighting and projection equipment.

9.3.3 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.

- Beauty Parlour (1)
- Gents Hair Stylists (2)
- Diary outlet (1)
- Bakeries (2)
- Laundry and Dry Cleaners (2)
- Tailoring Shops (2)
- Food Courts (5)
- Fruit Stall & Juice Centre (1)
- Courier & Mobile Services shop (1)
- Photocopying and DTP Centers (2)
- General Stores (2)
- Student council (1)
- Campus Book Store (1)
- Photo Studio (1)
- Cable Network Providers (1)
- Internet Service Providers (1)
- Restaurants (1)
- Play School (1)
- Super Market (1)
- Cycle repair shops (2)
- Medical Shop (1)
- Creche (2)
- Mobile Food Van (1)
- Departmental Eateries (6)

Communications: Post Office (Science Institute, Bangalore – 560 012), Telecom Centre and STD booths. The Institute is connected by the Centrex Exchange from BSNL with **1775 extensions.** In addition, there are nearly **350 direct lines** to different departments and centers. **IISc has set up a helpline extension 5555 for reporting any emergency.**

Centralised electronic franking takes care of outward postage. The CMC section maintains a fleet of service vehicles through approved travel agencies.

Bank: Canara Bank and State Bank of India have fully computerised branches with many facilities including foreign exchange transactions and ATM machines.

10.0

Endowed

Chairs

10.1

Endowed Chairs for Faculty

A number of Endowed Chairs have been instituted in recent years to recognise the outstanding contribution of Institute faculty members.

YEAR	NAME	DEPARTMENT
ABB CHAIR		
2012-15	PS Sastry	EE
2015-18	K Gopakumar	ESE
2018-21	L Umanand	ESE
2022-24	G Narayanan	EE
2025-27	Udaya Kumar	EE
AMRUT MODY CHAIR		
2015-18	Binny J Cherayil	IPC
2018-21	Aninda J Bhattacharyya	SSCU
2022-24	Balaji R Jagirdar	IPC
2025-27	Satish Amrutrao Patil	SSCU
ASTRA CHAIR		
2012-15	Sandhya S Visweswariah	MRDG
2015-18	C Jayabaskaran	BC
2018-21	Dipshikha Chakravortty	MCB
2022-24	Aditya Murthy	CNS
2025-27	Pundi N Rangarajan	BC
HAL CHAIR		
2017-18	KPJ Reddy	AE
2018-21	Debasish Ghose	AE
2022-25	Radhakant Padhi	AE
2025-28	Debiprosad Roy Mahapatra	AE
J N TATA CHAIR		
2017-20	DD Sarma	SSCU
2020-23	Umesh Varshney	MCB
2023-26	Usha Vijayraghavan	MCB
JRD TATA CHAIR		
2017-20	V Kumaran	Chemical Engg
2020-23	Pradeep Dutta	ME
2023-26	Arindam Ghosh	Physics
HOMI BHABHA CHAIR		
2017-20	Sriram Ramaswamy	PHY
2020-23	SK Satheesh	DCCC
2023-26	Mahesh Ramesh Kakde	Maths

YEAR	NAME	DEPARTMENT
KSIIDC CHAIR		
2012-15	PP Mujumdar	Civil
2015-18	TG Sitharam	Civil
2018-21	SGopalakrishnan	Aerospace
2022-24	SDasappa	CST
2025-27	Saptarshi Basu	ME
MSIL CHAIR		
2012-15	Chanda J Jog	PHY
2015-18	B Ananthanarayan	CHEP
2015-18	Vasant Natarajan	PHY
2018-21	S Asokan	IAP
2023-24	Apoorva D Patel	CHEP
2025-27	Jaydeep Kumar Basu	PHY
SATISH DHAWAN CHAIR		
2012–15	KPJ Reddy	AE
2015-18	Ranjan Ganguli	AE
2018-21	D Nagesh Kumar	CEaS/CiE
2022-24	Ashitava Ghosal	ME.
2025-28	Radhakant Padhi	AE
TATACHEM CHAIR		
2012–15	P Vijay Kumar	ECE
2015-18	N Surya Prakash	NMRC
2018-21	Vinod Sharma	ECE
2022-24	Chiranjib Bhattacharyya	CSA
2025-27	Jayaraman N	OC
RAMAKRISHNA RAO CHAIR		
2014-17	Srinivasan Raghavan	CeNSE
2017-20	Ambarish Ghosh	CeNSE
2020-23	Shankar Kumar Selvaraja	CeNSE
2024-26	Akshay Naik	CeNSE
PRATT & WHITNEY CHAIR		
2016-18	Gopalan Jagadeesh	AE
2018-21	R V Ravikrishna	ME
2022-23	Saptarshi Basu	ME
2025 -26	Ratnesh K Shukla	ME
REVATI & SATYANADHAM ATLURI CHAIR		
2018-21	Rishikesh Narayanan	MBU
2021-24	Amit Singh	MCB
2025-27	Aravind Penmatsa	MBU
MINDTREE CHAIR		
2018-21	Vijay Natarajan	CSA
2022-24	Uday Kumar Reddy B	CSA
2025-27	Siddharth Barman	CSA

YEAR	NAME	DEPARTMENT
DRDO CHAIR		
2018-21	D Roy Mahapatra	AE
2018-21	Saptarshi Basu	ME
GORE SUBRAYA BHAT CHAIR		
2021-24	Sai Siva Gorthi	IAP
2024-27	Sridharan Devarajan	CNS

10.2
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 VISITING CHAIR PROFESSOR		
2015	Tamas Ungar	Eotvos University, Budapest, Hungary
2015-16	Kannan M Krishnan	University of Washington, Seattle, USA
2016	Jiang-Zhong Jiang	Zhejiang University, Hangzhou, PR China,
2016	Tamas Ungar	Eotyos University, Budapest, Hungary
2016	David P Field	Washington State University, Pullman, USA
2016-17 2017-18	Surya R Kalidindi	George W Woodruff School of Mechanical Engineering, Atlanta, USA,
2017	Jerzy Antoni Szpunar	Univ. of Saskatchewan, Saskatoon, Canada
2017	David P Field	Washington State Univ., Pullman, USA
2017-18	Sridhar Seetharaman	Colorado School of Mines Golden, USA
2018	Hamish L Fraser	Dept. of Materials Science & Engg, The Ohio State University, Columbus
2018	Manoj Gupta	National University of Singapore
2019	Sergiy Divinskyi	University of Munster, Germany
2019	Werner Skrotzki	Dresden University of Technology, Germany
2019	Shervanthi Homer Vanniasinkam	University College London, UK
2020	Maria Teresa Perez-Prado	IMDEA Materials Institute, Madrid, Spain
2022	Apparao Mohan Rao	Clemson University, Clemson, South Carolina
2022	Shigeru Ueda	Tohoku University, Institute of Japan
2024	Easo P George	University of Tennessee
2024	Maria Teresa Perez-Prado	IMDEA Materials Institute, Madrid Spain
SATISH DHAWAN VISITING CHAIR PROFESSOR		
2015	Tribikram Kundu	University of Arizona, Tucson, AZ
2016	P Guruswamy	Ames Research Center, California, USA
2016-17	DS Naidu	University of Minnesota, USA
2017	Garry L Brown	Princeton University, Princeton, NJ
2017	Rama K Yedavalli	The Ohio State University, Columbus, USA
SATISH DHAWAN (IoE) VISTING CHAIR PROFESSOR		
2019	Siva Athreya	Indian Statistical Institute, Bangalore
2019	Arun Shukla	Univ of Rhode Island, USA
2019	Murugesu Sivapalan	Univ of Illinois at Urbana-Champaign, USA
2019	Prasad Tetali	Georgia Institute of Technology, USA
2019	Rajesh P N Rao	Univ of Washington, USA
2019	Rao R Tummala	Georgia Institute of Technology, USA
2019	Sajal K Das	Missouri Univ of Science and Technology
2019	Ramachandra Guha	Historian and Sociologist
2019	Ravinder S Dahiya	University of Glasgow
2020	Sargur N Srihari	University of Buffalo, USA
2020	Daniel Wyler	University of Zurich, Switzerland
2020	Giancarlo D'Ambrosio	INFN Sezione di Napoli
2020	Sougato Bose	University College London
2020	Samir D Mathur	The Ohio State University
2020	Pavithra Prabhakar	Kansas State University
2020	V Parameswaran Nair	City College of the CUNY
2020	Nandini Trivedi	The Ohio State University
2020	Herbert Levine	Northeastern University
2020	Elisabeth Guazzelli	Universite de Paris
2020	Aparna Bhaskaran	Brandeis University
2020	Allan R Pinhas	University of Cincinnati
2021	Pranav Soman	Syracuse University
2021	Pandurangan C	Indian Institute of Technology Madras
2021	K V Venkatesh	Indian Institute of Technology Bombay
2021	Mukesh Jain	McMaster University
2021	Bharat Bhushan	The Ohio State University
2021	Srihari Keshavamurthy	Indian Institute of Technology Kanpur
2021	Ing. Lucienne Theresia Maria Blessing	Singapore University of Technology and Design (SUTD)
2022	Sridhar Kota	University of Michigan
2022	Shyni Varghese	Duke University
2022	Satish Nagarajaiah	Rice University
2022	A R Ravishankara	Colorado State University
2022	Latha Venkataraman	Columbia University
2022	Satyandra K Gupta	University of Southern California
2022	Andy Ruina	Cornell University
2022	Govindaraju S Rao	Purdue University
2022	Vinaya Simha	Mayo Clinic
2022	Ana Mijic	Imperial College London
2023	Sarthak Misra	University of Twente
2023	Gregory A Voth	University of Chicago
2023	Rajendra Kumar Bordia	Clemson University
2023	Carla V Rothlin	Yale University
2023	Prakash Narayan	University of Maryland

YEAR	NAME	DEPARTMENT
2024	K R Sreenivasan	New York University
2024	C M Chandrashekar	The Institute of Mathematical Sciences
2024	Chandra R Bhat	The University of Texas at Austin
2024	Arun Yethiraj	University of Wisconsin
2024	Jonathan Louis Bamber	University of Bristol
2024	Eung Jin Chun	Korea Institute for Advanced Study
2024	Aruna Sivakumar	Imperial College, UK
2024	Adimurthi Adi	Indian Institute of Technology, Kanpur
2024	Tracy Slatyer	Massachusetts Institute of Technology
2024	Murthy S Gudipati	California Institute of Technology
2024	Aravind Rao	University of Michigan Medical School
2024	Kasthuri Venkateswaran	Jet Propulsion Laboratory, U.S.A.
2024	V John Mathews	Oregon State University
2025	Venkataraman (Venkat) Lakshmi	University of Virginia
SUNDARARAJAN CHAIR		
2015	Uma Das Gupta	Kolkata
2019 - 2020	Chintan Vaishnav	MIT Sloan School of Management, Cambridge
2024-25	Elisabeth Eppinge	University of Applied Sciences for Technology and Economics, Berlin
PRATT & WHITNEY VISITING CHAIR PROFESSOR		
2015	Ravi N Banavar	IIT Bombay
2018	A M Rajendran	University of Mississippi, USA
2023	S Chandrasekar	Purdue University
DST-IISC CENTENARY CHAIR		
2015	Ramesh Narayan	Harvard University, USA
2015	Jainendra K Jain	Pennsylvania State University, USA
2015	William A Goddard	Caltech, California, USA
2017	Allan Peter Young	Univ of California, USA
2017	Richard N Zare	Stanford University, Stanford, CA
BHARAT ELECTRONICS CHAIR		
2016	Goutam Chattopadhyay	Jet Propulsion Lab, USA
SMT. RUKMINI – SHRI GOPALAKRISHNACHAR DISTINGUISHED CHAIR		
2015	Michael L Norman	University of California, San Diego, USA
2016	Rakesh Agrawal	Microsoft Research, Redmond, USA
2018	Sargur M Srihari	State University of New York, Buffalo, NY, USA
2022	Murali Annavaram	University of Southern California
2023	Chandra Chekuri	University of Illinois
2024	Laxmi Parida	IBM T J Watson Research Centre
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2023-2026	Barbara Shinn-Cunningham	Carnegie Mellon University
SMT. SUDHA MURTHY DISTINGUISHED VISITING CHAIR		
2016-2019	Vasant Honavar	Pennsylvania State University, USA
2023-2026	Maneesh Sahani	University College of London

YEAR	NAME	DEPARTMENT
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2021	Sachin Deshmukh	Wellcome Trust/DBT Intermediate Fellow
2022	Rajesh P N Rao	University of Washington
INFOSYS VISITING CHAIR		
2016-2020	Jainendra K Jain	Pennsylvania State University, USA
	Susanne C Brenner	Louisiana State University, USA
	Aneesh V Manohar	University of California, USA
2018	Xerxes Tata	Dept. of Physics & Astronomy, Univ. of Hawaii at Manoa, USA
2018	Harald Upmeier	Dept. of Mathematics and Computer Science, Philipps-Universitat Marburg, Germany.
2019	Harald Upmeier	Dept. of Mathematics and Computer Science, Philipps-Universitat Marburg, Germany.
2019	David Logan	Physical and Theoretical Chemistry Laboratory, Univ. of Oxford, UK
2019	Guy Theraulaz	Centre de Recherches sur la Cognition Animale, Universite Paul Sabatier, France.
2019	Vyjayanthi Chari	University of California, USA
2019	Girish S Agarwal	Texas A&M University, USA
2019	Mohit Randeria	The Ohio State University
2019	Roland R Netz	Frie Universitat Berlin
2019	Ananth Grama	Purdue University
2019	James A D Connolly	Swiss Federal Institute of Technology
2019	Swapan Chattopadhyay	Fermi National Accelerator Laboratory
2020	Yuval Gefen	The Weizmann Institute of Science
2020	Ueli Grossniklaus	University of Zurich
2020	Ashoke Sen	Harish-Chandra Research Institute, Allahabad
2020	Ramanujan Hegde	MRC Laboratory of Molecular Biology, Cambridge, UK.
2020	Venkatesh Kodur	Michigan State University
2022	A R Ravishankara	Colorado State University
2022	Je-Geun Park	Seoul National University
2022	Jean-Pascal Sutter	LCC-CNRS France
2023	Arif Babul	University of Victoria, Canada
2024	Pawan Kumar	University of Texas, Austin
2024	Sajal Das	Missouri University of Science and Technology, Rolla
2024	Eric Laenen	University of Amsterdam
MRS. URMILA AGRAWAL IISc DISTINGUISHED VISITING CHAIR PROFESSOR		
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2023-24	Emina Soljanin	The State University of New Jersey
DR. RAM KUMAR IISc DISTINGUISHED VISITING CHAIR PROFESSORSHIP		
2022-24	Ingrid Hotz	Linköping University
2024-25	Geert Leus	Delft University of Technology, Netherlands

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