Indian Institute of
Space Science and Technology

ANNUAL REPORT

2019-2020

Annual Report

2019-2020

Indian Institute of Space Science and Technology

Declared as Deemed to be University under Section 3 of the UGC Act, 1956

An autonomous institute under Department of Space, Govt. of India

Valiamala P O, Thiruvananthapuram - 695 547, Kerala

www.iist.ac.in

Vision & Mission

Vision

To be a world class educational and research institution contributing significantly to the Space endeavours.

Mission

- ❖ Create a unique learning environment enriched by the challenges of the Space Programme.
- ❖ Nurture the spirit of innovation and creativity.
- ❖ Establish Centres of Excellence in niche areas.
- ❖ Provide ethical and value based education.
- ❖ Promote activities to address societal needs.
- ❖ Network with national and international institutions of repute.

Key Functionaries

Dr. K. Sivan
President, IIST Governing Body
Chairman, IIST Governing Council
Secretary, DoS / Chairman, ISRO

Dr. B. N. Suresh
Chancellor

Dr. Vinay Kumar Dadhwal
Director &
Chairman, Board of Management

Prof. Y V N Krishna Murthy
Senior Professor &
Registrar

Prof. A. Chandrasekar
Dean
(Academic &
Continuing Education)

Prof. Raju K. George
Dean
(Research & Development, IPR)

Prof. Kuruvilla Joseph
Dean
(Student Activities,
Student Welfare &
Outreach Programme)

CONTENTS

FOREWORD >>> Dr. V. K. Dadhwal, Director

The financial year 2019-2020 brought accolades and progress of several kinds to the institute, but ended with the melancholy of the pandemic. I am proud to present this annual report depicting the advancements in the areas of academics and research. The students, staff and faculty have raised the bar of excellence in every passing year with the continuous encouragement of our leaders.

The institute continued to get the inspirational leadership and support of Dr. B N Suresh, Chancellor, IIST and Dr. K Sivan, President, Governing body, IIST. The opening up of the space sector throws up several new opportunities and the reforms and framework we setup now would help us reap the maximum benefits. The institute gratefully acknowledges our leaders' sincere efforts in guiding us to develop systems of excellence in academics and research, equipping us to deal with the emerging scenarios.

IIST continued to have its good standing in the NIRF ranking at 33 among the institutions in the engineering category.

As a milestone in our growth, the Advanced Retarding potential analyser for Ionospheric Studies, ARIS was launched using the PS4 platform by ISRO. This experiment gave very high quality data output and the success boosted the confidence of the students and the faculty to undertake similar missions in the future.

Several infrastructure projects were initiated and completed during this time. The student activity centre, the rain water harvesting project and several new labs in the Avionics and the Interdisciplinary blocks are a few to mention.

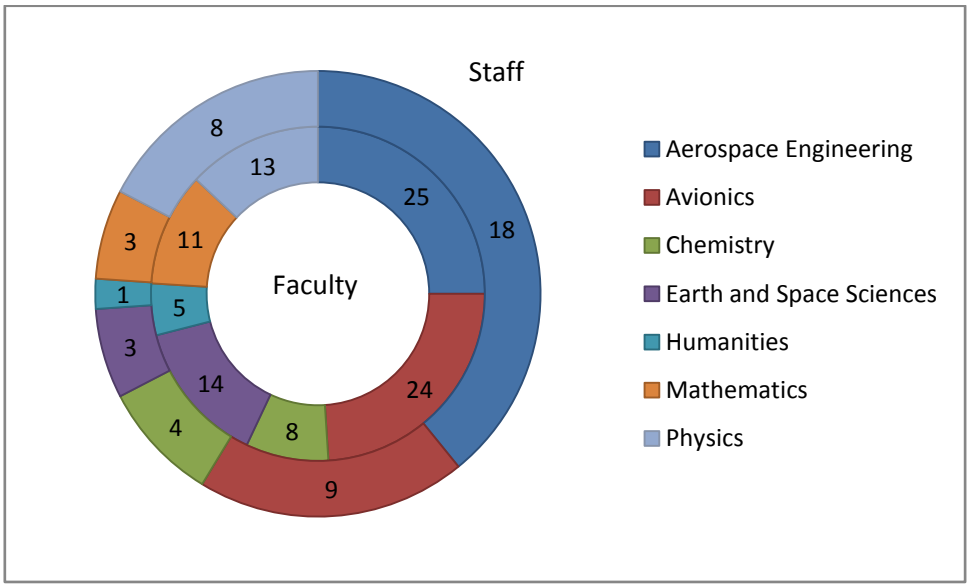
IIST graduated 114 B.Tech, 71 M.Tech and 14 Ph.D candidates in the 7th convocation conducted on 5th July, 2019. The Institute admitted 154 B.Tech, 92 M.Tech and 44 Ph.D students this year. ISRO offered placement for 106BTech and dual degree graduates.

The institute adapted to the COVID pandemic disruption by continuing the curricular activities through the online classes. How technology can act as a bridge in a difficult time is amply demonstrated during the pandemic and our determination to excel and solve many societal problems through technology development is stronger than ever.

IIST AT A GLANCE 2019-20

Departments and its Strength

Department	Academic Faculty	Technical/Scientific Staff
Aerospace Engineering	25	18
Avionics	24	9
Chemistry	8	4
Earth and Space Sciences	14	3
Humanities	5	1
Mathematics	11	3
Physics	13	8

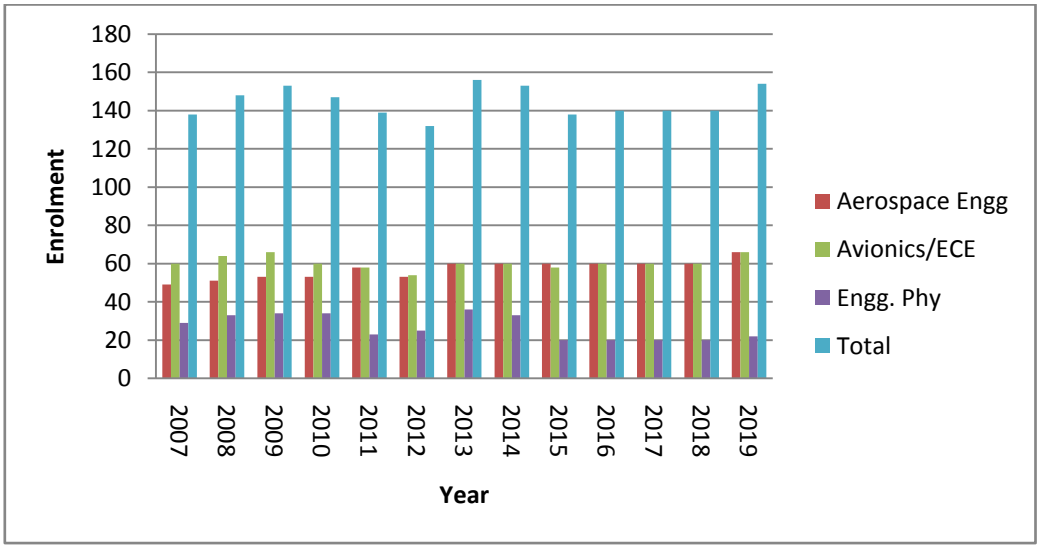


Administration

Officers	14
Administrative staff	9

B.Tech (Year Wise Enrolment)

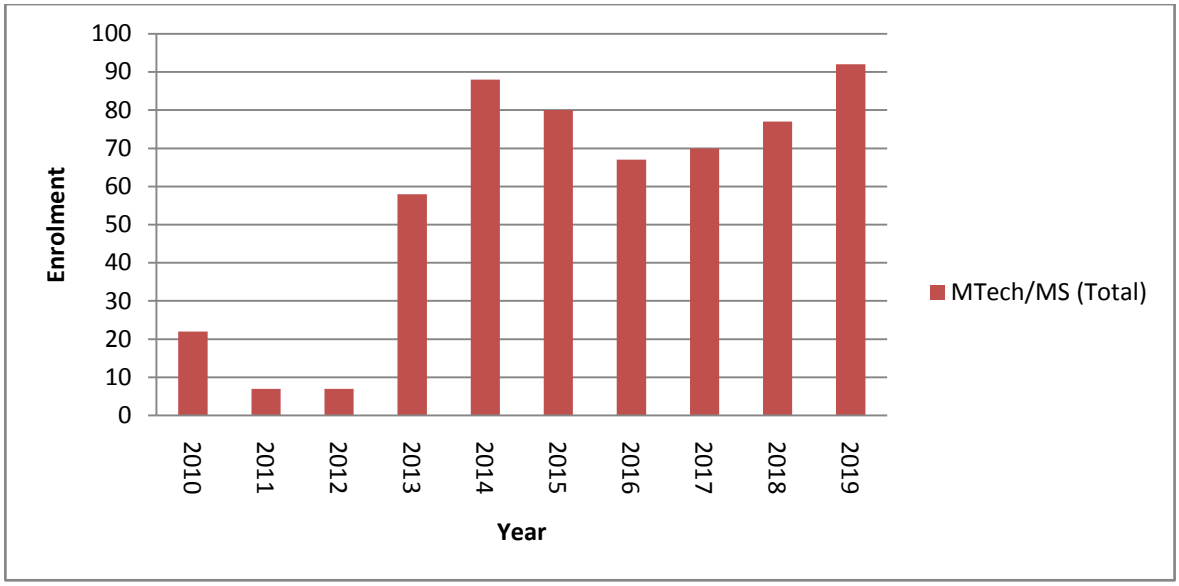
Admission Year	Aerospace Engineering	Avionics/ECE	Physical Science/Engineering Physics	Total
2007	49	60	29	138
2008	51	64	33	148
2009	53	66	34	153
2010	53	60	34	147
2011	58	58	23	139
2012	53	54	25	132
2013	60	60	36	156
2014	60	60	33	153
2015	60	58	20	138
2016	60	60	20	140
2017	60	60	20	140
2018	60	60	20	140
2019	66	66	22	154
Total	743	786	349	1878



M.Tech. (Year Wise Enrollment)

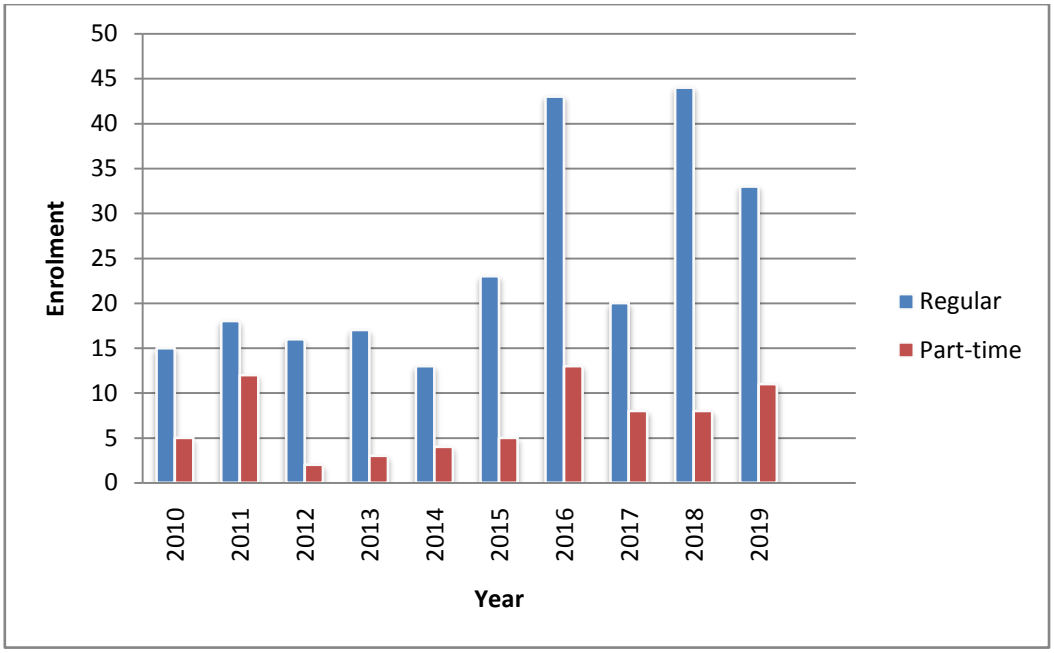
Admission Year	Maths	Physics		Chemistry		Earth & Space Sciences			Aerospace Engineering			Avionics					Total
	SC & ML	OE	SST	CS*	MST	ESS	GI	A & AP	A&FM	T&P	S&D	CS	DSP	PE	VLSI & MS	RF &ME	
2010	14			8													22
2011	2			5													7
2012	3			4													7
2013	4	5	3	-	3		3	4	4	7	3	6	6		4	6	58
2014	6	6	4	-	7	5	5	4	7	8	8	6	8		7	7	88
2015	4	5	5	-	6	3	5	6	7	7	8	5	5		9	5	80
2016	5	5	5	-	6	4	4	5	3	4	5	3	6	4	3	5	67
2017	6	1	0	-	6	3	5	3	6	7	8	5	2	5	8	5	70
2018	5	3	0	-	6	4	8	3	6	8	6	7	5	6	6	4	77
2019	8	5	5	-	7	6	5	4	7	6	7	7	7	6	7	5	92
Total	57	30	22	17	41	25	35	29	40	47	45	39	39	21	44	38	569

(**SC& ML**- Machine Learning and Computing, CS*- Chemical Systems(discontinued) **OE**- Optical Engineering, **SST**- Solid State Technology, **MST**- Materials Science and Technology, **ESS**- Earth System Sciences, **GI**- Geoinformatics, **A&AP**- Astronomy and Astrophysics, **A&FM**- Aerodynamics and Flight Mechanics, **T&P**- Thermal and Propulsion, **S&D**- Structures and Design, **CS**- Control Systems, **DSP**- Digital Signal Processing, **PE**- Power Electronics, **VLSI & MS-** VLSI and Microsystems, **RF&ME**- RF & Microwave Engineering)



PhD (Year Wise Enrollment)

Admission Year	Students Admitted	
	Full Time	Part Time
2008	0	1
2009	0	2
2010	15	5
2011	18	12
2012	16	2
2013	17	3
2014	13	4
2015	23	5
2016	43	13
2017	20	8
2018	44	8
2019	33	11
Total	242	74
Grand Total	**316**	



Other Details

NIRF Rank 2019	33
Post Doctoral Scholars	3
No. of Research Projects	64
No. of Journal Papers	142
No. of Conference Papers	127
No. of Books Published	6
No. of PhD Thesis Accepted	14
No. of Patents (Applied / Granted)	5 (4+1)
Visit Abroad (Faculty)	20
Visit Abroad (Students)	14
Placement (B.Tech- ISRO)	106
Placement (M.Tech- Placement Cell)	12
MoUs signed	7
New Books/E-books/Reports Added in the library	5421

RTI Status

From April, 2019 to March, 2020 (Decentralised the processing of applications under RTI and CPIO, IIST has been disseminating the information directly to the applicants)

Application Received	Information given	Appeal	CIC Hearing
61	61	4	Nil

Vigilance Status

Number of Vigilance Cases : NIL


विज्ञान खंड
SCIENCE BLOCK

1. THE INSTITUTE

Indian Institute of Space Science and Technology (IIST), situated at Thiruvananthapuram, a Deemed to be University under Section 3 of the UGC Act 1956, established by Department of Space (DoS), Government of India, in 2007 has moved to its thirteenth year with renewed vigour and achieving several milestones. IIST offers various undergraduate and postgraduate programmes in areas that are relevant to space studies. The academic programmes have been envisioned to strengthen the fundamentals, experience the realities through practical work, and enhance the knowledge and understanding in the areas relevant and related to space. The major feature of the undergraduate program is the liberal offer of assistanceship to meritorious students, rendering the education "completely free", to those students securing a stipulated minimum academic requirement. These students on completion of the degree are absorbed by various centers and labs of ISRO/DoS.

The institute is the first of its kind in the country, to offer high quality education at the undergraduate, graduate, doctoral and post-doctoral levels on areas with special focus to space sciences, space technology and space applications. The past review headed by Dr. P S Goel, Former Secretary, Ministry of Earth Sciences, Govt. of India had lauded the research activities going on in IIST and emphasized the need to have more focused research, seamlessly integrating with the research activities of ISRO.

The institute recognizes the importance of research in developing future technologies and applications of space research. IIST encourages all its faculty members to guide and supervise young scholars for the PhD programme as well as for Post-Doctoral programmes. The major theme of our research portfolio is the application of cutting - edge science to generate new technology. The style of research in IIST is both theoretical as well as richly experimental, and the institute is setting up state-of-the-art facilities in all departments to support its research activities. The Institute is focused on strong interdisciplinary and collaborative work both within the various departments and across the various centres of ISRO, which will help to generate excellent technologies responding to the need of local, national and global interest. IIST also encourages its faculty to closely collaborate with scientists/engineers from ISRO/DoS through joint research projects funded by the institute and also encourages its faculty to write research proposals for funding from external sources. IIST also has a number of international collaborations, both as MOU at the level of institute and faculty-to-faculty collaboration.

Road Map of IIST

With more than 10 yrs of success and achievements, IIST, has created a draft roadmap for the next decade focussing on Basic Research for Space Sciences, Space Technology and Applications, Education, Infrastructure, Governance and Collaboration. This strategic plan identifies the means by which the institute intends to advance in the coming year and establish itself as an Institute of National importance. IIST would also be the 3rd centre of the UN training centre and this is expected to provide an international outreach in areas of remote sensing, development of small satellites, satellite and lightwave communications, sensors and so on.

NIRF 2020

In the year 2019-20, according National Institutional Ranking Framework (NIRF) set up by the Ministry of Human Resource Development (MHRD), Government of India, IIST was ranked as 33rd in the Engineering category in year 2020 among all Engineering institutions in the country.

The composition of the statutory bodies of the institute is summarized here.

1.1 THE GOVERNING BODY

K. Sivan	Secretary, DOS /Chairman ISRO President
Anoop Srivastava	Joint Secretary & FA,DOS
R. Umamaheswaran	Scientific Secretary ISRO Headquarters
S. Somanath	Director, VSSC
V. Narayanan	Director, LPSC
D. K. Das	Director, SAC
Santanu Chowdhury	Director, NRSC
Vinay Kumar Dadhwal	Director, IIST Secretary

1.2 IIST GOVERNING COUNCIL

K. Sivan	Secretary, DOS /Chairman ISRO Chairperson
Anoop Srivastava	Joint Secretary & FA, DOS

Chintamani Manohar Sane	Joint Secretary (Finance), DOS - Invitee
R. Umamaheswaran	Scientific Secretary ISRO Headquarters
Vinay Kumar Dadhwal	Director, IIST Secretary

1.3 IIST BOARD OF MANAGEMENT

Vinay Kumar Dadhwal	Director, IIST Chairman
S. Kumaraswamy	Additional Secretary Department of Space
R. Umamaheswaran	Scientific Secretary, ISRO Headquarters
V. Narayanan	Director (LPSC)
Santanu Chowdhury	Director (NRSC)
Partha Pratim Chakraborti	Director, IIT Kharagpur
Bhaskar Ramamurthi	Director, IIT Madras
A. Ajayaghosh	Director, NIIST
Anil Bharadwaj	Director, PRL
A. Chandrasekar	Dean (Academics), IIST
Kuruvilla Joseph	Dean (Student Activities), IIST
C S Narayana Murthy	Senior Professor, Department of Physics, IIST
Nirmala Rachel James	Professor Department of Chemistry, IIST
Harsha Simha M. S. (till 18/07/2019) **Anoop C S** (19/07/2019 onwards)	Associate Professor Assistant Professor Department of Avionics, IIST
Y. V. N. Krishna Murthy	Registrar, IIST Secretary

1.4 IIST FINANCE COMMITTEE

Vinay Kumar Dadhwal	Director, IIST Chairman
Anoop Srivastava	Joint Secretary, FA Department of Space
Bijay Kumar Behera	Director, BEA ISRO Headquarters
A.Chandrasekar	Dean Academics and CE
Raju K. George	Dean (R&D) and (Student Welfare), IIST
Y. V. N. Krishnamurthy	Registrar, IIST
Sivanandan G	Sr. Head Accounts / IFA LPSC, Valiamala
R. Hari Prasad	Finance Officer - Member Secretary

1.5 IIST ACADEMIC COUNCIL

Vinay Kumar Dadhwal	Director, IIST
A. Chandrasekar	Dean, Academic & CE
Raju K. George	Dean, R & D, Dean, IPR & CE
Kuruvilla Joseph	Dean, Student Activities, Students Welfare & Outreach
K. Sudhakar	Former Professor, IIT Bombay
K. R. Ramakrishnan	Former Professor, IISc Bangalore
A. Ajayaghosh	Director, NIIST Trivandrum
K. Kurien Issac	Senior Professor
C. S. Narayanamurthy	Senior Professor Department of Physics
N. Sabu	Professor & Head Department of Mathematics
Nirmala Rachel James	Professor Department of Chemistry
Anandmayee Tej	Professor Department of Earth and Space Sciences

K. S. S. Moosath	Professor Department of Mathematics
C. V. Anilkumar	Professor Department of Mathematics
A. Salih	Professor Department of Aerospace Engineering
B. S. Manoj (till 27/11/2019) **Deepak Mishra** (28/11/2019 onwards)	Professor & HOD Associate Professor & HOD Department of Avionics
Manoj T. Nair	Associate Professor & Head Department of Aerospace Engineering
K. Prabhakaran	Professor & Head Department of Chemistry
Lekshmi V. Nair	Associate Professor & Head Department of Humanities
Samir Mandal	Associate Professor & Head Department of Earth and Space Sciences
Umesh R. Khadane	Associate Professor & Head Department of Physics
N. Selvaganesan	Professor Department of Avionics
Pradeep Kumar P	Associate Professor Department of Aerospace Engineering
Naveen Surendran	Associate Professor Department of Physics
S. Murugesh	Associate Professor Department of Physics
V. Ravi	Associate Professor Department of Humanities
Y. V. N. Krishnamurthy	Registrar, Secretary

ACADEMIC DEPARTMENTS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2. ACADEMIC DEPARTMENTS

The academic programmes of the institute are run by seven departments comprising of two engineering, four scientific and a humanities department. Faculty, scholars, laboratories and other relevant details are provided here.

2.1 DEPARTMENT OF AEROSPACE ENGINEERING

IN NUMBERS

25 Faculty Members
55 Research Scholars
40 M.Tech Students
18 Laboratory Staff/Technical Staff

Aerospace Engineering deals with the design and development of machines that can fly. These machines could be aircraft that fly within Earth's atmosphere such as gliders, fixed-wing aeroplanes and helicopters, or spacecraft that fly outside Earth's atmosphere.

The department offers one undergraduate degree (B.Tech) in Aerospace Engineering, three postgraduate degrees (M.Tech), and a PhD programme. Aerospace engineering requires in-depth skills and understanding in physics, mathematics, aerodynamics, flight mechanics, propulsion systems and materials science. In the undergraduate programme, the students develop a basic understanding of these core areas. The postgraduate programmes are offered in three specialisations:

a) Aerodynamics and flight mechanics, b) Thermal and propulsion, c) Structures and design. These courses further strengthen the knowledge in the respective streams. The postgraduate courses give equal emphasis on research and design with the students having the option of taking advanced electives and design courses.

Faculty & Core Research Areas

Head of Department

Manoj T Nair
PhD (IIT, Kanpur)
| Aerodynamics, Computational Fluid Dynamics.

Senior Professor

Kurien Issac K
PhD (IIT, Madras)
| Kinematics, Dynamics and Robotics.

Adjunct Professors

Ramanan R V PhD (University of Kerala, Thiruvananthapuram)	Space Missions: Optimal Trajectory/ Manouvre Design.
Raveendranath P PhD (IIT, Kharagpur)	Advanced Finite Element Method.

Professors

Abdusamad Alias Salih PhD (IIT, Kharagpur)	Numerical solution of multiphase flows.
Aravind V PhD (University of Florida, USA)	Laser Diagnostics, Combustion.

Associate Professors

Anup S PhD (IIT, Madras)	Mechanics of biological and bio -inspired composites.
Chakravarthy P PhD (IIT, Madras)	Materials Forming, Powder Metallurgy, Aerospace Materials, Metal joining, Heat treatment
Deepu M PhD (NIT, Calicut)	Computational fluid mechanics, heat transfer, and combustion.
Girish B S PhD (Anna University, Chennai)	Sequencing and scheduling issues in manufacturing systems and Air traffic management, vehicle routing and scheduling issues in supply chains.
Prathap C PhD (IIT, Delhi)	Fundamental and applied research in Combustion.
Shine S R PhD (IIST, Thiruvananthapuram)	Heat transfer in Space Applications.
Vinoth B R PhD (IIT, Kanpur)	Aerodynamics, Aeroacoustics, Unsteady flows, Flow instability, Experimental methods.
Pradeep Kumar P PhD (IIT, Bombay)	Two - phase flow and heat transfer, Electronic cooling in micro and macro scale.
Praveen Krishna I R PhD (IIT, Madras)	Nonlinear Dynamics, Fluid Structure Interaction, Acoustics.

Arun C O PhD (IIT, Madras)	Structural mechanics, Computational Mechanics-Meshfree, methods, Finite element method, Stochastic mechanics, Structural reliability, Sloshing of liquid in tanks, Design of steel structures, Thin - walled structures etc.
Bijudas C R PhD (IIT, Bombay)	Structural Health Monitoring.
Rajesh S PhD (University of Karlsruhe, Germany)	Optical and Laser Diagnostics, Combustion.
Satheesh K PhD (IISc, Bangalore)	High Temperature Aerodynamics.
Sooraj V S PhD (IIST, Thiruvananthapuram)	Machining and Precision Manufacturing.

Assistant Professors

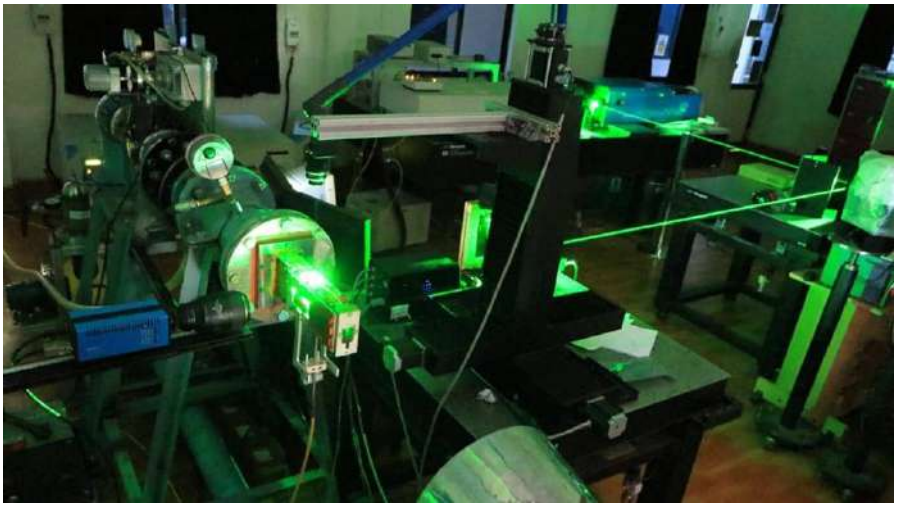
Dhayalan PhD (IIT, Kanpur)	Flight Dynamics, Aircraft System Identification.
Devendra Prakash Ghate PhD (University of Oxford, UK)	Multidisciplinary optimisation.
Mahesh S PhD (IIT, Kanpur)	Jet/Swirl flame characteristics, Micro combustion.
Manu K V PhD (IISc, Banglore)	Fluid Dynamics.

Reader (on Contract)

Sam Noble M.Tech. (University of Kerala)	Robotics, optimisation.

Laboratory Facilities

Manufacturing Processes Lab



Advanced Propulsion and Laser Diagnostic Laboratory

Major lab facilities established under Department of Aerospace Engineering include:

Engineering workshop, Strength of Materials Lab, Engineering Drawing Lab, Thermal and Propulsion Lab, Fluid Mechanics Lab, Heat Transfer Lab, Computer Aided Design and Analysis Lab, Metrology and Computer Aided Inspection Lab, Manufacturing Processes Lab, Materials Characterization Lab, Aerospace Structures Lab, Aerodynamics Lab, Flame Diagnostics Lab and Flight Mechanics Lab.

The manufacturing processes lab and Engineering workshop under Department of Aerospace Engineering does effectively support many of the project and research related activities in IIST, encompassing all the departments in IIST.

Recently various equipment that were added to the laboratories include:
Electro-dynamic shaker units, Data acquisition system with software, Impact hammer, accelerometers, stereo microscope, condenser microphones, high speed LED light, tuned diode laser, high speed camera, dynamic and unsteady pressure transducer, digital delay pulse generators and 6 workstations and A mini CNC platform for lab scale testing/ experimentation purposes.

2.2 Department of Avionics

IN NUMBERS

24 Faculty Members
64 Research Scholars
02 Post Doctoral Fellows
58 M.Tech Students
09 Laboratory Staff/Technical Staff

The Avionics department ensures the deeper understanding of the fundamentals and advanced courses of Avionics with a special thrust to enhance research capability of students to undertake the challenges in the field of avionics engineering. The department offers undergraduate course in Electronics and Communication with specialization in Avionics and post graduate courses in RF and Microwave Engineering, Digital Signal Processing, Control Systems, VLSI & Microsystems and Power Electronics. Moreover, the department also offers Ph.D. in various disciplines of Avionics/ Electrical/ Electronics/ Communication/ Computer Science Engineering/interdisciplinary areas. The department provides a vibrant and dynamic research ecosystem in the institute with expertise in all these areas.

Faculty & Core Research Areas

Head of Department

Manoj B S PhD (IIT, Madras) (till 27/11/2019)	Computer networks, internet security, next generation internet, wireless networks, ad hoc wireless networks, wireless mesh networks, sensor networks, complex networks, and cyber security

Deepak Mishra PhD (IIT, Kanpur) (28/11/2019 onwards)	Computer vision and graphics, image processing, deep learning and artificial neural networks, biometrics, machine learning, soft computing, computational neuroscience, nonlinear dynamics.

Satish Dhawan Professor

Madhav Vasudeo Dhekane	Space transportation - Mission design and Analysis, Launch vehicle Dynamics Modeling, Digital Autopilot Design

Adjunct Professors

Sam K Zachariah Ph.D (IIST, Thiruvananthapuram)	Autonomous locomotion control of biped humanoid robot. Nonlinear mathematical modeling, compensator design and simulation of electro mechanical and electro hydraulic servo actuation systems and components. Digital autopilot design of launch vehicles and realization of mechatronic systems.

Professor

Selvaganesan N PhD (Anna University, Chennai)	System identification and adaptive control, fractional order control, fault detection and diagnosis.

Associate Professors

Basudeb Ghosh PhD (IIT, Roorkee)	Computational electromagnetics, fractal, waveguide passive components, aperture antennas, Frequency Selective Surfaces (FSS), Electromagnetic Band Gap (EBG) structures, Substrate Integrated Waveguide (SIW).
Chinmoy Saha PhD (University of Calcutta, Kolkata)	Multifunctional UWB Antennas/ Reconfigurable Antennas. Antennas for SDR and CDR Applications. Dielectric resonator based WPT system.
Lakshmi Narayanan R PhD (IIT, Madras)	Estimation, detection and signal processing algorithms.

Palash Kumar Basu PhD (Jadavpur University, Kolkata)	Nanotechnology based Gas Sensor, THz devices, biosensor and flexible electronics.
H Priyadarshnam PhD (IIT, Bombay)	Design, modeling and development of satellite systems and control systems.
Rajeevan Puthan Purayil PhD (IISc, Bangalore)	Power electronics – power converters - topologies and PWM techniques, control of multiphase drives, power quality, and renewable energy.
Rajesh Joseph Abraham PhD (IIT, Kharagpur)	Control systems and applications. Power systems control guidance and navigational control. Robust control and applications.
Seena V PhD (IIT, Bombay)	Micro/Nanoelectronics, MEMS and sensors, polymer MEMS.
Sheeba Rani J PhD (Anna University, Chennai)	Computer vision and pattern recognition, image analysis and understanding. Design and performance evaluation of hardware solutions for signal and image processing techniques.
Harsha Simha M S PhD (IIT, Bombay)	Nonlinear dynamical systems and control.

Assistant Professors

Anindya Dasgupta PhD (IIT, Kanpur)	Modelling and control of power electronic (PE) converters, PE topologies and applications in distributed generation.
Anoop C S PhD (IIT, Madras)	Measurements and instrumentation, interface electronics, direct - digitizers,analog signal processing, biomedical electronic systems.
Basudev Majumder PhD (IIT, Bombay)	Planar antenna and passive system design. Application of metamaterials and meta surfaces in antenna design. Reconfigurable antenna design.
Chris Prema S PhD (IIST, Thiruvananthapuram)	Wideband spectrum sensing in CR, Multirate signal processing. Sub - nyquist techniques for spectrum sensing, and FBMC systems for 5G

	communication.
Sooraj R PhD (GIST, South Korea)	Semiconductor optoelectronics and photonics, optical sensors, semiconductor nano - structures, optical interconnects and integrated circuits,photovoltaics, plasmonics.
Sudharshan Kaarthik R PhD (IISc, Bangalore)	Power electronics, multilevel converters, electric drives, modulation and switching techniques, power hardware in – the - loop emulation, grid connected systems, analog and digital circuit design.
Vineeth B S PhD (IISc, Bangalore)	Applied probability &stochastic processes, stochastic control and optimization for computing and communication systems, queueing theory, machine learning, performance analysis and optimization.
Vani Devi M PhD (IIST, Thiruvananthapuram)	Signal processing in 5G communication, Massive MIMO channel estimation and decoding algorithm, NOMA – SCMA receiver design, MIMO - OFDM system, Error control coding –LDPC,TURBO decoder and real time RF communication in RTL-SDR.
Immanuel Raja PhD (IISc, Bangalore)	Broad area of analog, mixed - signal and RF IC design. Developing low - power, efficient transmitters and receivers for RF communication

Laboratory Facilities

The department has excellent laboratory facilities and state-of-the-art software tools in various disciplines of electrical engineering, electronics and communications engineering, and computer science and engineering. These laboratories cater to the academic programs offered by the department at the undergraduate and post graduate levels. Many post graduate laboratories in the department are equipped to support advanced research activities across various disciplines. Subsequent to the movement of the Department to Avionics Block at D3, the following teaching and instructional laboratories have been established.

Analog Electronics Lab, Basic Electrical Lab, Basic Electronics Lab, Computer Networks Lab, Control System Lab, Digital Communication Lab, Digital Electronics Lab, Digital Signal Processing Lab, ECAD Lab, Instrumentation and Measurement Lab, Micro Processor and Microcontroller Lab, Navigation Systems and Sensor Lab, Power Electronics Lab, RF and Microwave Lab, VLSI and Microsystem Lab , Micro/Nanosystem Characterization Lab, MEMS &NanoFAB

Some of the Instructional Laboratories in the Department of Avionics

Research & Development labs

The department of Avionics has a strong focus on excellence in education through fundamental and applied research activities carried out by the faculty members and students. Hence the department is in the process of establishing various research laboratories to support these activities. Many post graduate laboratories in the

department have also been equipped to support advanced research activities across various disciplines. Details of some of the laboratories are provided below: -

GAS and BIOSENSOR FACILITY / ChemiSens Lab

The main activity of this lab is to carry research on gas sensor and biosensor The facility is equipped with three gas calibration facility which is upgrading to multi gas calibration facility to calibrate the gas sensors in different environment. The facility is also having material synthesis unit (nano materials) to develop gas sensors. Similarly, the lab is well equipped to carry the research activity in the field of biosensor. At the moment it is looking to develop first prototype for liquid biopsy of cancer. The up gradation is going on to include the cell culture facility.

ChemiSens lab: Avionics Block

- Centralized sensor lab facility (125 sq m).
- Separate sections for material preparation and gas sensing.
- Separate section for Bio sensing activity
- The lab is upgrading to handle 11 gases at time.
- It will have a gas storage bay (65 sq m) out the building to accommodate 65 gas cylinders

POWER ELECTRONICS RESEARCH LAB

This lab incorporates the research work of B. Tech, M. Tech and PhD students in the area of power electronics and drives. Research works are done in the area of electric drives, multilevel inverters, multi-phase drives, grid connected systems, battery chargers, solid-state transformers, and high performance DC-DC converters.

Research for improved performance of drives through different control schemes such as Direct Torque Control and space vector based PWM schemes for five phase machines and conventional three-phase machines have been implemented. Works based on innovative control of series and parallel connection of six phase permanent magnet machines are being carried out in the lab. Research on grid connected systems include sensor less control scheme for single phase integrated battery charger and Integrated battery charger

using three-phase supply with split phase induction machines. Multilevel inverters based on dodecagonal space vector modulation schemes using cascaded H-bridges were implemented. Research on power quality improvement using STATCOM with novel control techniques have been performed.

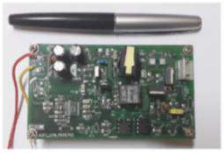
Project works on the control strategies for BLDC motors and Hub motors are also being carried out in the lab. Low power high efficiency isolated DC-DC power supply with both voltage control and current control mode was designed, built and tested in lab. Distribution system based 1.5 kVA Solid state transformer hardware is being developed and currently some developed modules are under test. Furthermore, onboard electronics and Electrical Power System EPS for small satellites and payloads are designed and built in this lab.

4 leg 2 level inverters

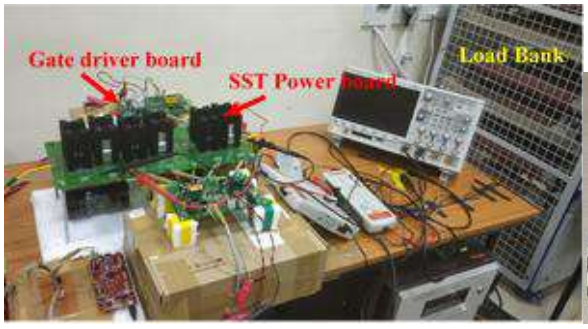
5 phase 1 hp OEWIM

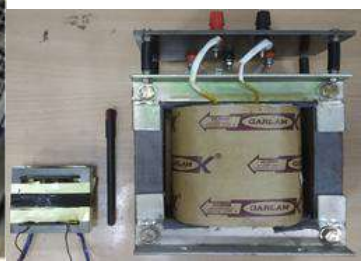
Series connected 6 phase PMSMs

Developed Voltage Control isolated DC-DC power supplies



Developed Current Control isolated DC-DC power supplies





1.5 kVA SST prototype developed inhouse at PEDS Lab Comparison: 1.5 kVA HFAC (left) with normal 50 Hz transformer

Advance Microwave Lab

Advance Microwave Lab of the Department of Avionics is equipped with state of the art facilities in frontier areas of microwave circuits and antennas across various electromagnetic spectrum and caters to the research activities of PhD and M.Tech. Students along with various other R&D projects. This lab caters to the various advanced research in diversified areas, like, advanced electromagnetics, antenna technology, microwave and mm-wave circuits, metamaterials, THz Technology, wireless power transfer, energy harvesting etc.

Glimpses of the selective major equipments and devises/antennas/system realized by the M.Tech. RF and Microwave students at IIST

Thanks to the availability of the well equipped antenna fabrication facilities and high frequency measuring instruments in this laboratory, students get ample exposure on various practical experiments, hands-on experience and associated system aspects through various research projects of Department of Science and Technology, (Government of India), ISRO centres along with IIST projects. Various projects in collaboration with various ISRO Centres, executed in this lab are Design and Implementation of a Helmet Antenna : Dr.Basudeb Ghosh (IIST), Design and Implementation of a Compact Wideband Microstrip Patch Antenna (Completed) (Dr. Chinmoy Saha, IIST and Mr. Mukundan, VSSC), Design and implementation of Integrated Tri-Band Monopulse Auto-Tracking Feed for Remote Sensing Satellite Communications (Dr. Chinmoy Saha, Dr. Basudeb Ghosh, IIST, S. S. Roy, T Naga Sekhar and G Baig, NRSC), SIW based Horn Antennas for MM wave Applications (IIST and SAC, Ahmadabad) and Design of Photoconductive Antenna for THz Applications (IIST, SAC, Ahmadabad, IISER Trivandrum)

Systems and Networks Lab (SysNet Lab)

Systems and Networks Lab (SysNet Lab) is one of the major research labs of the Department of Avionics. SysNet Lab focuses on research activities in the broader area of networked computer and communication systems. Major research areas include Mobile Ad-hoc Networks (MANETs), Wireless Mesh Networks (WMNs), Wireless Sensor Networks (WSNs), Delay Tolerant Networks (DTNs), Software Defined Networks (SDNs),

Satellite Networks, Internet of Things (IoT), network security, complex networks, graph signal processing, and quantum computing.

As part of the research, a WMN testbed "IIST MeshNet" is set up to analyze the behavioral characteristics of multihop wireless networks. At present, the advanced networking techniques such as SDN are integrated into wireless environments in order to analyze network control at finer levels. As far as Internet of Things (IoT) is concerned, the lab includes different sensors especially to develop the concept of smart homes. Further, an Internet of Things for Ambient Assisted Living (IoT AAL) testbed is developed for research activities. The lab is also equipped with an enterprise level network testbed to simulate different malware behaviors and, thereby, developing solutions to detect and prevent them. Recent activities include development of Small satellite network payloads.

2.3 Department of Chemistry

IN NUMBERS

08 Faculty Members
16 Research Scholars : 2 (full time) + 5 (part time)
02 Post Doctoral Fellows :1
11 M.Tech Students : 7 (2019) batch
04 Laboratory Staff/ 05 Technical Staff

Department of Chemistry undertake teaching in the undergraduate and postgraduate level where strong foundations are laid facilitating the design and development of novel materials and processes to meet future technological challenges. The department offers Chemistry courses (core as well as electives) for B.Tech programmes of the institute, M.Tech programme in Materials Science and Technology and PhD programs.

Faculty & Core Research Areas

Head of Department

Prabhakaran K PhD (CSIR-NIIST, University of Kerala)	High temperature materials, materials for environmental applications, ceramic powder processing.

Senior Professor, Dean (Student Activities)

Kuruvilla Joseph PhD(CSIR-NIIST, MG University, Kottayam)	Polymer nanocomposites for electronic and structural applications, Bio - nanosensors for biomedical applications, Elastomers and lends, Bio-composites.

Professor

Nirmala Rachel James PhD (CSIR - NCL, Pune University)	Step growth polymers, Polymers for medical applications, Hydrogels for tissue engineering. Nanofibers for biomedical applications, polysaccharide based nanomaterials for drug delivery applications, light emitting polymers, nanocomposites.

AssociateProfessors

Gomathi N PhD (IIT, Kharagpur)	Surface modification, nanomaterials, sensors.
Jobin Cyriac PhD (IIT, Madras)	Chemical Sensors, Nanomaterials, Mass Spectrometry.
Sandhya K Y PhD (CSIR-NIIST, University of Kerala)	Electrochemical Energy storage and sensing, photocatalysis, Adsorption - Removal of pollutants from water.
Sreejalekshmi K G PhD (University of Kerala)	Computational and Synthetic Organic Chemistry.
Mary Gladis J PhD (CSIR - NIIST, University of Kerala)	Energy storage materials:Metal-Sulfur batteries and supercapacitors, Trace and ultratrace analysis.

Laboratory Facilities

Department has established a high temperature facility during 2019-20 for synthesis, processing of nanomaterials, energy storage materials and high temperature materials.

2.4 Department of Earth and Space Sciences

IN NUMBERS

14 Faculty Members
23 Research Scholars
00 Post Doctoral Fellows
28 M.Tech Students
17 Dual Degree
03 Laboratory Staff/Technical Staff
04 Project Staff

The department is inter-disciplinary in nature, bridging gaps between technology and its application to fundamental research areas in physical sciences. The faculty of the department carry out research in four broad areas: (i) Astronomy & Astrophysics, (ii) Atmospheric Sciences, (iii) Geology and (iv) Remote Sensing. It offers two Dual degree Masters programs (Astronomy & Astrophysics, Earth System Science). It also offers post-graduate programs in Astronomy & Astrophysics, Earth System Science and Geoinformatics. In addition, PhD programs are offered are in the main areas of research, namely, Astronomy & Astrophysics, Atmospheric Sciences, Geology and Remote Sensing.

Faculty & Core Research Areas

Head of Department

Samir Mandal PhD (Jadavpur University, Kolkata)	High Energy Astrophysics.

Outstanding Professor, Dean (Academics)

A Chandrasekar PhD (IISc, Bangalore)	Mesoscale modeling, data assimilation

Professor

Anandmayee Tej PhD (Gujarat University)	Understanding the formation of high-mass stars and their influence on the surrounding interstellar medium.

Associate Professors

Anand Narayanan Ph D (Pennsylvania State University, USA)	Spectroscopic observations of galaxies and intergalactic medium
Gnanappazham L PhD (University of Madras)	Remote sensing and coastal resources management, monitoring of mangroves using satellite data

Govindan Kutty M PhD (IIT, Kharagpur)	Atmospheric Modelling, Data Assimilation, Predictability
Jagadheep D PhD (Cornell University, USA)	Massive star formation, 6.7 GHz methanol masers, HII regions
Rajesh V J PhD (Yokohama National University, Japan)	Mineralogy, Igneous Petrology, Geochronology & Planetary Geology
Rama Rao Nidamanuri PhD (IIT, Roorkee)	Hyperspectral and LiDAR remote sensing.
Resmi L PhD (IISc, Bangalore)	Gamma Ray Bursts, Gravitational Wave Astronomy, High Energy Astrophysics
Sarita Vig PhD (TIFR, Mumbai)	Massive star formation, Protostellar jets, Hots stars in globular clusters

Assistant Professors

A M Ramiya PhD (IIST, Valiamala)	Automated processing of LiDAR point cloud, Applications related to natural and man-made resource management.
P R Sinha PhD (TIFR Balloon Facility, Hyderabad / Pt. Ravi Shankar Shukla University, Raipur)	Balloon-borne and ground-based measurements of aerosols, Aerosol-cloud interaction.
Sayantani Ojha PhD (SavitribaiPhule Pune University)	Climate Modeling, Sea level variability, Air-Sea interaction processes

Laboratory Facilities

Geology Lab

Astronomy & Astrophysics Lab

Atmospheric Science Lab

The department has developed various facilities across sub-disciplines for research and Under Graduate / Masters courses.

Atmospheric Science Lab

Atmospheric science lab is equipped with state-of-the art field instrumentation for the measurement of aerosol optical/physical properties and cloud microphysics along with meteorological variables for constraining important processes associated with aerosol-cloud interactions to develop robust aerosol models for air quality and climate research. These instruments are also extensively used for teaching courses. The lab also has the computing facilities for weather data processing and analyses.

Astronomy & Astrophysics Lab

An experimental and computational lab along with the Astronomical Observatory is setup. A CCD characterisation experiment set-up is routinely used for the UG and PG courses. In addition, the lab is equipped with a blackbody, infrared photometer and a spectrograph, used in teaching and outreach. The lab includes computing facilities for Astronomical Data Analysis and Computational Astrophysics courses. Two telescopes, a 14-inch Cassegrain and a 8-inch Newtonian, are housed in the Observatory. These are extensively used for teaching and outreach.

Geology Lab

The geology lab has a geological museum with good collection of rock samples, ore minerals, rock forming minerals, precious and semi-precious minerals, and various faunal and floral fossils. The lab also has variety of terrestrial analogue minerals and rocks to study the geological conditions and evolution of Moon and Mars. 3D models of various geomorphological features are available to teach students about the basic geological concepts. The lab hosts an advanced petrologicaltrinocular microscope (Nikon Eclipse LV100 optical microscope) and a dedicated petrological microscope equipped with heating freezing stages for the fluid inclusion study. The research on planetary

geosciences includes processing and interpretation of satellite data from Moon and Mars for terrain morphology and spectral characterization of various rocks and minerals to understand the evolutionary processes. The softwares required for carrying out the scientific studies on planetary data are also available in the lab.

Remote Sensing Lab

Remote sensing lab is installed with updated set of remote sensing and image processing software for multispectral, hyperspectral and LIDAR data of field / air / space borne data and GIS softwares for 3D geospatial data analysis. Good amount of satellite data archive is available as repository which is also used for the regular lab sessions, internships and projects of B. Tech and M Tech students. Further research activities on various fields of geospatial technology are supported by necessary field data collection equipments such as spectro-radiometer, Plant canopy analyser, Differential Global Positioning System, hyperspectralimager, Terrestrial Laser Scanner etc. benefiting the research scholars.

2.5 Department of Humanities

IN NUMBERS

05 Faculty Members
10 Research Scholars
01 Laboratory / Technical Staff

The Humanities department plays a unique and distinctive role in IIST where the ethos of science and technology prevails. The department tries to bring in a holistic education that necessitates the study of the language, management and social sciences so that the application of the sciences for the improvement of the quality of life is aware of humanitarian and social concerns. In addition to the carefully designed undergraduate programs (core as well as electives), the department offers opportunities and facilities for the pursuit of research in Economics, English, Management and Sociology.

Faculty & Core Research Areas

Head of Department

Lekshmi V Nair PhD (University of Kerala)	Science, Technology and Society.

Associate Professors

Ravi V PhD (IIT, Delhi)	Operations Management, Supply Chain Management, Quantitative modelling, General Management
Babitha Justin PhD (University of Hyderabad)	Gender and Travel, Cultural Studies

Shaijumon C S PhD (University of Kerala)	Technology diffusion and development, Space Economics and Development economic, Macro Economy, Climate change and economic development

Assistant Professors

Gigy J Alex PhD (M G University)	Cultural Studies, Gender Studies, Science Fiction

Laboratory Facilities

Audio Visual Lab

Department of Humanities offers a course in Communication Skills which uses both theory and practical classes for learning and teaching language in one semester so as to equip students of engineering and technology with effective communication skills in English. Last year lab practices were divided into two categories as "English Language Lab" where listening comprehension, reading comprehension and vocabulary and speaking tests were conducted, and "Career Lab" where writing tests on Resume/Report preparation and Letter writing were conducted.

Language Lab

Department of Humanities has a multimedia-based language lab for enhancing the language proficiency of students. Currently, we make use of the language learning software provided by Orell Digital language lab and Edutech. These language teaching and learning tools are effectively structured to enhance the listening, speaking, reading, and writing (LSRW) skills of the students. A batch of forty students can attend per session.

2.6 Department of Mathematics

IN NUMBERS

11 Faculty Members
16 Research Scholars
11 M Tech Students
03 Laboratory / Technical Staff

Department of Mathematics offers courses at undergraduate and post graduate level for Aerospace and Avionics Engineering branches. Department also runs an M.Techprogramme in Machine Learning and Computing. Research in the department mainly focus on various areas of pure as well as applied mathematics including: Control Theory, Numerical analysis, Partial Differential Equations, Commutative Algebra, Machine Learning, Differential Geometry, Stochastic Modelling & Analysis, Queuing Theory and Time Series Analysis etc. Faculty members have strong research collaboration with

reputed Indian institutions such as IITs and IISc etc. and international institutions include: Monash University, Australia, University of Concepcion, Chile and University of Bio-Bio, Chile. Moreover, department is also actively engaged in other activities like organizing training/nurture programme in mathematics for undergraduate/postgraduate students as well as seminars/workshops by renowned scientist from various parts of the world.

Faculty & Core Research Areas

Head of Department

Sabu N PhD (University of Madras)	Partial Differential Equations, Homogenization.

Senior Professor, Dean (Research & Development and IPR)

Raju K George PhD (IIT, Bombay)	Mathematical Theory of Control, Machine Learning, Industrial Mathematics

Professors

Anilkumar C V PhD (CUSAT)	Nonlinear Dynamics and Chaos, Time series Analysis.
Subrahamanian Moosath K S PhD (University of Hyderabad)	Differential Geometry and Applications.

Associate Professors

Deepak T G PhD (CUSAT)	Probability theory and Stochastic processes.
Kaushik Mukherjee PhD (IIT, Guwahati)	Numerical Analysis of Singularly Perturbed Differential Equations.
Prosenjit Das PhD (Indian Statistical Institute, West Bengal)	Commutative Algebra and its applications to Affine Algebraic.
Sarvesh Kumar PhD (IIT, Bombay)	Computational Partial differential equations, finite element methods, finite volume methods, virtual element methods.
Natarajan E PhD (IIT, Madras)	Numerical analysis.
Sumitra S PhD (Sheffield University, England)	Machine Learning, Data Mining.

Assistant Professors

Sakthivel K
PhD (Bharathiar University, Coimbatore)

| Control and Inverse Problems of Partial Differential Equations

Laboratory Facilities

The following laboratory facilities are available to support the teaching programme for the undergraduate students of IIST and the M.Tech students of the department of Mathematics, IIST.

Programming Lab, M.Tech Machine Learning and Computing Lab

Programming Lab

Machine Learning and Computing Lab

2.7 Department of Physics

IN NUMBERS

13 Faculty Members
27 Research Scholars
28 M Tech / M S Students
08 Laboratory / Technical Staff

The Department of Physics offers a five-year dual-degree programme where the students receive a B.Tech. in Engineering Physics and a Master of Science in Solid State Physics or Master of Technology in Optical Engineering. The department also offers independent M. Tech. programs in Solid State Technology and in Optical Engineering. The members of the department are actively involved in research in diverse areas of physics, which is supported by a flourishing Ph. D. programme.

Faculty & Core Research Areas

Head of Department

Umesh R Kadhane | Atomic and Molecular Physics.
PhD (Tata Institute of Fundamental Research, Mumbai)

Senior Professor

Narayanamurthy C S | Applied and Adaptive Optics.
PhD (IIT, Madras)

Associate Professors

Apoorva Nagar | Nonequilibrium Statistical Mechanics and Biological Physics.
PhD (Tata Institute of Fundamental Research, Mumbai)

Kuntala Bhattacharjee | Experimental condensed matter physics.
PhD (Institute of Physics, Bhubaneshwar)

Jinesh K B | Semiconductor and device physics.
PhD (University of Twente, Netherlands)
PhD (Leiden University, Netherlands)

Murugesh S | Nonlinear dynamics: Integrable systems and solitons. Applications to spintronics.
PhD (Institute of Mathematical Sciences, Chennai)

Solomon Ivan J PhD (Institute of Mathematical Sciences, Chennai)	Classical Optics, Quantum Optics, Quantum Information.
Sudheesh Chethil PhD (IIT, Madras)	Quantum Information, Quantum Optics and Nonlinear Dynamics.
Jayanthi S PhD (IISc, Bangalore)	Nuclear Magnetic Resonance, pulse sequence development and applications.
Naveen Surendran PhD (Institute of Mathematical Sciences, Chennai)	Condensed matter theory.

Assistant Professors

Asok Kumar Physical Research Laboratory, Ahmedabad	Experimental Quantum Optics
Dinesh N Naik PhD (The University of Electro Communication, Tokyo)	Spectrally resolved incoherent holography for space based imaging.
Sourin Mukhopadhyay PhD (Tata Institute of Fundamental Research, Mumbai)	Spectroscopic studies on correlated electrons systems.

Laboratory Facilities

Atomic and Molecular Physics Lab

Modern Physics Lab

Applied and Adaptive Optics Lab

Electronic Materials and Devices

Space-Technology Innovations Lab

Solid State Technology Lab

The following laboratories with state-of-the-art facilities support the research and teaching programmes of the department.

Applied and Adaptive Optics, Atomic and Molecular Physics, Computational Physics Electronic Materials and Devices (EMERALD), General Physics, Lasers and Photonics, Modern Physics, Optics, Solid State Technology Lab, Space Technology Innovations and Characterization Lab (STIC), Electric Propulsion Diagnostic Lab

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ACADEMIC PROGRAMMES

3. ACADEMIC PROGRAMMES

This Chapter presents details related to academic programmes, comprising of the courses offered at UG, PG and doctoral levels, student enrolment, internships, degrees awarded and student placements. The institute offers two undergraduate, a dual degree, fifteen post-graduate programmes and full-time/part-time PhD programmes. The undergraduate program comprises of B.Tech in Aerospace Engineering and B.Tech in Electronics & Communication Engineering (Avionics), each with 66 seats annually and a dual degree program with B.Tech in Engineering Physics with 22 seats. Students of the Dual degree programme spend an additional fifth year to acquire either Master of Technology degree in Optical Engineering or Earth System Sciences, or Master of Sciences in Astronomy or Astrophysics, or Solid State Physics.

3.1 Admission

The following are the enrolment details of the undergraduate programs offered by the institute and for the year 2019-20

UG Programme	General	OBC	SC	ST	PD* General	PD OBC	EWS**	Total
Aerospace Engineering	21	20	9	5	-		11	66
Electronics & Communication Engineering (Avionics)	25	16	9	5	1	-	10	66
Dual Degree	8	7	3	2	-	-	2	22

*Persons with Disabilities (PD)

**Economically Weaker Sections (EWS). As per government directive, the reservation for the EWS has been started from the academic year 2019-2020.

The institute currently offers 15 Master of Technology/Master of Science programs. Admissions to the programs are based on the performance in national level examinations such as GATE or JEST, followed by an interview. Category-wise details of students admitted during the reporting period across various M.Tech and Master of Science Programmes of IIST are as follows:

		Admission 2019-2020						
Sl. No.	**Name of the M.Tech. and Master of Science Programme**	**Gen**	**OBC**	**SC**	**ST**	**EWS**	**Sponsored from DOS/ISRO**	**Total**
1	Thermal and Propulsion	3	1	1		1		6
2	Aerodynamics and Flight Mechanics	3	1	2		1		7
3	Structures and Design	3	2			1	1	7
4	RF and Microwave Engineering	3	1	1				5
5	Digital Signal Processing	3	1	1	1	1		7
6	VLSI and Microsystems	3	2	1		1		7
7	Control Systems	3	2	1		1		7
8	Power Electronics	2	1	1	1	1		6
9	Machine Learning and Computing	4	1	2			1	8
10	Materials Science and Technology	3	1				3	7
11	Earth System Sciences	2	2	1			1	6
12	Geoinformatics	1	2	1			1	5
13	Astronomy and Astrophysics	3	1					4
14	Optical Engineering	3	1	1				5
15	Solid State Technology	3	1	1				5
Total		**42**	**20**	**14**	**2**	**7**	**7**	**92**

Doctoral Programmes

To enhance research output, the institute continues to strengthen PhD programme. Admissions were held in January and July based on test and interview and is restricted to those candidates who qualified GATE/UGC/CSIR NET-JRF/JEST or equivalent exams. During this period, 44students registered for PhD, the details of which are given below:

Department	**Full Time**	**Part-Time**	**Total**
Aerospace Engineering	5	2	7
Avionics	9	1	10

Chemistry	2	3	5
Earth and Space Sciences	6	1	7
Humanities	3	1	4
Mathematics	3	2	5
Physics	5	1	6
Total	**33**	**11**	**44**

3.2 Successful Completion Details of academic programmes

114 B.Tech students and 71 M.Tech students passed out in the year 2019-20

3.2.1 B.Tech

Degree	Discipline	Number of Students Passed out
Bachelor of Technology	Aerospace Engineering	55
	Electronics & Communication engineering (Avionics)	58
	Dual Degree	31

3.2.2 M.Tech/Master of Science

Degree	Discipline	Number of Students Passed out
Master of Technology	Aerodynamics and Flight Mechanics	6
	Structure and Design	8
	Thermal and Propulsion	7
	Control Systems	5
	Digital Signal Processing	2
	RF and Microwave Engineering	5
	VLSI and Microsystems	7
	Power Electronics	5
	Material Sciences and	5

	Technology	
	Earth System Sciences	3
	Geoinformatics	5
	Machine Learning and Computing	6
	Optical Engineering	1
	Solid State Technology	0
Master of Science	Astronomy and Astrophysics	3
Total		**68**

3.2.3 Ph.D. Thesis accepted/ published (14)

Fourteen students had completed their Ph.D. programme and successfully defended their thesis the report period.

1. **Aswathi R**
   Graphene and MoS_2 Based Nano Functional Materials for Electro-Chemical Sensing/ Storage Applications.
   Department: Chemistry / Guide: Dr. K. Y. Sandhya / Defense on: 24-04-2019
2. **Deepak Gopalakrishnan**
   Regional 4D var Assimilation Studies on Weather Systems over India Using the WRF Model.
   Department: ESS / Guide: Prof. A. Chandrasekar / Defense on: 22-04-2019
3. **Reshma C**
   Heteroatom Containing Porous Carbon Materials for Electrochemical Energy Storage Applications.
   Department: Chemistry / Guide: Dr. J. Mary Gladis / Defense on: 25-04-2019
4. **Parvathi S. P**
   Iterative Analytical Techniques for the Design of Transfer Trajectories for Direct Interplanetary Orbiter Mission
   Department: Aerospace / Guide: Dr. R. V. Ramanan / Defense on: 22-05-2019
5. **Binu P Thomas**
   Digital Holographic Studies on Detection of Defects in Honeycomb Sandwich Structures and Imaging of Stresses in Transparent Objects.
   Department: Aerospace / Guide: Prof. C. S. Narayanamurthy /
   Defense on: 14-06-2019
6. **Devi Renuka K**
   Supramolecular Assemblies of Carbon Nanomaterials with Photo Chromic Molecules for Sustainable Molecular Electronics.
   Department: Chemistry / Guide: Prof. Kuruvilla Joseph & Dr. Mahesh S /
   Defense on: 11-06-2019

7. **Meegle S Mathew**
   Synthesis and Characterization of Protein Templated Multifunctional Noble Metal Quantum Clusters for Biomedical Applications.
   Department: Chemistry / Guide: Prof. Kuruvilla Joseph / Defense on:11-06-2019
8. **Ameen Yasir P A**
   Some Aspects of Phase Estimation.
   Department: Physics / Guide: Dr. J Solomon Ivan / Defense on: 04-06-2019
9. **Rahul. O. R**
   Breather Modes in Spin Chain- A Study on the Geometry and Dynam of Certain Special Magnon Modes.
   Department: Physics / Guide: Dr. S. Murugesh / Defense on: 19-11-2019
10. **Shashank Vadlamani**
    A stochastic Wavelet Finite Element Method using B-Spline Wavelet on the Interval for Problems in Structural Mechanics.
    Department: Aerospace / Guide: Dr. C. O. Arun / Defense on: 31-10-2019
11. **Sathishkumar. P**
    Fractional Order Controllers for Complex Valued Systems and Systems and Systems with Multiple Nonlinearity.
    Department: Avionics / Guide: Dr. N. Selvaganesan / Defense on: 15-11-2019
12. **Arun D I**
    Investigation on Electro-Acive Shape Memory Polymer Nanocomposites Polyurethane carbon Black/ Carbon Nanotube System.
    Department: Aerospace / Guide: Dr. P. Chakravarthy / Defense on: 12-09-2019
13. **Bibin Johnson**
    A High Throughput Multiscale Optical Flow Architecture and its Application towards Cloud Tracking.
    Department: Avionics / Guide: Dr. J. Sheeba Rani / Defense on: 17-12-2019
14. **Aravind G P**
    Numerical Studies on Mass Transfer Enhancement by Vortex Generators.
    Department: Aerospace / Guide: Dr. M. Deepu / Defense on: 28-02-2020

3.3 Convocation

The seventh convocation of IIST was held on 5th July 2019 at Dr. Srinivasan auditorium, VSSC, Thiruvananthapuram. In this convocation, 112 B. Tech, 30 Dual Degree, 71 M. Tech and 12 Doctoral students were conferred to their respective degrees. Dr. Ajay Mathur, Director General, The Energy and Resources Institute (TERI), New Delhi was the chief guest of the convocation. The convocation started at 13.30 hrs with a majestic academic procession led by Registrar, IIST. Dr. B N Suresh, Hon. Chancellor, IIST declared the convocation 'open', for further proceedings. Dr. V K Dadhwal, Director and Chairman,

BoM, IIST welcomed the dignitaries, invitees, graduating students, faculty, staff and parents to the convocation. Director introduced the Chief Guest, Dr. Ajay Mathur, to the audience and mentioned about his scientific contributions, especially in shaping India's energy requirements.

Academic Procession

At the outset, Director congratulated the graduating students for their accomplishments. In his academic report, he spoke about current on-going academic programmes, curriculum, introduction of choice based credit system, new elective, AICTE fellowship for M.Tech students and other initiatives for improving quality of academics. Director mentioned about implementation of UGC/AICTE guidelines and approval of B.Tech, M. Tech and Ph.D programmes run by IIST by the AICTE Committee. The Director touched upon establishments of various space technology and research programs like Advanced Propulsion and High Speed Flows, Nano-Science and Energy Materials, Small Space Craft and Payload Centre (SSPACE), Nano-MEMS Opto-Electronics, Multi Disciplinary Computing Center and UHF/VHF Antennas for Receiving Direct Satellite Data. He informed that about 42 IIST-ISRO joint projects are running now. He emphasized about 'Development of Hydrogen Sensor' with IPRC, Mahendragiri, IIST/IISU joint project on 'Surface Engineering Techniques', IIST/LPSC joint projects on 'Laser Based Ignition Systems for Cryogenics Engineering' etc. Director showered praise on the team behind 'Advanced Retarding potential analyser for Ionospheric Studies' (ARIS), the first space mission of IIST, which was launched on 1st April 2019 in the PS4 stage of PSLV C45. He

congratulated the team members, Dr. Umesh Khadane (Physics), Dr. Sudarshan Karthik (Avionics), Dr. Suraj (Aerospace) and Dr. Anoop (Avionics)), project fellows and students who worked hard to make the mission possible within 49 days. He thankfully remembered the support received from IISU/VSSC in this regard. He briefed about the MOU's signed by IIST with national and international Universities and highlighted achievements made by students and faculty. Director thanked the Chief Guest Dr. Ajay Mathur, Dr. B N Suresh, Hon. Chancellor and Dr. K Sivan, Chairman Governing Council, IIST for gracing the convocation with their presence and support.

Shri. S Somanath, Director, VSSC - the Guest of Honor - spoke about the need for creativity for developing future ISRO's mission and what role IIST can take in this direction. He wished a bright career for all the graduating students.

Dr. Ajay Mathur in his Convocation Speech congratulated the graduating students and their parents for putting years of hard work. Dr. Mathur remarked that as technologies change challenges also changes and continuous learning has become very important.

Degrees were awarded to 112 B.Tech graduates, 71MTech, 30Dual Degree and12 PhD degree recipients. Remaining students were awarded the degree inabsentia. Institute medals were given to the best academic performers of undergraduate programmes and post-graduate programmes.

Dr. Ajay Mathur delivering the 7th convocation address

Ms. Garima Aggarwal
Aerospace Engineering
Best Academic Performer for Undergraduate Programmes

Ms. Rwitika Chatterjee
Astronomy and Astrophysics
Best Academic Performer for Post-graduate Programmes

3.4 Placement

106 students, who have completed their B.Tech programme in IIST with a good CGPA are absorbed in the different centres of ISRO. Other B.Tech and M.Tech students are placed through the placement of IIST.

3.4.1 ISRO Placement for BTech

From the group of passing out B.Tech students,106 students (out of conferred degrees) were offered placement in ISRO in 2019.

ISRO/ DoS absorption data (2011-2019)

Year	AE	AV	PS	Total
2011	41	54	22	117
2012	42	52	30	124
2013	39	54	29	122
2014	35	43	26	104
2015	44	45	13	102
2016	43	39	21	103
2017	39	42	23	104
2018	36	33	-	69
2019	42	38	26	106
Total	**361**	**400**	**190**	**951**

3.4.2 Non-ISRO Placement for UG, PG & Others

List of Students placed Through IIST Placement cell

M.Tech Placement Cell Record for 2018 Batch*			
Sl No	**Company**	**Student Name**	**Course**
1	M/s Agnikul Cosmos	MayukhmaliChakraborty	Thermal and Propulsion
2	M/s Agnikul Cosmos	Yeshwanth Kumar	Geoinformatics
3	M/s Delta Electronics	Srikara Reddy G	Power Electronics
4	M/s Delta Electronics	Pragya Yadav	Power Electronics
5	M/s Tata Consultancy Services	Rajat Kumar Sarkar	Aerodynamics and Flight Mechanics
6	M/s Tata Consultancy Services	RagjaPalakkadavath	Machine Learning and Computing
7	M/s IQuantela Technologies Pvt Ltd	Amitesh Sharma	Machine Learning and Computing
8	M/s IQuantelaTechnologies Pvt Ltd	Mahesh Kumar Pal	Digital Signal Processing
9	M/s Mantra Softtech Pvt Ltd	Jay Krishna Anand	Optical Engineering
10	M/s Subex	Sanjay G	Digital Signal Processing
11	M/s Comsol India	Vaibhav Adhikar	RF and Microwave Engineering
12	M/s KPIT	Gokul P N	Digital Signal Processing

*Apart from these placements, 12 M.Tech students from different branches are doing their internship in various private companies.

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RESEARCH & DEVELOPMENT

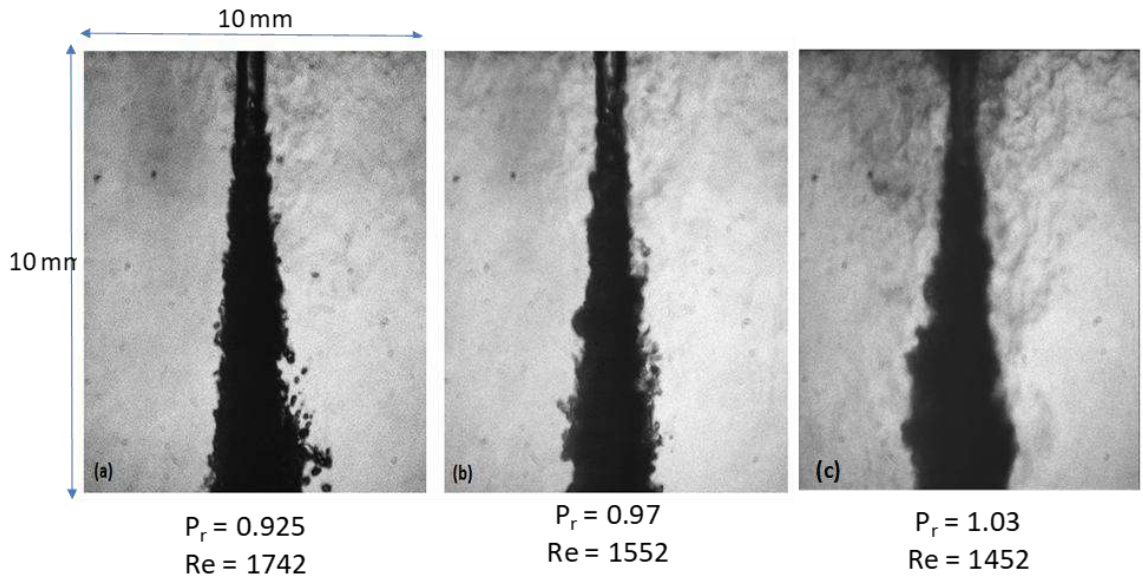
4. RESEARCH AND DEVELOPMENT

Research and development in various areas of space science, space technology, and its applications, as well as related areas of basic science and relevant humanities topics, is undertaken at IIST through its faculty, visiting researchers and collaborators, postdoctoral fellows and project-funded junior research fellows and project engineers. The R & D ecosystem is strongly supported by Ph.D. scholars, PG and UG students in their project/internship semesters. While the majority of the research is funded from the institute, faculty are encouraged to obtain competitive research grants from funding agencies and consultancy project funds from ISRO and other industries. This is managed under Dean (R&D) through an institute level Research Council. During its twelve years of growth, IIST has developed a good number of research laboratories and centers of excellence. IIST continuously improves the research facilities by procuring and developing several innovative and groundbreaking technologies. Research scholars and teachers are actively involved in the research. This is evident in the increase in the number of patents, publications, and research output. IIST provides financial support to participate in conferences, workshops, and seminars to nurture a research culture among students and faculty.

4.1 Snapshots of Research

Department of Aerospace Engineering

Prof. Aravind Vaidyanathan's Research includes (a) Characterization of effervescent strut for scramjet combustion and (b) Liquid jet break up behind a pylon in supersonic flow. The liquid jet injection provided maximum break up and penetration height. The 60 degree angled injection exhibited better spreading and penetration into the supersonic main flow. The other area of research included the evaluation of liquid jet break up in supercritical condition using DMD analysis. Different coherent structures of the jets were obtained of which a few showed alternate white and black fringe patterns.The wavelength of these fringe patterns of the most dominant mode was in close agreement with those obtained from the stability analysis at subcritical chamber conditions. The interface and its features for a jet at sub critical to supercritical condition is presented here. At supercritical condition ($Pr = 1.03$), there is hardly any droplet formation and the sharp interface that is observed in subcritical cases ($Pr < 1$) has become less distinct.



The nonlinear response of globally unstable elliptic jet diffusion flame under acoustic excitation is studied experimentally and compared with circular jet diffusion flame. Both circular and elliptical jet diffusion flames were forced near the fundamental frequency of global (self-excited)oscillation and away from the it. When the globally unstable jet flames (circular and elliptic) are excited near the fundamental frequency, both flames get locked into forcing frequency through quasiperiodic state with increase in forcing amplitude. However, if the forcing is away from the natural frequency, the flames gets in to quasiperiodic state but never gets locked with the forcing frequency in the range of forcing amplitude studied in the present work.

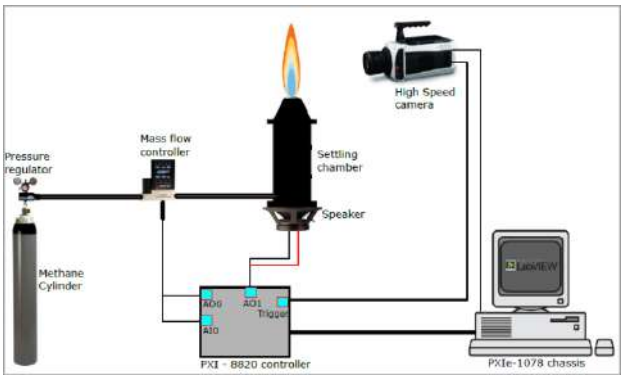


Figure: Experimental Set up

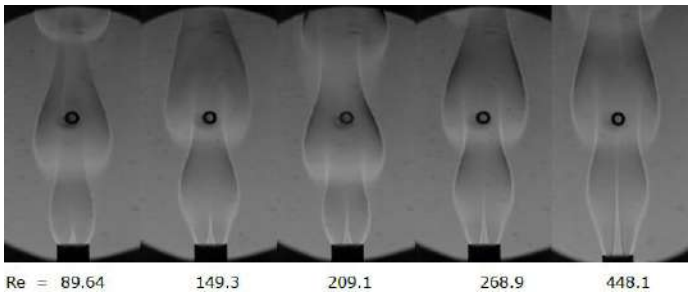


Figure: Variation of schlieren flow field with Reynolds number for elliptic jet diffusion flame (AR = 2).

Priy Devvrat Singh, B. R. Vinoth *and* ***Mahesh S.*** *Acoustic excitation of self-excited elliptic jet diffusion flame.*

Prof. R.V. Ramanan and his undergraduate and research students made research advancements in the following areas resulting in new methodologies;

a) Development of unified Approach for the Optimal Constellation Design of Satellites in Low-Earth Circular/Elliptical Orbits for Continuous Coverage
b) Low thrust optimal transfers between planetary parking orbits
c) Halo orbit design under elliptic three-body problem framework
d) minimum fuel/energy lunar soft landing trajectories and
e) Collaborative project on CubeSat constellation design around Mars with ISAESUPAERO, France.

Research work was carried out to investigate the impact of chamber volume on the measured value of laminar burning velocity using a constant volume spherical flame method. Experimental unsteady pressure-time data of stoichiometric methane air mixture recorded in spherical chambers of different volumes ranging from 0.5 to 20 L was obtained from different research groups. All the collected data in the reduced normalized pressure range of 0.25–0.5 were processed with a two-zone thermodynamic model. One dimensional unsteady spherical flame model at constant volume in COSILAB along with the GRI-Mech3.0 reaction mechanism was used for predicting laminar burning velocity. The values of stretched burning velocity at elevated pressures and temperatures differed with chamber volume due to flame stretch effects. The extrapolated stretched laminar burning velocity at 1 bar and 300 K using power-law found to be independent of spherical chamber volume. From the present comparison of stretched burning velocity data between 0.5 and 20 L, it was found that the constant volume spherical flame method may deliver laminar burning velocity with less stretch effects if a spherical combustion chamber of 4.4 L range was used.

M. Tippa, S. Subbiah, C. Prathap. *Impact of chamber volume on the measurement of laminar burning velocity using constant volume spherical flame method, Fuel 256, 115936.*

IIST undertake research on the area of mechanics of bio-inspired composites and Micro and nanomechanics of composite failure in our lab. The design of a bio-inspired composite using probabilistic fracture mechanics was attempted. Biological composites such as bone and Nacre have excellent mechanical properties such as toughness, and this has led researchers to explore these materials as imitable motifs for artificial materials. These composites are made up of staggered tablets embedded in a soft matrix. The dimensions of these tablets are an important parameter in the design of such bio-inspired composites. Deterministic models have been used in literature to analyse the strength of such

composites though randomness in properties could exist in real situations. In our study, the effect of such disorder in the constituent properties was considered, and using probabilistic fracture mechanics techniques, the critical aspect ratio of tablets is computed. We used Finite element analyses and Monte Carlo techniques to find these results. The figure shows the design curves from probabilistic and deterministic analysis (Saroj. A. et al., 2019)

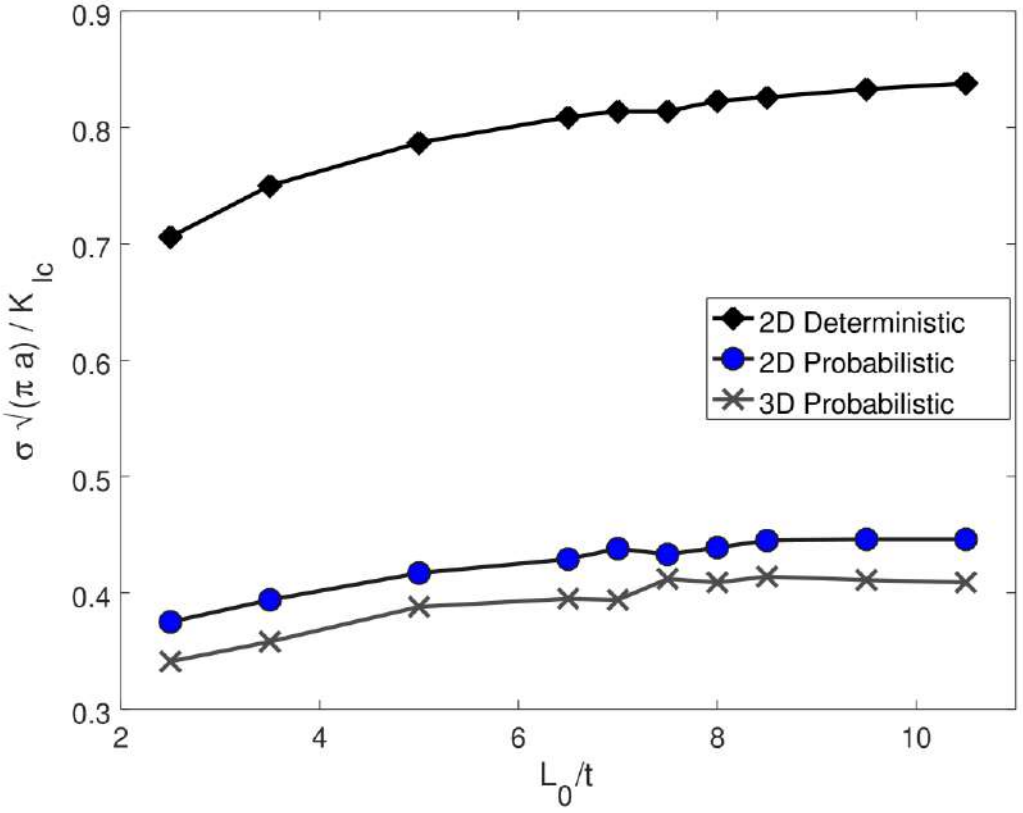


Figure: Design curves for deterministic and probabilistic analysis. The probabilistic methods are more reliable forthe design

Saroj, A., Rose, K.J., Arun, C.O., & Anup, S. *(2019). Design of a bio-inspired composite using probabilistic fracture mechanics. Journal of the Mechanical Behavior of Biomedical Materials.*

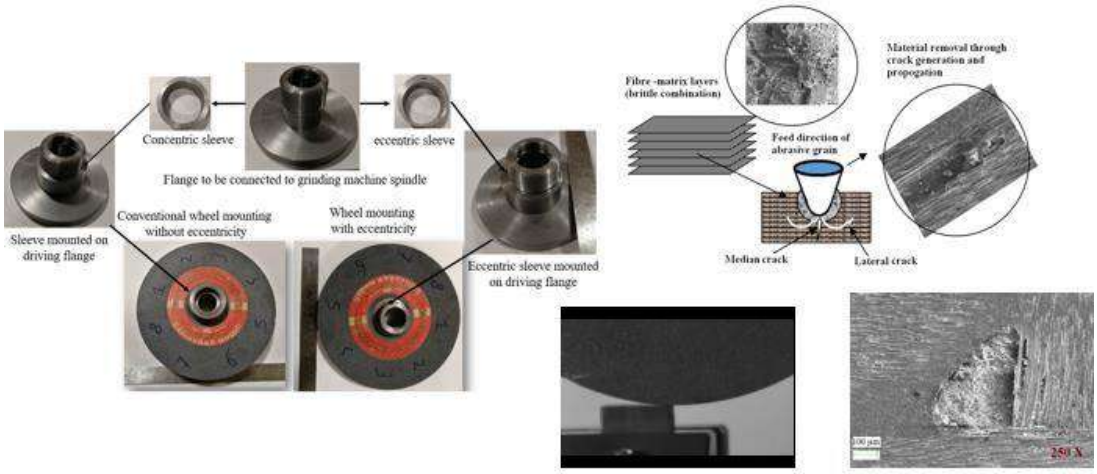
Space Missions and Related projects

(i) Contributed as a team member of first space mission from IIST in PSLVC45. Involved in the design, development and successful launch of ARIS-101F [Advanced Retarding Potential Analyser for Ionospheric Studies], in collaboration with IISU and VSSC. Actively involved in the integration activities at Satish Dhawan Space Centre, Sriharikota.

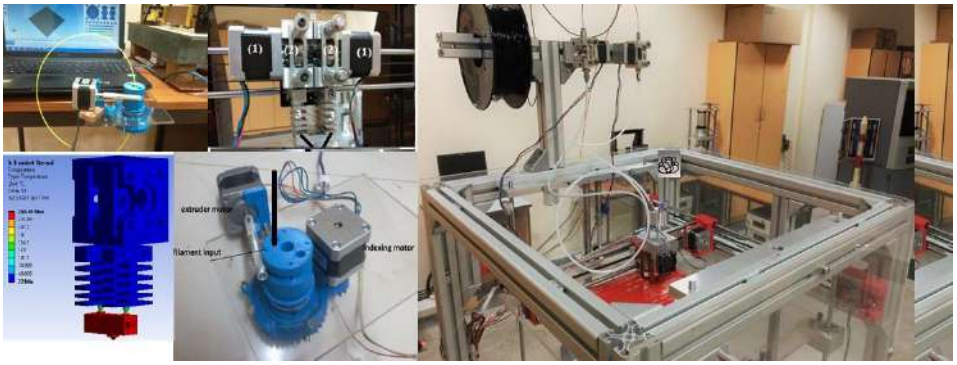
(ii) Realization of 3U satellite structures/dummy mass system for MirrorSat in AAReST project, both for IIST and University of SurreyUoS). Realization of 3U satellite structure and dummy-mass system for IIST Nanosat project 'AHAN'.

Manufacturing research and development activities

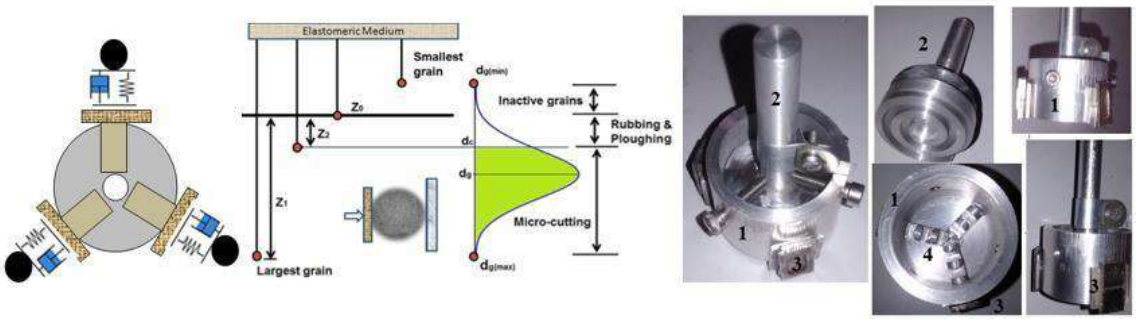
(i) Investigations on minimal damage progressive grinding strategy for fibre reinforced composites using eccentric sleeve grinding.



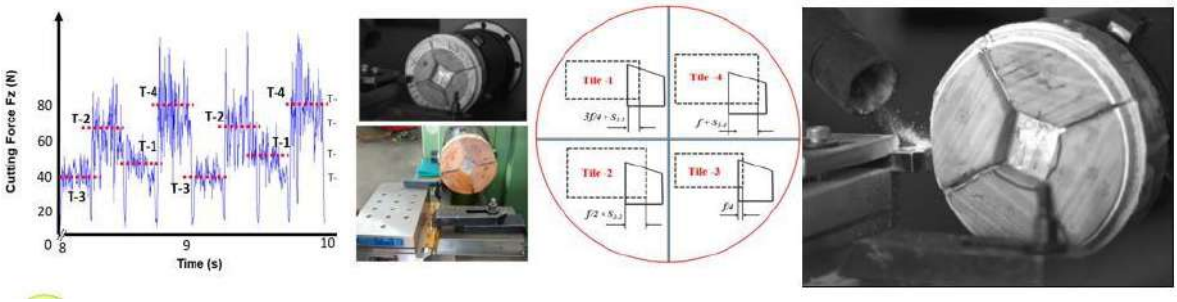
(ii) Preliminary Studies on Additive manufacturing – Design and Development of open source FDM based additive manufacturing systems



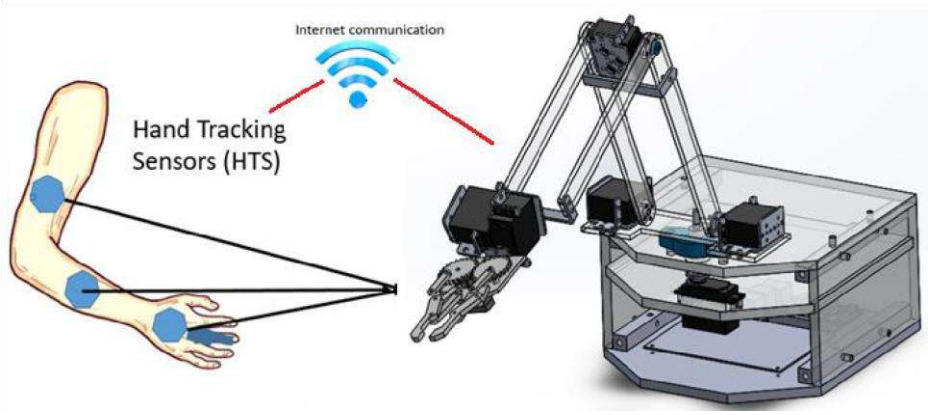
(iii) Investigations on Deployable Magneto-Elastic Abrasive Tools for fine finishing



(iv) Machinability Studies on Ablative Composite Materials: An extension of work in collaboration with CMSE



(v) *Design and Development of a five degree of freedom robotic manipulator operated though Sensor controlled wearable Hand Tracking System (HTS) or via IoT (Internet of Things):* Completed by students as a course project of elective course 'Advanced Manufacturing and Automation'.



(vi) Investigations of Matrix Failure of Fibre Reinforced Polymer Composites and Feasibility Study of Self-Healing.

Dr. V. S. Sooraj

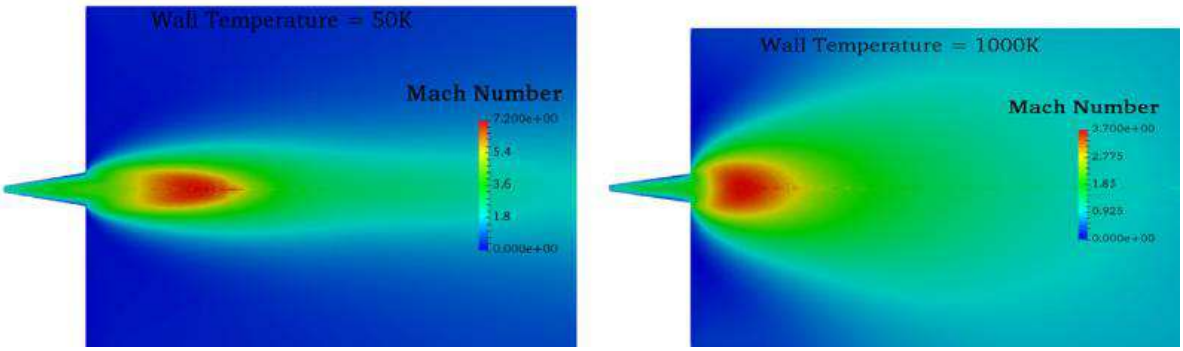
As a part of the research work on coupled numerical simulation of the thermal, structural, and chemical response of ablative composites, developed finite volume codes for ablation response and was validated for decomposition kinetics and thermal response separately using thermo-gravimetry test results and closed form solution, respectively. Carbon-Phenolic specimens were prepared with four different ply orientations having in-depth instrumented thermocouples. Radiography was carried out on the specimens to ascertain the actual depth of the sensor from the exposed face. Arc jet tests were conducted in the plasma arc facility of VSSC for the four different test cases, and experimental data was generated. Tested specimens were subjected to post-test evaluation, and the extent of

charring was recorded. The effect of ply orientation on the temperature, density, and pore-pressure distribution was studied from the simulations, and inferences were drawn. Future work includes Modelling the structural response of the porous fluid-saturated solid and coupling it with the thermochemical response and its experimental validation.

Tushar R. Phadnis, P. Raveendranath *and T. Jayachandran (2020)Effect of ply orientation on the in-depth response of Carbon-Phenolic ablative. Journal of Thermo-physics and Heat transfer.*

Micro-thrusters employed in miniature spacecraft and microsatellites for its attitude control, orbit maintenance, and station keeping experience substantial changes in wall thermal conditions. This can influence the internal boundary layer development and the exit plume structure of a micro-nozzle. These changes in flow physics differ with the nozzle divergence angle and the proximity of a similar nozzle in the cluster. Coupled Navier-Stokes and Direct Simulation Monte Carlo (NS-DSMC) simulations of gas flow in micro-nozzles for various wall thermal conditions and geometrical aspects have been carried out. The present computations are useful in calibrating micro-propulsion controllers to adapt to the substantial momentum changes associated with various nozzle wall thermal conditions and the proximity of similar nozzles in the cluster.

The state-based one-way spatial-coupled continuum-DSMC solver is found to be a suitable numerical procedure for analyzing a micronozzle operated in high vacuum conditions, which experiences all degrees of rarefaction. The subsonic layer present within the micro-nozzle is found to grow with the rise in wall temperature and reduces the effective nozzle area-ratio. Effect of the presence of a similar thruster in the vicinity of a microthruster is also studied by modeling an infinite rectangular cluster.



K. M. M. Rafi, ***M. Deepu****, and G. Rajesh, Effect of Heat Transfer and Geometry on Micro-Thruster Performance, International Journal of Thermal Sciences, Vol. 146, 106063, 2019.*

The current research focuses on modeling, fabrication, and control of fully automated unmanned aerial vehicles in the small and micro class. Full automation involves proper

system identification, flight dynamics, and control. The system identification includes the conceptual design, fabrication, state measurements, flight tests and parameter estimation of the aerodynamic models. Further, the usage of proper estimator corresponding to the flight vehicle and flight data is paramount importance. A few classical methods such as Least Squares and Maximum Likelihood along with data driven methods like Neural and Fuzzy networks have been used for the parameter estimation. The flight dynamics of the corresponding flight vehicles are characterized by modelling the aerodynamics of the flight vehicles over a wide range of flight regimes. The estimated model can be used as a control variable for various algorithms. The control of UAVs are achieved by classical and state space methods. However, the research involves the implementation of optimal control and neural-fuzzy based control logic. Contemporary designs such as VTOL, Tail sitter, and High Altitude Soaring UAVs are considered for implementing the control and estimation algorithms. Multi-rotor UAVs have been fabricated and will be used for the purpose of aerial land surveys and high altitude surveillance.

Dr. Dhayalan, R.

Improving the mobility of rovers with rocker-bogie suspension was addressed. For a rover operation, friction and torque requirements for climbing a single step were considered as performance parameters. The main contribution is an improved formulation for rover optimization using smooth functions, enabling the use of powerful gradient-based nonlinear programming (NLP) solvers to find solutions. This formulation allows us to obtain special cases, which were not studied. The formulation of the optimal design of the rover was done using smooth functions. The solution for climbing a step of height two times the wheel radius is 13% better than that of the nominal rover. Karush–Kuhn–Tucker (KKT) conditions check was done to confirm the solution to be the local minimum. The optimum design for climbing steps of three different heights, r, 2r, and 3r, were conducted and results that the friction requirement for this is 15% lower than that of the nominal rover.

Mr. Sam Noble

Department of Avionics

Integrated Battery Chargers for Electric Vehicles- Need for Electric Vehicle Technology and Green Energy

Electric vehicle (EV) and hybrid electric vehicle (HEV) technologies are getting attention in industry and academia due to its positive impact on the environment. Increase in usage of electric vehicles results in cleaner environment because of the possibility to use green and

cleaner sources of energy for transportation. This resulted in rapid research and development in areas such as permanent magnet synchronous motor drives, induction motor drives, battery technologies, wireless power transfer technologies, battery charging topologies and associated control algorithms.

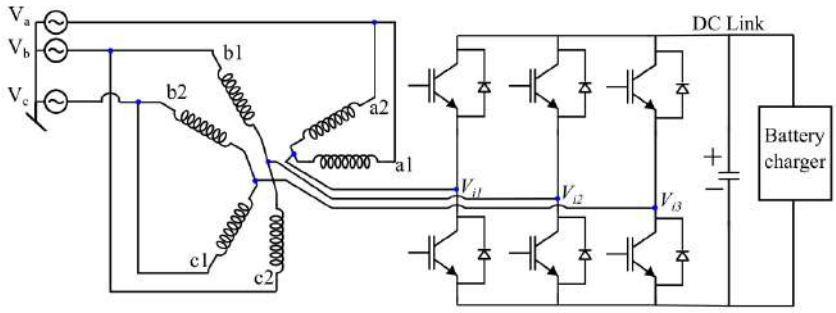
The recent trend is to move towards on-board chargers, which accelerates EV technology adoption as it addresses issues such as range-anxiety and lack of charging infrastructure. In typical on-board chargers, the entire charging and driving hardware is within the vehicle, with additional charging circuit resulting in increased vehicle weight, consuming larger space and higher cost and lower efficiency and reduced range.

Advantages

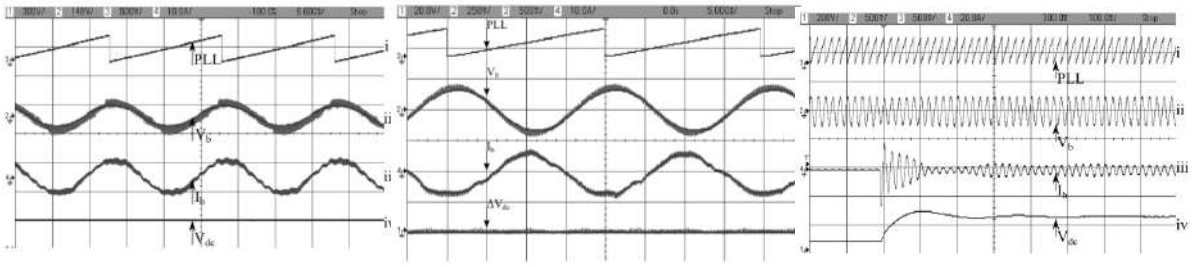
1) Existing 3-phase inverter (available in the vehicle) can be used
2) Existing 3-legged inverter can be reused
3) Possibility of retro-fit (reduced cost-to-change and market acceptance)
4) No brakes required during charging and produces zero mechanical vibration and noise while charging
5) Can be used for power-quality and energy security applications
6) Higher power handling capacity compared to existing on-board chargers – results in quick charging

Applications of Proposed Technology:

1) Three-phase Integrated Battery Chargers for high power EVs
2) Level-1 and level-2 charging for EVs
3) Level-1 charging with single phase grid with power decoupling
4) V2G and STATCOM operation is possible



(a) Proposed topology of the Integrated Battery Charger



(b) Charging mode (c) V2G mode (d) Transient performance

(i) ***Ranjith S, Vidya V and R. Sudharshan Kaarthik****, "An Integrated EV Battery Charger With Retrofit Capability" in IEEE Transactions on Transportation Electrification (Accepted Feb 2020), (ii)* ***Vidya V and R. SudharshanKaarthik****, "A Control Scheme for Integrated Battery Charger With Split-Phase Machine," IEEE International Conference on Power Electronics, Smart Grid and Renewable Energy (PESGRE-2020), Kochi, India, Jan 2020, (iii)* ***Vidya V, and R. Sudharshan Kaarthik****, "Mathematical Modeling of Split Phase Machine based Integrated Battery Charger," IEEE International Conference on Transportation Electrification - 2019 (iTEC-2019), Bangalore, India, Dec 2019, (iv)* ***Pragya Yadav, Vidya V, and R. Sudharshan Kaarthik****, "A Voltage Sensor-less Single-Phase Unity Power Factor AC-DC Front-End Converter," IEEE International Conference on Transportation Electrification - 2019 (iTEC-2019), Bangalore, India, Dec 2019, (v)* ***S. Ranjith and R. Sudharshan Kaarthik****, "An Integrated EV Battery Charger with Retrofit Capability," IECON 2018 - 44th Annual Conference of the IEEE Industrial Electronics Society, Washington, DC, 2018, pp. 5021-5026.*

Dr. Chinmoy Saha's research contribution encompasses key areas of applied Electromagnetics in general and state of the art techniques and methodologies in the area of i) microwave and mm wave circuits and antennas, ii) multi-functional antennas for modern wireless applications, iii) metamaterial inspired circuit and antennas, iv) wireless power transfer and energy harvesting and v) optical fiber based sensors, in particular. During this report period, his group has contributed seven high quality journal publications and a research level book with Taylor and Francis, USA [1]. One of the key contributions, evolved from effective collaboration between his research group and National Remote Sensing Centre, Hyderabad is the design, fabrication, and realization new set of feed antennas for satellite tracking applications. As shown in the block diagram of Fig. (a) and the fabricated antenna prototype of Fig. 1(b), the proposed X-band tracking antenna system consists of one large-aperture corrugated horn acting as the main element to extract the communication (sum port) signal and four side-launched circular waveguide elements around the central corrugated horn acting as tracking elements by extracting error signals in both azimuth and elevation [2]. The realized dual polarized compact antenna acts as feed for a 4.5 m Cassegrain ground-station reflector antenna and currently operational for efficient communication and tracking of Low Earth Orbit (LEO) satellites.

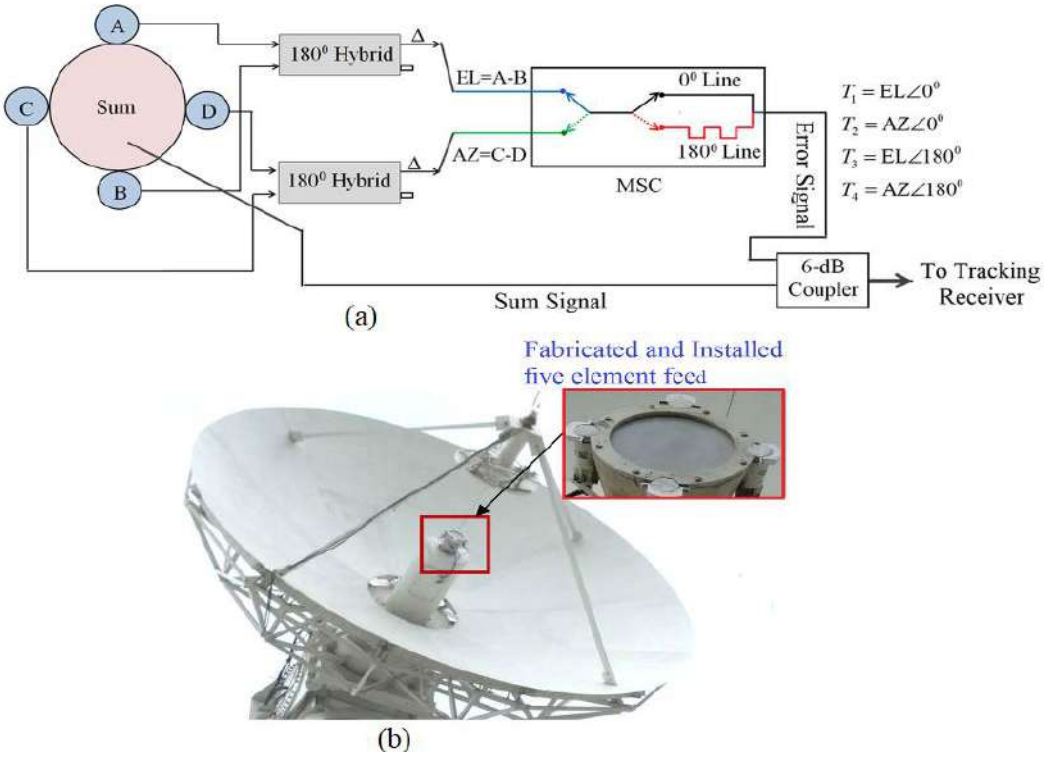


Figure: X-band Feed Antenna System for Satellite Tracking Applications: (a) over-all block diagram and (b) realized antenna prototype currently in operation

[1] ***C. Saha, J. Y. Siddiqui and Y. M. M. Antar****, "MulltifunctionalUltrawideband Antennas: Trends, Techniques and Applications", Taylor and Francis, 6000 Broken Sound Parkway , NW, Suite 300, Boca Raton, Florida 33487, USA (April 2019, ISBN: 9781138553545).[2]S. S. Roy,* ***C. Saha****, S.B. Mane, T. Nagasekhar, , M Naresh Kumar, C S Padmavathy and G. Umadevi, "Design of a Compact Multi-Element Monopulse Feed for Ground Station Satellite Tracking Applications "IEEE Antennas and Wireless Propag. Lett. Vol. 8, pp. 1721-1725, 2019.*

LOC approaches for Separation and analysis of Exosome Derived Biomarkers for Cancer Prognostics

Description: The analysis of exosomes thanks to lab on chip (LOC) approach is receiving an increasing interest but is currently limited to the separation step, the detection of exosomes being operated off-chip by conventional approaches. Even more, to our best knowledge, processing online, on-chip, exosome separation and molecular profiling of exosome-derived biomarkers (DNA, proteins) is well above the state-of the art.

The fundamental positioning and originality of this project is to tackle on line (on-chip) the separation of exosomesflowing in their complex native medium and the extraction/analysis of derived protein. This is an ambitious objective which implies that each step, taken individually, must be highly efficient and compatible with the upstream

or downstream one. This project beneficiates, however, from encouraging preliminary results obtained by the French and Indian partners.

In that perspective, we propose to evaluate the coupling of two performing methods within a single integrated chip.

Features:

a. Lab on Chip based Exosome separation
b. Detection of exosome derived protein by nanomaterial-based electrochemical system for cancer diagnosis
c. Coupling all the suitable methods to realize an Integrated LOC platform for Exosome derived protein analysis

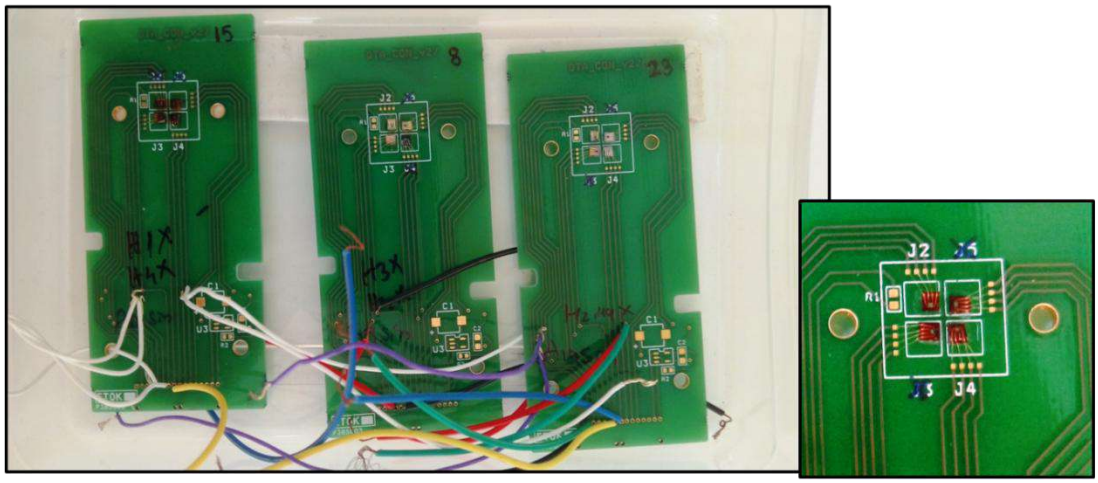
Development of Real Time Gas Sensor Array to Monitor Critical Gases in Crew Module for Human Space Mission.

Description: Spacecraft are partially- or fully-closed environments that demand environmental monitoring to protect the health of the crew and the vehicle. Many sources of air and water pollutants exist on spacecraft (e.g., humans, material off-gas products, system chemicals, and experiments), which are scrubbed by various Environmental Control and Life Support Systems (ECLSS). How much monitoring is required and the characteristics of the monitors all depend on the mission scenario, particularly mission durations and the ability of the crews to return to Earth or seek safe in the event of environmental contamination of their primary vehicle. An initiative has been taken by IIST to Design, development and qualifies the gas sensors (CH_4, CO, NH_3 and O_2) for upcoming Gaganyyanmission .

Features:

a. Design and development of Metal Oxide based gas sensors: Only Indigenous sensors for upcoming Gaganyaan mission (Human space Program , Dec 2021).
b. Exploring the Photocatalytic properties of optically-activated nanomaterials.
c. Optical activation to provide necessary activation to reduce base line drift. [Patent by Palash Kumar Basu/Patent 2017: 201741027050.]
d. Packaging, Qualification and Readout: Compatible to Human rated GSLV platform
e. Follow up the progress and take active part during qualifications of gas sensors for Unmanned Mission and Manned mission.
f. Final Gas Sensor Module for Final Flight: December, 2021

Development of Real Time Gas Sensor Array to Monitor Critical Gases in Crew Module for Human Space Mission



CO, NH3,CH4 and CO2 Sensor:
Characterization is Going On:

Dr.Palash Kumar Basu, projects under *DST-CNRS (CEFIPRA) -ongoing and Human Space Flight Centre, ISRO HQ –approved.*

Department of Chemistry

A transparent and electrically conducting polyimide composites having electrostatic charge mitigating characteristics have been developed to address the concern related to the surface charging of satellites. Super toughened epoxy composite was another material developed for space-related applications. Without compromising on the mechanical property of the epoxy material a super toughened composite was prepared using surface engineered nanomaterials. Another noted material is the CNT loaded PP/Nylon 6 Microfibrillar Composites (MFCs) with excellent mechanical properties (with a tensile strength of 250 MPA) and electrical conductivity with a percolation threshold of 0.2% nano-filler. Significant contribution towards disease diagnosis has been made thorough biosensors for the detection of fructose in semen for infertility test, *E coli* in UTI patients, choline for Alzheimer's screening, to mention a few. These sensors have very high societal importance. Apart from these, several industrially relevant biocomposites have been developed.

Prof. Kuruvilla Joseph

Prof. Nirmala Rachel James's group focuses on polymeric thermally activated delayed fluorescence (TADF) materials.Polymeric TADF emitters are particularly suitable for solution processing technologies. However, synthesizing TADF oligomers and polymers is challenging, and there are no clear guidelines for their optimal molecular structures.

The objectives of the work are

1. To study the molecular, optoelectronic and charge transport properties of standard materials in Polymeric Light Emitting Diodes (PLED)

2. Design of TADF blue light emitting polymers by combinatorial approach

3. Develop a theoretical model to tune the of HTL,EML and ETL layers

4. Investigate and optimize the TADF polymer charge transport characteristics, mobility, trap states, recombination, carrier density etc. by QM, CM, and Device simulation tools.

- Poly-3,4-ethylenedioxythiophene: polystyrene sulfonate (PEDOT: PSS) is a conducting polymer used as hole transport material in light emitting devices (LED) where, PSS acts as solubility enhancing component. However, electrical conductivity (EC) (< 10 S cm $^{-1}$) and hole mobility ($< 10^{-3}$ cm ^{2} V $^{-1}$ s $^{-1}$) of PEDOT PSS is not satisfactory for device applications. This is due to the formation of insulating PSS outer layers which inhibits the formation of well-aligned PEDOT conducting chain networks. To resolve the issue, we have developed a theoretical model to separate PSS chains from the PEDOT: PSS. In our work, we have carried out the quantum mechanical studies of interaction of PEDOT PSS with different solvents. Neutral (PSSH, PEDOT) and charged (PEDOT+, PSS-) trimers were considered for theoretical studies. MD simulation using NVT ensemble is also performed for analyzing mobility in amorphous state. It is found that there is increase in the hole mobility of PEDOT PSS in selected polar solvents. These findings are important for the selection of alternative solvents for further EC enhancement of PEDOT: PSS in display applications.

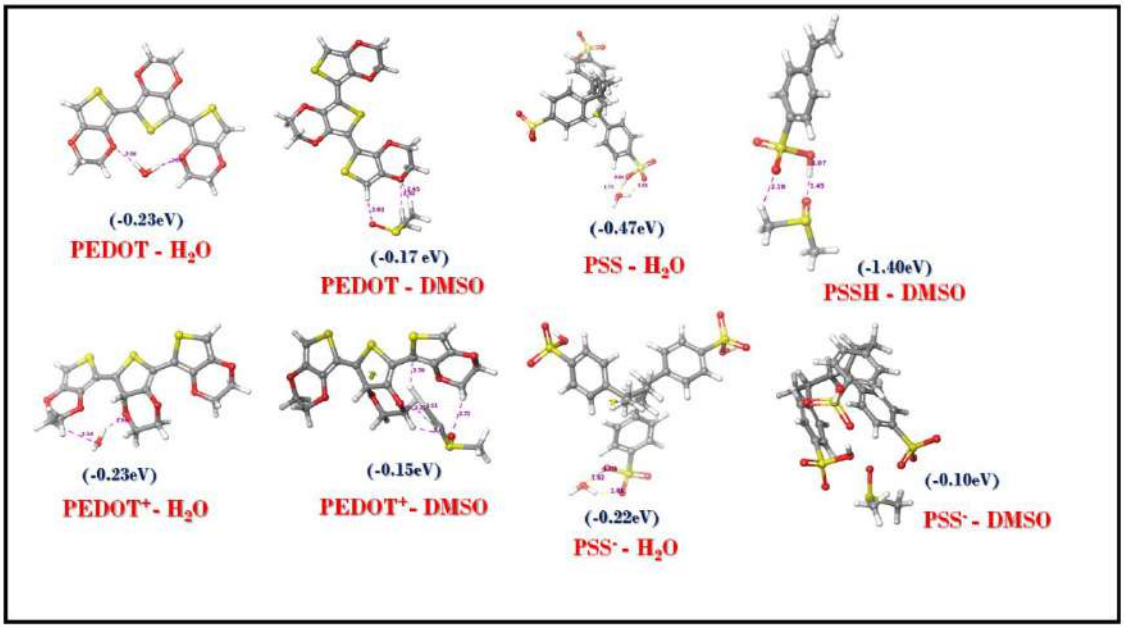


Figure: PEDOT-PSS /water and DMSO intyeractions optimized by an in house theoretical model

- Currently, the synthesis of feasible polymeric TADF materials are attempted. Laboratory for synthesis of TADF materials and fabrication/characterization of OLED devices have been established recently. A new architecture for OLED assisted Digital Data Transfer communication is developed.

Photoluminescent WS2 quantum dots (WS2 QDs) have been prepared from the bulk WS2 employing hydrothermal synthetic strategy in the presence of NaOH. The monodispersed QDs were endowed with characteristics such as excellent water solubility, good photostability, and temporal stability, with the best emission in the alkaline pH. Selective and sensitive detection of 2,4,6-trinitrophenol (TNP), a member from the family of nitroaromatics (NAs) explosives, was demonstrated using the WS2 QDs. Upon interaction with TNP, the PL emission of WS2 QDs were quenched linearly over a range of 2.5 to 100 μM. The limit of detection was low as 0.27 μM, which attests the potential of the WS2 QDs as TNP sensor. The electron transfer, Förster resonance energy transfer (FRET) and inner filter effect (IFE) together constitute the mechanism of quenching. Since all the NAs are electron deficient, they can facilitate the quenching of PL of a fluorophore by electron transfer. Primarily, the latter two quenching mechanisms furnish the selectivity towards TNP over other NAs. We envisage that these water-soluble QDs are potential chemical sensors in the biological domain.

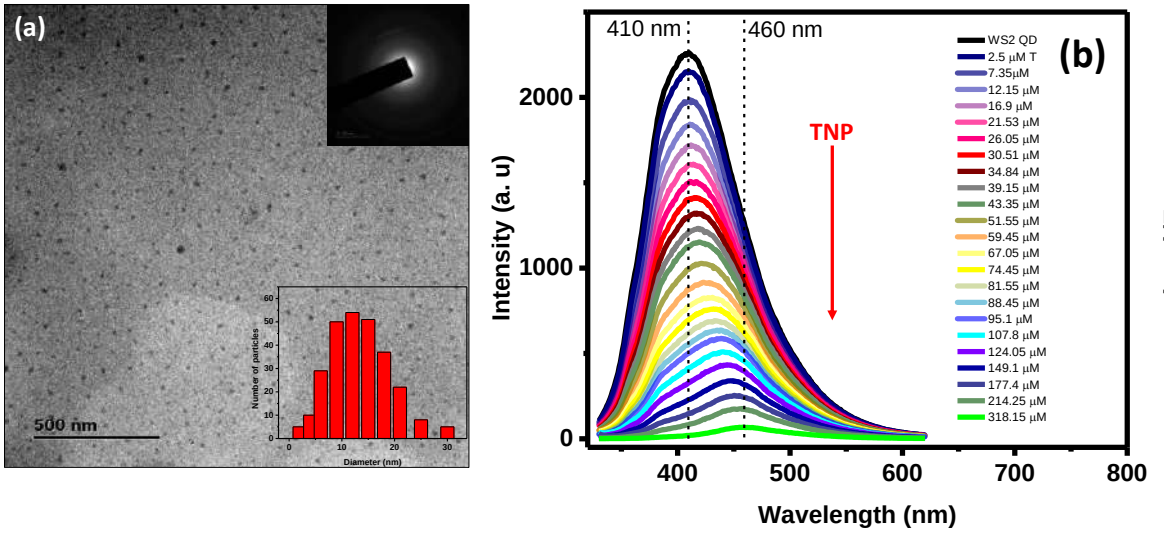


Figure: (a) TEM image of the WS2 quantum dots. (b) Decrease in fluorescence intensity in the presence of TNP

Neema ***P M; Cyriac Jobin,*** *Hydrothermal synthesis of WS_2 quantum dots and their application as a fluorescence sensor for the selective detection of 2,4,6-trinitrophenol. New Journal of Chemistry (2020), 44, 10840-10848.*

Department of Earth and Space Sciences

The supersonic winds produced by massive stars carry a large amount of kinetic power. In numerous scenarios such winds have been proven to produce shocks in which relativistic particles are accelerated emitting nonthermal (NT) radiation. Here, we report the first detection of NT emission from a single stellar bubble, G2.4+1.4, associated with a WO star. We observed this source with the upgraded Giant Meterwave Radio Telescope in Band 4 (550–850 MHz) and Band 5 (1050–1450 MHz). We present intensity and spectral index maps for this source that are consistent with synchrotron emission (average spectral index, $\alpha = -0.83 \pm 0.10$). The fraction of the available kinetic wind power that is converted into cosmic-ray acceleration is estimated to be of the order of a few percent. This finding constitutes an observational breakthrough and gives new insight on the NT physical processes taking place in the environments of isolated massive stars. In particular, our results show that non runaway isolated massive stars are capable of accelerating relativistic particles and are therefore confirmed as sources of Galactic cosmic rays.

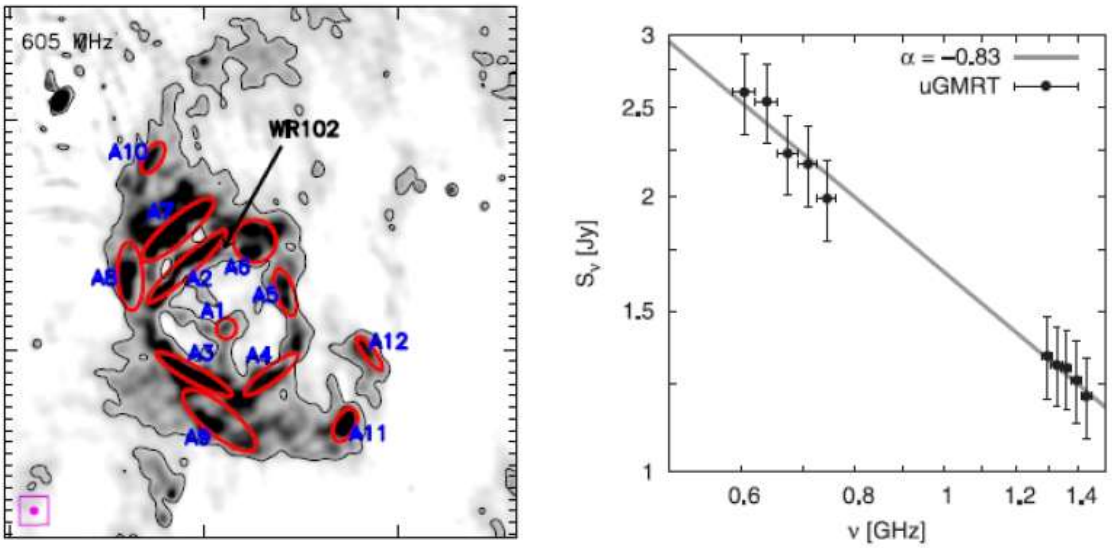


Figure: uGMRT radio map of WR 102 and the radio spectral energy distribution showing clear evidence of non-thermal emission.

Particle Acceleration in the Wolf–Rayet Bubble G2.4+1.4- ***Prof. Anandmayee Tej***

Galaxy clusters are the most massive gravitationally bound structures in the universe. They possess copious amounts of gas in a diffuse form outside of the cluster member galaxies. Referred to as the intracluster medium, routine observations of this gas has been done at X-ray wavelengths that only reveal plasma at temperatures of a few million kelvin. In Pradeep et al. (2019) and Manuwal et al. (2019) we provided observational evidences using the Hubble Space Telescope that much cooler (T ∼ 10,000 K) gas as large columns are present in galaxy over density environments. The detections we presented are some of the largest neutral gas columns reported till date in galaxy cluster spaces, increasing the size of an otherwise small sample of detections of such gas. The project and the publications that resulted from it have IIST students in the lead.

Jayadev Pradeep, Anand Narayanan, *Sowga tMuzahid, Daisuke Nagai, Jane C Charlton, Srianand Raghunathan, October 2019, Monthly Notices of the Royal Astronomical Society, 488, 5327.*

A supernova explosion heralds the death of a massive star and a supernova remnantrepresents the heated leftover gaseous matter of this event in the neighbourhood. Whatremains behind of the massive star is a neutron star or a blackhole. A supernova remnant is usually seen in the sky as a hot filamentary distribution of matter, often in the form of bubble structures, a telltale sign of the dramatic event. The supernova remnant in question, G351.7, was discovered using GMRT recently. A jet of atomic hydrogen has been found towards the supernova remnant G351.7. In addition to the fragmented shell structure of the supernova remnant that was observed in atomic hydrogen, we chanced upon the high velocity jet located towards the interior of the shell. Jets represent matter

from the vicinity of rotating cosmic objects beamed out at high velocities along the axis of rotation. 'The jet from G351.7 extends upto a total length of nearly 20 lightyearsand is highly directional unlike the earliercases', observes Nirupam Roy of the Indian Institute of Science, Bangalore and a member of the team. The object beaming out the jet has not yet been detected. A search for a rotating neutron star, also called a pulsar, towards the central regions of the supernova remnant using radio wavelengths yielded negative results. This does not mean that there is no pulsar or rotating blackhole, as the very presence of jet points towards the presence of a compact object. Followupstudies should give more hints about the nature of the compact source that is responsible for the genesis of this jet within the supernova remnant.

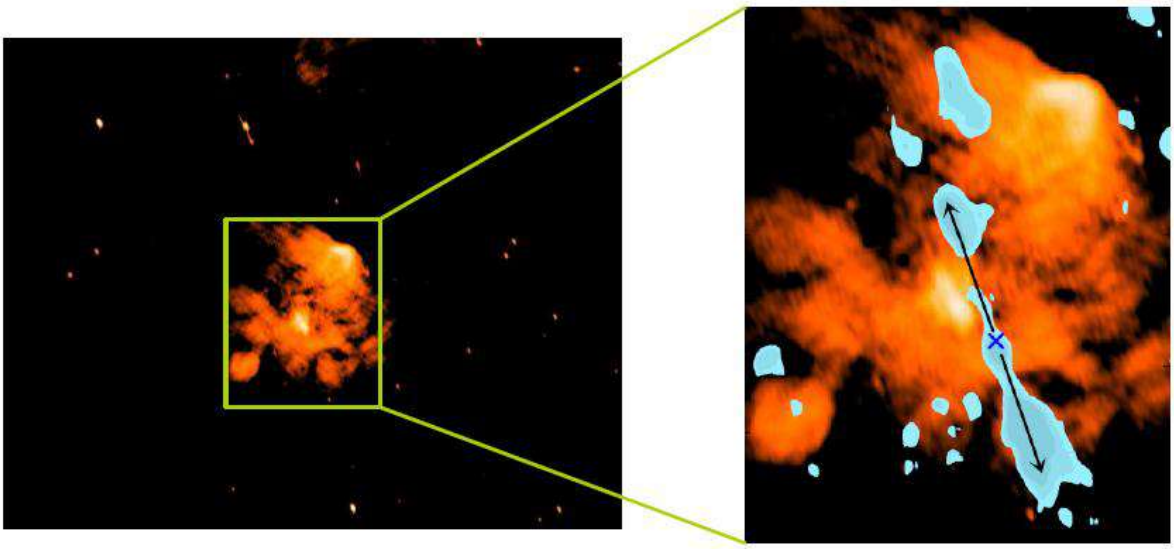
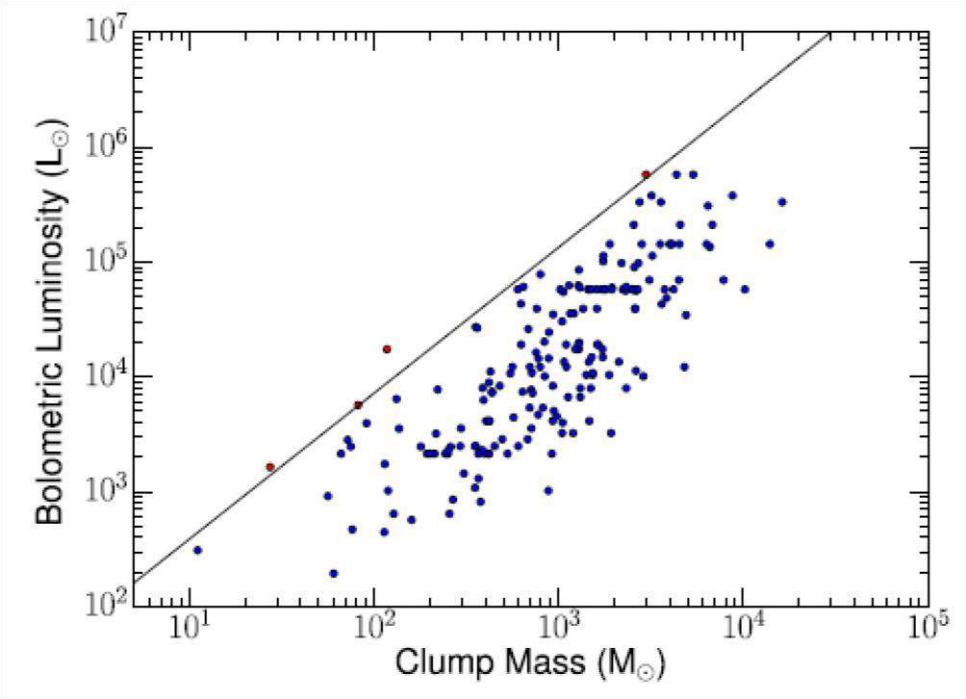


Image shows radio continuum emission from supernova remnant G351.6 at 325 MHz. The blue colour on the right enlarged picture depicts the atomic hydrogen. The arrows indicate direction of the jet lobes and cross shows the location of high energy gamma-ray source.

Veena V. S., S. Vig, *et al. A supernova explosion heralds the death of a massive star and a supernova. Monthly Notices of Royal Astronomical Society (MNRAS) Letters, vol. 488, L59, 2019*

The $5_0 - 6_1$ A^+ line of methanol at 6.7 GHz is the strongest of Class II methanol masers. There is strong evidence that the masers are exclusively associated with early phases of the formation of massive stars. In order to test the association between massive star formation and 6.7 GHz methanol masers, and to probe the evolutionary state of the young stellar objects exciting the masers, spectral energy distributions of 320 methanol masers were constructed from 870 μm to 70 μm using data from ATLASGAL and Hi-GAL surveys. We observe a mean dust temperature of 22 K confirming that the sources exciting methanol masers are more evolved than infrared dark clouds. A comparison of the mass luminosity diagram of the target sources with simple evolutionary tracks from a model of massive star formation suggests that over 90% of the sources to be in stages of

accelerating accretion prior to the formation of a HII region. While most of the masers appear to be indeed associated with massive star formation, there appears to be a small fraction of sources that may be associated with intermediate or low-mass stars. This work has been published in the Monthly Notices of the Royal Astronomical Society (Paulson &Pandian 2020).

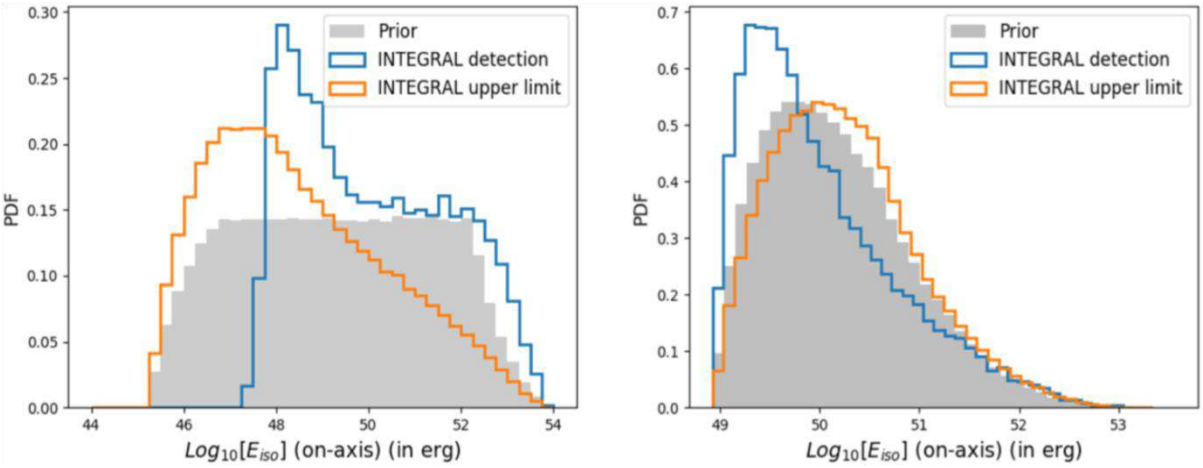


The figure shows the mass-luminosity diagram for 198 methanol maser sources for which bolometric luminosities could be determined. Sources below the solid line are in the phase of active accretion while sources above the solid line are in clearing phase. The vast majority of the sources are seen to be in accretion phase.

***Dr. Jagadheep. D**. -Probing the early phases of massive star formation through 6.7 GHz methanol masers*

Advanced LIGO and Virgo (AdvLIGO/VIRGO) detectors reported the first binary neutron star merger candidate in the third observing run, S190425z, on 2019 April 25. A weak γ-ray excess was reported nearly coincidentally by the INTErnational Gamma-Ray Astrophysics Laboratory (INTEGRAL) satellite, which accidentally covered the entire localization region of AdvLIGO/VIRGO. Electromagnetic follow-up in longer wavelengths has not lead to the detection of any associated counterparts. Here we combine the available information from gravitational wave measurements and upper limits of fluence from INTEGRAL to show that the observations are completely consistent with a relativistic Gaussian structured jet and a typical short duration gamma-ray burst (GRB) being produced in the merger. We obtain posterior bounds on the on-axis isotropic

equivalent energy of the associated GRB under different prior distributions. This study demonstrates that even limited gravitational wave and electromagnetic information could be combined to produce valuable insights about outflows from mergers. Future follow-ups may help constrain the jet structure further, especially if there is an orphan afterglow detection associated with the candidate.



M Saleem, ***L Resmi****, K G Arun, &****S Mohan.*** *Of Relativistic Jets Associated with Binary Neutron Star Mergers. ApJ, 2020, vol 891, page 130.*

Volcanic landforms are the most prominent features present on the surface of Earth's Moon. Serial magmatism that began at around ~4.1 Ga ago continued till ~1.2 Ga and filled the low-lying regions of the major lunar basins (Diameter >300 km), which formed the vast mare basaltic plains on the Moon. The signs of volcanic eruptions are directly linked to the thermal history of the Moon as mare basaltic magmas are commonly the result of the partial melting of the lunar mantle. Recent findings from the Moon have provided evidence for younger volcanic events from chemically heterogeneous source regions in the lunar mantle. The study has attempted to understand the volcanic and thermal history of the Grimaldi basin on the nearside of the Moon using orbital remote sensing data. This study investigated the spectral and chemical characteristics as well as the ages of the chemically distinct mare basaltic units within the Grimaldi basin (two units, namely Mare Grimaldi and Mare Riccioli), which revealed mare basalts of varying TiO_2 and FeO contents in the region. It is found that at least two phases of basaltic magmatism have occurred in the Grimaldi basin spanning ~3.5 Ga to 1.5 Ga. High-Ti olivine basalts dated at 2.05 Ga are found to be surrounded by older (~3.47 Ga) low-Ti basalts in Mare Grimaldi. Medium to low-Ti basalts observed in Mare Riccioli date back to two different volcanic events at ~3.5 Ga and ~3.2 billion years, while patches of basalts having remarkably higher titanium content within the Mare Riccioli record the youngest age of ~1.5 Ga. The present study inferred that the high-Ti basalts in the Mare Grimaldi

crystallized from a Fe-enriched late-stage magma while the low-Ti basalts crystallized from an Mg and Ca-rich initial magma that experienced an ultra-late stage quenching. The low-Ti basaltic magma erupted in both the units was derived by partial melting of olivine-orthopyroxene cumulate materials in the post-overturn upper mantle and made its way to the surface through the fractures caused by the basin forming impact event. The high-Ti magma erupted in the Mare Grimaldi was generated by a hot plume ascended from deeper clinopyroxene-ilmenite rich cumulate layer near the core-mantle boundary. Whereas, the youngest (~1.5 Ga) high-Ti volcanic activity in the Mare Riccioli rather sourced from the ilmenite-clinopyroxene cumulate materials remained in the upper mantle after mantle overturn. The new results suggest that volcanism had not ceased in the Grimaldi basin at 3.27 Ga;instead, it was active and fed by different mantle sources until 1.5 Ga for a period spanning ~2 billion years.

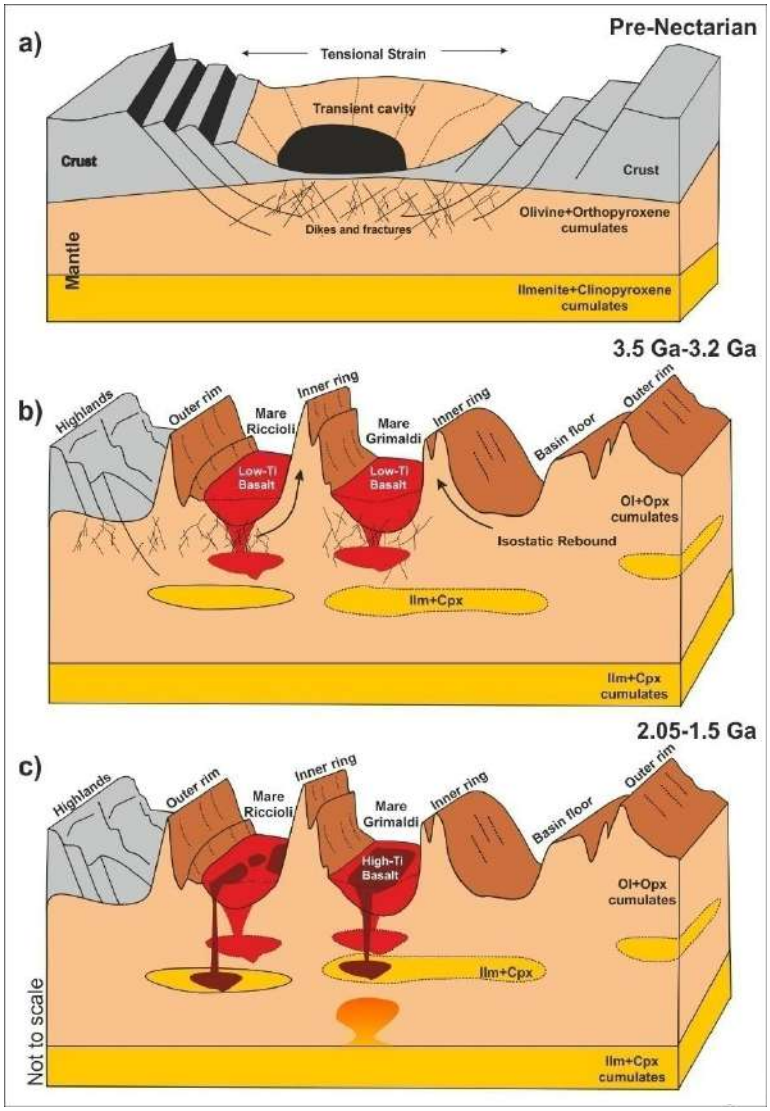


Fig. Schematic representation showing the stages involving emplacement of mare basaltic units in the Grimaldi basin. A) The early stage of the Grimaldi basin consisting of a transient crater cavity in the pre-Nectarian period (>3.9 Ga). B) The eruption of the low-Ti basalts from the olivine-Opx cumulates in the upper mantle during ~3.5 Ga to 3.2 Ga period, which filled the low-lying interior of the basin and forms the lower Mare Grimaldi and Mare Riccioli units. C) Younger events of high-Ti magmas erupted at ~2.05 Ga and ~1.5 Ga ago in the Mare Grimaldi and Mare Riccioli respectively, which possibly sourced from a hot plume, risen from ilmenite-clinopyroxene cumulate layer near

Similarly, Mare Humorum has experienced magmatism during a period spanning from ~3.5 Ga to 2.7 Ga, indicating that Moon was volcanically active during its early history and continued to produce basaltic magmas at least till ~1 billion years. Furthermore, we have identified and characterized terrestrial spinels that are chemically analogous to chromium spinels detected on the lunar surface. The chromium spinels from Sittampundianorthosite complex in southern India are found to have chemistry more or less similar to that of lunar spinels. This study is useful in interpreting similar spinel compositions from the Moon obtained through orbital remote sensing data and better understand the lunar lithologies through terrestrial analogies.

Thesniya P. M. and V. J. Rajesh *Compositional and morphological characterization of pyroxene spinel bearing lithologies on the Moon: implications for the Lunar evolutionary history. ISRO-Chandrayaan –I AO Project.*

Department of Humanities

A study was conducted to survey, and compare across states, the influence of applications of space technology(Telecommunication -Mobile phone, and ISD services, Broadcasting services –DTH, Television -Doordarsan, Business Purposes – Fishery, Banking and Others- Tele education, Tele medicine, Disaster management system (DMS), Village resource centers) in the social and economic life of households in South India. The sample consisted of 6000 households belonging to Kerala (n=750), Telengana (n=500), Puducherri (n=250), Tamilnadu (n=1750), Andhrapradesh (n=1250), and Karnataka (n=1500). S&T tools have revolutionized the life of people. It revolutionized the life of people both personal and socio-economic. But very few people are aware that these applications are the contributions ofspace technology. Even though accessibility to S&T tools is high there is a high need for appropriate dissemination of information about the use of space technology, indicating
scope for improvement.

Shaijumon C S and **Lekshmi Nair**

Department of Mathematics

(i) **Geometry of immersions into statistical manifolds.**

A necessary and sufficient condition is obtained for statistical manifold structures to be dual to each other for a non-degenerate equiaffine immersion. Then we obtain conditions for realizing an n-dimensional statistical manifold in an (n+1)-dimensional statistical manifold and its converse. Centro-affine immersion of codimension two into a dually flat

statistical manifold is defined. Also we have shown that statistical manifold realized in a dually flat statistical manifold of codimension two is conformallyprojectively flat.

(ii) Conformal Submersion and Statistical Manifolds.

We obtained a necessary and sufficient condition for tangent bundle TM to become a statistical manifold with respect to Sasaki lift metric and complete lift connection. Also we studied statistical structure on the manifold B induced by affine submersion of M onto B with horizontal distribution. A necessary and sufficient condition for submersed statistical manifold to be dually flat is given. We introduced the conformal submersion with horizontal distribution which is a generalization of affine submersion with horizontal distribution and generalized the results of Abe and Hasegawa.

Prof. Subramanian K S Moosath – the research work in the area of information geometry.

Elastic bodies like plates, shells, rods etc are three dimensional bodies. However, often, one or more of their dimensions say, the "thickness", is "small" compared to the others. In such cases lower dimensional theories has been proposed as approximations of the usual three dimensional theory. The main reasons for preferring lower dimensional models are their amenability to numerical computations and their simpler mathematical structure produces richer variety of results.

Most of the lower dimensional theories proposed by Koiteretc rely on a priori assumptions of mechanical geometrical nature. Further it is not clear which is the lower dimensional model most suited for a particular three dimensional model in hand. Thus one is lead to the question of mathematically deriving (or justifying) a lower dimensional model starting from the three dimensional model.

Prof. Nicholas Sabu

The research focus is on the development of discontinuous finite volume method and virtual element methods for the approximation of coupled flow-transport problems, immiscible displacement problems, Stokes equations, nonlinear hyperbolic conservation laws and optimal control problems. Recently, we have design new numerical techniques for the numerical approximation of control problems, and the details of this work are as follows: Fluid control problems are highly important in diverse fields of science and engineering. Recently, with Dr. Ricardo Ruiz-baier (when he was working at Oxford University, UK, presently working in Monash University, Australia) we have introduced a discontinuous finite Volume method for the approximation of distributed optimal

control problems governed by the Brinkman equations, and this study has appeared in Journal of Scientific Computing (2019). In view of certain applications of discontinuous methods and finite volume methods in poroelasticity, a discontinuous finite volume method is designed in collaboration with Ricardo Oryzua (University of Bio-Bio, Chile) for the approximation of solid displacement using a dual mesh, whereas a mixed approach is employed to approximate fluid flux and the two pressures. This work appeared in Mathematical Modelling and Numerical Analysis (M2AN: ESIAM) in 2020. Moreover, development of an accurate and efficient numerical technique for seeking solution of fluid flow problems is challenging and one of the most active research lines in the numerical analysis of partial differential equations (PDEs).

Sarvesh Kumar *- A proposal from DST entitled`` Discontinuous virtual element approximations for non-stationary fluid flow problems" was sanctioned in March 2020.*

The onset of turbulence is often related to the randomness of background movement, for instance, structural vibrations, magnetic fields, and other environmental disturbances. One way to model this is to consider a randomly forced Navier-Stokes equations. The stochastic forcing that is added to the deterministic Navier-Stokes equation models the influence of the random environment on the fluid in fully developed turbulence. Small noise prevalent in nature is magnified by the instabilities in the flow and therefore, it becomes more useful to consider the velocity in turbulent flow to be a stochastic process. In this context, we considered the Navier-Stokes equations subject random noise which is the sum of Gaussian noise for the continuous process and Levy noise to model the jump part of the process. We studied the rigorous mathematical justification of the following ergodic principle for the 3D stochastic Navier-Stokes equations which lies at the foundation of the statistical approach to the theory of fluid dynamics: there exists an equilibrium measure over the phase space consisting of velocity fields such that, for every regular observable defined over the phase space, and for every initial velocity field, the time average of the observable tends to the mean value of the observable with respect to the equilibrium measure as time goes to infinity.

Since we are considering the 3D stochastic Navier-Stokes equations with Levy noise, we first construct a Markov family of martingale solutions for this equation. It is then constructively used to obtain the existence of a unique invariant measure, which is ergodic and strongly mixing. Indeed, ergodicity and strongly mixing properties of the invariant measure are obtained from the strong Feller property and irreducibility of the transition semigroup.

*Manil T.Mohan, **K. Sakthivel** and S. S. Sritharan, Ergodicity for the 3D stochastic Navier-Stokes equations perturbed by Levy noise. MathematischeNachrichten, 292 (2019), 1056-1088.*

Department of Physics

Topological phases of matter fall outside the realm of Landau's classification of phases based on symmetry. Such phases can have remarkable properties: robust quantum numbers that are impervious to perturbations and are therefore protected from decoherence, exotic quasiparticle excitations with exotic exchange statistics, etc.

Kitaev's honeycomb lattice spin model is a paradigm system in the study of topological order. Together with PhD student Randeep NC, we have studied the topolgical boundary states in a three-dimensional generalization of the Kitaev model. We obtained exact solutions of the boundary modes corresponding to the complete phase diagram of the model. We also verified the bulk-boundary correspondence – the manifestation of the topology of the bulk at the boundary.

The three-dimensional Kitaev model is a nodal line semimetal in the gapless phase and has a contour in the momentum space over which the energy gap vanishes. We obtained solutions of boundary modes called the drumhead states, which are characterstic of nodal line semimetals.

***N. C. Randeep, Naveen Surendran**, "Zero-energy Majorana edge modes in three dimensional Kitaev model," Phys. Rev. B, vol. 100, p. 045134, July 2019.*

In the work carried out at IIST and reported as[1], we studied the robustness of single-mode squeezing nonclassicality against the action of single-mode Gaussian noise (Gaussian channels), first in its local single-mode form and second in its nonlocal distributed form as two-mode entanglement. The channel was acting locally on the single-mode in both the instances. We find that the distributed single-mode nonclassicality is more robust than local single-mode nonclassicality against the local application of the canonical single-mode Gaussian channels i.e., for the canonical attenuator channel, the canonical amplifier channel, the canonical phase-conjugation channel, and the channel with a singular X matrix, with the exception of the channel with a singular Y matrix. This robustness persists even when the canonical channel is nonclassicality breaking. For the canonical channel with a singular Y matrix, we find that the distributed as well as the local single-mode nonclassicality is equally robust against the local application of the channel. We illustrate examples where local single-mode squeezing is more robust than distributed squeezing against the local application of the channel, for channels not of the canonical form. The work is definitely relevant for ISRO, particularly in its recent efforts towards satellite based quantum communication. Note that the passage of 'quantum' light through earth's atmosphere can be efficiently modelled as a Gaussian channel process.

The work reported as[2] explores non-Gaussian channels as opposed to Gaussian channels. Recent literature suggests some advantages of non-Gaussian quantumness. We explore non-Gaussian physical processes(noise) in the context of the Tavis-Cummings Hamiltonianian evolution. Here, the time evolution of two-level atoms interacting with a single-mode radiation field through the Tavis-Cummings Hamiltonian is studied from the perspective of channel action on the radiation mode. The operator sum representation for the channel in the situation of one atom interacting in resonance with the radiation mode, and two atoms interacting in resonance with the radiation mode, is obtained in the Fock basis. The notions of entanglement breaking, extremality, non-classicality and non-Gaussianity are explored using the obtained operator sum representation. It is shown that the respective channels are not entanglement breaking, are extremal and can generate both non-classicality and non-Gaussianity.

[1] ***Sagnik Garai and J Solomon Ivan***, *Robustness of distributed nonclassicality against local Gaussian noise, Phys. Rev. A* ***100***, *013842 (2019).*

[2] ***Dasika Shishir and J Solomon Ivan***, *Non-Gaussian bosonic channels in Tavis-cummings model, Quant. Inf. process.* ***18***, *307 (2019).*

Measurement of spatial squeezing with the EMCCD camera: The observation of spatial quantum noise reduction, or spatial squeezing, with a large number of photons can lead to a significant advantage in quantum imaging and quantum metrology due to the scaling of the signal-to-noise ratio with the number of photons. Here we present a systematic study of the limiting factors that play a role on the measurement of spatial squeezing with an electron-multiplying charge-coupled device (EMCCD) camera in the limit of bright quantum states of light generated with a four-wave mixing process in an atomic vapor cell. We detect a total number of photons per beam of the order 10^8 in 1μs pulses, which corresponds to a photon flux per beam of the order of 10^{14} photons per second. We then investigate the role of different parameters, such as cell temperature, pump power, laser detunings, scattered pump background noise, and timing sequences for the image acquisition with the EMCCD camera, on the level of spatial squeezing. We identify critical parameters to obtain an optimum squeezing level and demonstrate that for bright beams it is essential to acquire images at a rate fast enough to overcome the effect of classical technical noise.

Ashok Kumar *and A. M. Marino, "Spatial squeezing in bright twin beams generated with four-wave mixing: Constraints on characterization with an electron-multiplying charge-coupled-device camera", Physical Review A 100 (6), 063828 (2019)*

4.2 Research Projects

IIST support the research of its faculty members through various schemes such as Fast Track projects for newly joined faculty, IIST Projects and IIST-ISRO Projects, coordinated by IIST Research Council headed by Dean (R&D) and Advanced Space Technology Development Cell (ASTDC). The faculty members are also working on projects funded by other external funding agencies such as DST, CSIR and UGC. Currently, …..research projects are in progress in IIST.

4.2.1 IIST Projects

Sl. No.	Name of the Project	Investigators
1.	Hydrodynamic instabilities in Solid Rocket Motors.	**Dr. Manu K. V**
2.	Intrinsically conducting Polyimide composites with CNT/graphene without compromising optical properties	**Prof. Kuruvilla Joseph**
3.	Reluctance-Hall EffectBbased Through-shaft Angular position Sensors- Finite Element Studies and Development	**Dr. Anoop C. S.**
4.	Development of rapid network stack development tools for internet-of-things operating systems.	**Dr. Vineeth B. S.**
5.	Subsystems for INSPIRE sat 1	**Dr. Priyadarshanam** **Dr. Harsha Simha M. S.**
6.	Mirror Satellite for Autonomous Assembly of Reconfigurable Space Telescope.	**Dr. Priyadarshanam** **Dr. Harsha Simha M. S.**
7.	Electrical Power System for Small-Spacecrafts	**Dr. Sudharshan Kaarthik R**
8.	Decoupled Control Scheme for Dual Permanent Magnet Machine Actuators	**Dr. Sudharshan Kaarthik R**
9.	3 on going one new submitted	**Dr. Deepak Mishra**
10.	Space Technology and its Penetration into the Socio Economic Space of the Households of India (25 lakhs),	**Dr. Shaijumon C S** **Dr. Lekshmi V Nair**
11.	Assessment of the contributions made by IIST alumni in the ISRO programmes	**Dr. V. Ravi**
12.	Development and analysis of image fusion techniques for satellite images	**Dr. Deepak Mishra** **Dr. Sarvesh Kumar**

13.	Electric Propulsion	**Dr. Sourin Mukhopadhyay**
14.	Optical Interferometry based sensor for structural displacement/ deformation measurement of materials.	**Dr. Dinesh Naik**

4.2.2 IIST-ISRO Projects (Internally funded)

Sl.No.	Name of the Project	Investigators
1.	Optimisation of regenerative cooling channels of liquid rockets engines.	**Dr. Shine S R** Mr. J. C. Pisharady
2.	Simulation of non equilibrium hypersonic flow in a shock tunnel nozzle.	**Dr. Satheesh K.** **Dr. Devendra Ghate** Dr. K. Srinivasan
3.	Development of an in-house CFD code for the performance prediction of cryogenic and semi-cryogenic engines.	**Dr. Deepu** Mr. K. N. Dileep
4.	Studies on crack propagation in composites by micro Raman spectroscopy	**Dr. Anup S**
5.	Experimental Investigation of Thermoacoustic Instability in Confined Swirl Coaxial Jet Flames	**Dr. Mahesh S.**
6.	Laser Sheet Droplet Sizing for Spray Studies	**Dr. Aravind V.**
7.	Modeling and Development of N2O4 (oxidant used in rocket engines) Scrubber System	**Dr. A. Salih**
8.	Experimental and numerical study of stationary flat flames	**Dr. Prathap C.** Dr. Assiz M P
9.	Experimental investigation of laminar burning velocity premixed Isrosene/air/oxygen mixtures using freely expanding spherical flames	**Dr. Prathap C.** Dr. Assiz M P
10.	Development of Laser Ignition Systems	**Dr. Jinesh** Dr. C. Prathap
11.	Spaceflight-induced changes in kidney stone formation in Drosophila Melanogaster- Microgravity science payload for Gaganyaan - first development flight	**Dr. K. G. Sreejalekshmi**
12.	Study of Silicon -Polymer Nanofibers as Anode Material for Lithium Batteries	**Dr.K.Y.Sandhya** Dr. Nirmala Rachel James
13.	Development of novel N2O4 scrubber system	**Prof. Kuruvilla Joseph** Dr. S.A. Sali Dr.K. Prabhakaran

14.	Superionic conductor as electrolytes for all solid-state- lithium sulfur batteries	**Dr. Mary Gladis**
15.	N-doped mesoporous carbon-sulphur composite based cathode materials for advanced lithium-sulfur batteries	**Dr. Mary Gladis**
16.	Plasma Functionalized CNT-polymer nanocomposites for Satellite	**Dr. N. Gomathi,** Prof. Kuruvilla Joseph, Dr.C. Gouri
17.	Design and Development of Brushless DC Motor	**Dr. N. Selvaganesan**
18.	Development of MEMS Accelerometer with Ultra-Sensitive Transductions for Space Applications	**Dr. Seena V.**
19.	Retarding Potential Analyser for Electron and Ion concentration measurement in Martian Atmosphere, Retarding Potential Analyser for Ionospheric Studies (ARIS 101F) - A scientific payload on PS4 orbital platform onboard PSLV C45	**Dr. Sudharshan Kaarthik R**

4.2.3 ISRO Funded / Consultancy Projects

1.	Spectral Characterization and morphology of Olivine-pyroxene spinel bearing lithologies on Moon: implications for lunar endogenic process.	**Dr. V. J. Rajesh** SSPO/Chandrayaan-I AO
2.	A comprehensive study on crustal dichotomy and extensional tectonics in and around valles marineris, mars	**Dr. V. J. Rajesh** SSPO/MOM-I -AO
3.	Algebraic Multigrid method for solving sparse system	**Dr. E. Natarajan Dr. Sarvesh Kumar** VSSC
4.	Advanced Retarding Potential Analyzer for Martian Ionospheric Studies (ARIS)	**Dr.Umesh, Dr.Sudarshan, Dr.Sooraj** SSPO/MOM
5.	Diagnostic system for testing 300MN SPT	**Dr. Umesh R Kadhane** LPSC
6.	Surface engineering techniques for improving the life performance of ball bearings in ISRO spacecraft mechanisms.	**Dr. Jinesh K. B.** IISU
7.	A Study on the effects of Ionospheric variabilities on the usability of NavIC/GAGAN using observations and models	**Dr. Priyadarshanam** SAC
8.	Development of Surface Discharge Sparkplugs	**Dr. Jinesh K. B.** LPSC

9.	Development of Laser Ignition Systems	**Dr. Jinesh K. B.** LPSC
10.	Development and Implementation of Diagnostic tools for High Thrust Electric Propulsion System	**Dr. Umesh R Kadhane** LPSC
11.	Design and development of High Performance Hydrogen Sensor	**Dr. Palash Kumar Basu** IPRC
12.	Above ground volume/biomass estimation and validation using airborne S- and L-band NISAR data and radiative transfer modelling	**Dr. Rama Rao** (Co-PI) SAC-Ahmedabad

4.2.4 Other External Funded Projects

Sl. No.	Title	Investigators/ Funding Agency
1.	Development of PZT Ceramic Foams.	**Dr. K. Prabhakaran** DRDO
2.	Monitoring the health of mangroves of Maharashtra state using near real time satellite remote sensing data	**Dr. L Gnanappazham** Mangrove Foundation, Dept. of Forest, Govt. of Maharashtra
3.	Integrating air and space borne spectroscopy and laser scanning to assess structural and functional characteristics of crops and field margin vegetation	**Dr. N. Rama Rao, S.** Nautiyal ISEC
4.	Spectral biochemical analysis of forest species using hyperspectral remote sensing – a case study from Eastern Ghats forest ecosystems	**Dr. N. Rama Rao** DST
5.	Development of a standalone atmospheric correction module for hyper spectral data for Indian context	**Dr. N. Rama Rao** DST
6.	Understanding the Physical Conditions of Baryons Outside of Galaxies in the Low Redshift Universe	**Dr. Anand Narayanan** DST
7.	Max Planck Partner Group for Galactic Star Formation	**Dr. Jagadheep D.** Max Planck Institute for Radio Astronomy
8.	Physics of radio Bright Gamma Ray Burst After glows	**Dr. Resmi Lakshmi** SERB (DST)
9.	Deep crustal processes during the evolution of archaean Nilgiri block, southern India	**Dr. Rajesh V J** MoES
10.	Arc accretion in the past and present and its bearing on metallogeny	**Dr. Rajesh V.J.** DST-JSPS India-Japan bilateral project

11.	Improving Operational forecast of SASE using four dimensional variational data assimilation technique	**Dr. Govindankutty M.** SASE (Snow and Avalanche Establishment)
12.	Design and Development of NavIC Receiver	**Dr. Priyadarshanam** SAMEER, Ministry of Electronics & Information Technology
13.	Investigation of Transition Metal Dichalcogenides based Thin filim transistors for Ultra Sensitive nanomechanical Bio/chemical Sensor.	**Dr. Seena V.** SERB (DST)
14.	Investigating the Nanomaterial based Exosome Sensor for Cancer Prognostic: An Approach towards Liquid Biopsy for Cancer	**Dr. Palash Kumar Basu** Dept. Of Biotechnology, Ministry of Science and Technology
15.	LOC approaches for Separation and Analysis of Exosome Derived Biomarker for Cancer Prognostic	**Dr. Palash Kumar Basu** IFCPAR, CEFIPRA
16.	Wireless-Relod- Wireless Reliable , Low Latency Networks for IIoT and Fieldbus replacent	**Dr. Vineeth B. S.** DST-SERB project
17.	To investigate the growth and the local electronic properties of two dimensional stanene on transition metal dichalcogenide (TMDC) and on topological insulator (TI) surface by LEED, STM and STS	**Dr. Kuntala Bhattacharjee** UGC-DAE CSR
18.	Study of Dynamics induced by very small amounts of water molecules through Deuterium MAS solid state NMR and molecular dynamic simulation	**Dr. Jayanthi S.** DST
19.	Discontinuous virtual element approximation for non-stationary fluid flow problems	**Dr. Sarvesh Kumar** DST- SERB

4.3 Centres of Excellences

4.3.1 Advanced Propulsion and High Speed Flows

(Department of Aerospace Engineering)

The setting up the Advanced Propulsion and Laser Diagnostics (APLD) is aimed at the establishment of a centre of excellence that will serve as (i) centre for conducting academic research in IIST which would assist ISRO activities, (ii) national facility for

performing advanced research and (iii) national technological development centre for aerospace organizations. The current objective is to perform propulsion research studies that are of academic interest and also complement ISRO's ongoing technological development activities. In this regard, the following major studies were carried out in the academic year 2019-20.

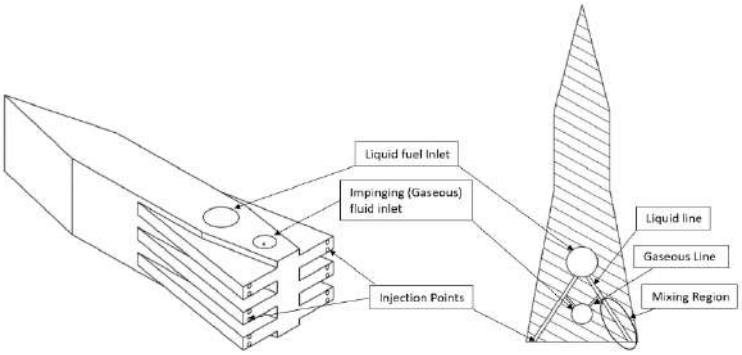


Fig 1: Isometric and cross-section view of the Strut Injector

Effervescent Strut Injection for Scramjet Combustors

With the increasing demand for air-breathing propulsion systems for reusable launch vehicles, scramjet engines have become inevitable. In these engines, the oncoming air enters the combustion chamber at supersonic speeds leads to milliseconds residence time during which complete mixing of fuel and air, as well as stoichiometric combustion, must be achieved. In actual flight, if the fuel is hydrogen, then the problem is straight forward where one has to concentrate the safety in storing and handling such fuel where large storage volume is required depending upon the total flight duration. On the other hand, once the hydrocarbon fuels/liquid fuels are used, its droplet size is the deciding factor for evaporation and subsequently the mixing efficiency as well as the combustion.

The scramjet engine requires a mechanism for quick and efficient mixing of fuel with a good flame holding mechanism. Of many other mechanisms proposed, Strut has been found to be one of the most promising hyper-mixers, offering enhanced mixing of fuel in the scramjet combustion chamber. In the present study, the internal geometry of the strut injector was modified to make it as an effervescent or aerated type injector (Fig 1). So, to understand the improvement in the quality of atomization and finding the possibility of sustainable combustion inside the supersonic combustion chamber are the major objectives of this study. Theoretical calculation considering the droplet burning and evaporation model provides an overall idea of the maximum kerosene droplet diameter that can completely burn within the short residence time inside the combustion chamber available length.

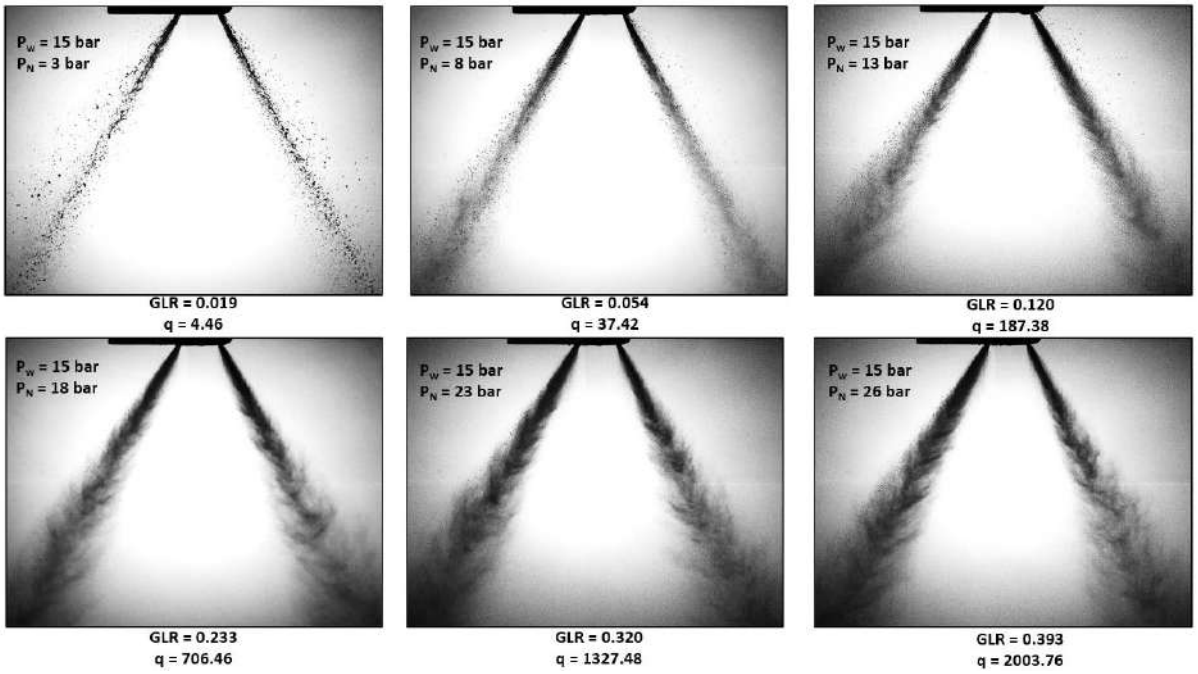


Fig 2 : Shadowgraph images for understanding the improvement in atomization quality due to internal impingement

High-speed shadowgraphy images (Fig 2) were taken to analyze and understand the spray structure and jet spreadangle due tothe internal impingement of the secondary fluid. For understanding the two-phase flow interaction at the downstream of the injection process, Mie scattering imaging (Fig 3) of the spray was conducted. With this Normalized Spread Area shows the advantageous effect of GLR and momentum flux ratio for the improvement in mixing efficiency for the actual flow condition. A statistical analysis of theses Mie scattering images (Fig 4) shows the process of interaction between the injected fluids and the high turbulence region in the spray core. Also, the PDPA and LDV experiments were conducted to find out the atomized kerosene droplet diameter and velocity for a wide range of momentum flux ratio and GLR. The experiment recorded the smallest diameter of kerosene droplet around $12.21\,\mu m$. The optimum condition for getting the smallest droplet diameter for a sustainable combustion inside the combustion chamberis one of the major findings of this study. It was also observed that, as the momentum flux ratio or GLR increases, there is a steep drop in droplet diameter size, but after a momentum flux ratio of 450 and a GLR value of 0.18, there is no significant change in the droplet diameter. The two-phase flow interaction in the mixing region may one of the major reasons for this behaviour. So for understanding the spray interaction and flow transition process in a better way, a modal decomposition analysis on the spray region was conducted.

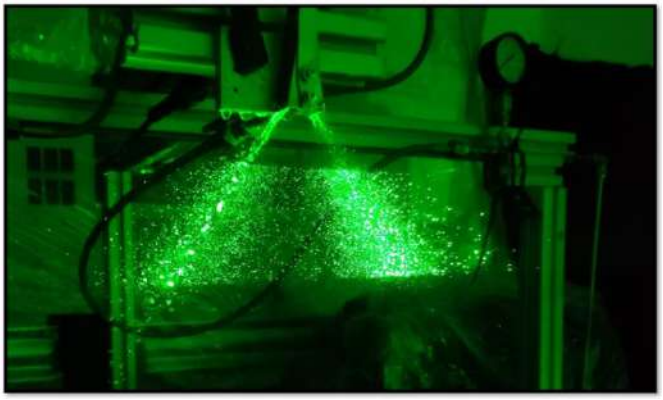


Fig 3: Scattering of laser light from the spray region

From the high-speed shadowgraph images, Proper orthogonal Decomposition extracts the Spatio-temporal fluid dynamic features from the flow field. It also extracts the coherent flow features from the spray field in order to understand the fundamental process of atomization. The flow transition phenomena can also be observed for various GLR and momentum flux ratio values (Fig 5). With this, the PSD plots for all different modes represent the frequency for a particular flow dynamic phenomenon to happen. All these experimental and computational analysis provides us a further opportunity in the development of this modified strut injector for the actual application.

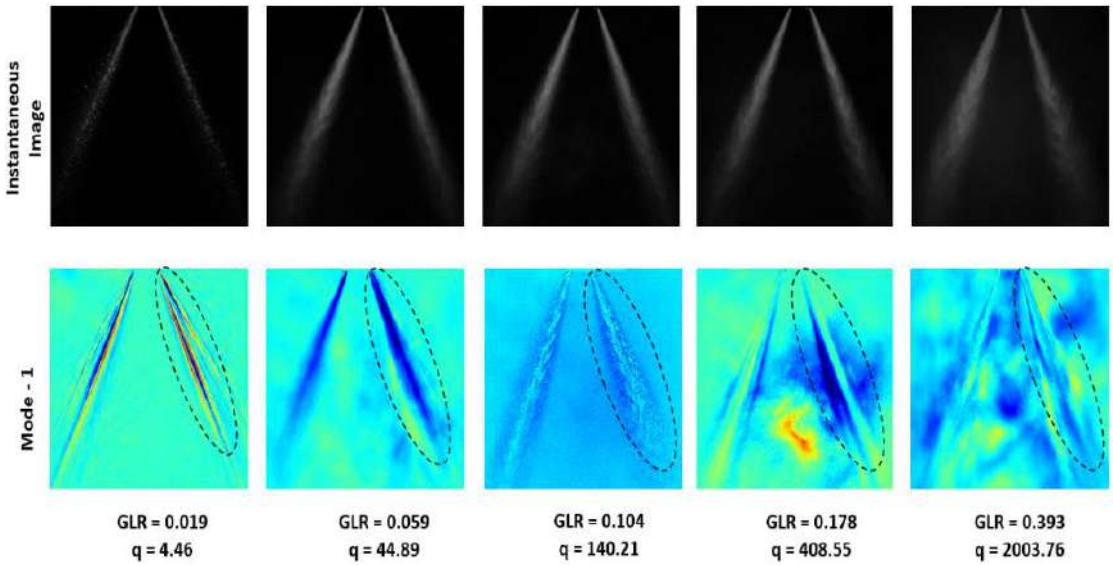


Fig 4: Statistical Analysis of Mie Scattering Images

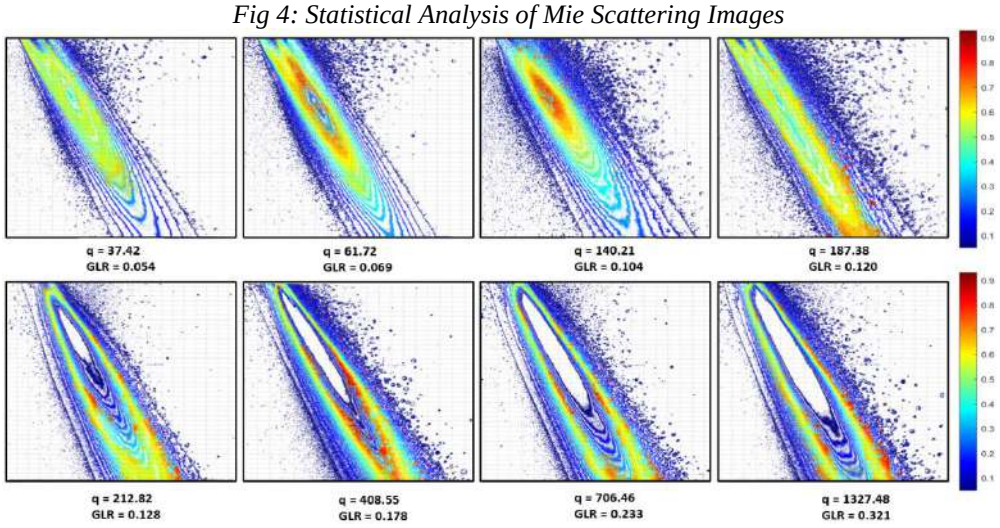


Fig 5: Mode-1 from POD analysis to understand the flow transition

4.3.2 Small Spacecraft and Payload Centre (SSPACE)

The Small-spacecraft Systems and PAyloadCEnter (SSPACE) is being established at IIST to promote interdisciplinary research and development activities in the area of space science and spacecraft engineering, providing hands-on training for the students and Faculty members. The SSPACE center is involved in realisation of payloads, related electronics, small satellites, assembly, integration, testing and ground station to carryout mission operations. The laboratories proposed under SSPACE would have facilities for design and realisation of small-spacecraft and small payloads for the ISROs space science missions. The SSPACE is spread out in the form of three laboratories, consisting of a payload realisation lab, spacecraft engineering lab, and ground station.

SSPACE at the moment is involved in the following projects

1. Advanced Retarding potential analyser for Ionosphere Studies (ARIS - 2) -- This is an PS4 payload for LEO ionosphere studies. After the successful launch of ARIS-1 in April 2019. The data collected was analysed and promising results were found. The ARIS-2 version is getting ready for launch. Furthermore, an ARIS payload was delivered to URSC for the UNNATI program during this period. [For more details contact, Dr.Sudarshan, Dr.Umesh]

2. AHAN -- This is the first satellite designed and developed by the students of IIST. The mission is expected to be flown on PSLV for carrying out measurements of radiation in LEO. The prototypes of all the subsystems were completed during this period. The satellite is waiting to be integrated and tested.

3. PILOT -- Pslv In-orbitaLObc and Ttc -- is an offshoot of AHAN where the subsystems developed for the AHAN mission will be tested in the PS4 stage prior the flight. The subsystem designs were completed during this period and are awaiting integration and testing.

4. InspireSat1 -- This is a student satellite developed as part of international collaboration with Laboratory of Atmosphere and Space Physics (LASP), University of Colorado, Boulder. During this period the satellite was integrated and is awaiting testing at LASP.

5. Autonomous Assembly of Reconfigurable Space Telescope (AAReST) – This is a collaborative mission with Caltech, USA and University of Surrey, UK. The MirrorSat mass dummy version 2 was delivered to Caltech and successfully completed the integrated vibration test. Furthermore, SSPACE delivered the MirrorSat structure for the University of Surrey, UK.

6. RPA for MoM-2 – For understanding the ionosphere of the planet Mars the payload RPA is being developed by SSPACE, IIST. The design of the high sensitive electronics is being developed. [Contact Dr.Sudarshan and Dr.Umesh]

7. RPA for Venus – The ionosphere of the Venus will be studied by an RPA being developed for the Venus mission. This

8. Nanosatellite for Venus – A proposal for the Nanosatellite spacecraft to make insitu measurements and expected to be flown as part of the ISROs mission was made during this period by SSPACE.

9. SSPACE conducted the international INSPIRE partners meeting during January 2019 where participants from more than 7 countries participated to discuss the present and future of the INSPIRE program.

Figure: AHAN mass dummy

Figure: Mirrorsat Mass dummy of IIST delivered to Caltech for integration and testing

Figure: Mirrorsat structure delivered to University of Surrey, UK

4.3.3 NEMS Nano & Optoelectronics Systems (NEMO)

(Department of Avionics)

IIST is active in R&D activities related to MEMS/NEMS, VLSI and opto/nanoelectronics based components and subsystems for space and terrestrial applications.

Laboratories and research facilities are being established to support this vision. These laboratories also provide academics and research platform for the PG program in the area of VLSI, Nanoelectronics& Microsystems. As per the current plan, these laboratories and research facilities would eventually evolve to an R&D Centre for NEMS &Opto/Nanoelectronics (NEMO) to promote research and technology development activities in these areas. The research work under the umbrella of NEMO being highly interdisciplinary, active collaborations are being undertaken across various disciplines. The scope of research activities is in line with ISRO's plan for miniaturization of sensor systems. NEMS has close collaborations with many ISRO centres like IISU, VSSC, SCL and IPRC. These are either through formal collaborative projects for development of Micro/Nanosensors or service. The key micro/nano fabrication process and characterization technologies developed at NEMO laboratories under the guidance of faculty members shall be made accessible to ISRO centres/units as well as external users on a collaborative basis or through MOUs.

The laboratories include Design and simulation tools for MEMS devices, Micro/Nanoelectronics devices and systems, MEMS &NanoFAB with deposition tools, double side mask aligner for photolithography, etch tools as well Micro/Nanosystem Characterization tools such as Wafer probe station, Semiconductor Parametric Analyzer, MSA-500 Microsystem Analyzer LDV, and Nanoindentation system etc. The Phase-II of MEMS &NanoFAB with 140 SQM Class 1000/Class 100 cleanrooms has also been designed and conceptualized.

The research work under the umbrella of NEMO focus on the indigenous development of miniaturized low power/self-powered smart sensor systems. Application areas that have been identified are (1) Environmental Sensors for Space and Terrestrial fields (2) Biomedical sensors/systems (3) Inertial/physical sensors. The scope of work includes design, new materials and fabrication process technologies for next generation NEMS devices and sensors and testing/characterization. Metal oxide-based gas sensors, MEMS Accelerometers with ultra-low cross axis sensitivity, CMOS-MEMS Accelerometers, Nanomechanical Sensors, silicon photonics-based devices are just a few examples of miniature sensors/systems being developed. The research activities carried out by us could invite research funding through various sponsored projects from ISRO, Science and Engineering Research Board (SERB), Department of Science and Technology (DST), Department of Biotechnology (DBT), ISRO Human Space Program (HSP) etc.

4.3.4 Computer Vision and Virtual Reality Center of Excellence (CVVR-CoE)

(Department of Avionics)

Our Vision: To transcend in the area of virtual reality and intelligent computer vision for cutting edge space science, societal and technological applications.

Our Mission: To design and develop state of the art technological solution, algorithms for both space and non-space applications.

Brief Description: Founded in 2010, the primary research focus of CVVR CoE lies mainly in the development of effective virtual reality, computer vision, and deep learning-based algorithms that help in both space and non-space applications. The lab is currently housed in Room No. L-204, D4-building, under the Department of Avionics, Indian Institute of Space science and Technology. The lab is well equipped with highly efficient GPUs that help in accelerating the pace of research. Image processing and Computer Vision lab sessions for the UG and PG students are also conducted in the CVVR lab. Current research in the lab focuses on Virtual reality tools for Disaster simulation, Object tracking, landslide detection in satellite images, image fusion, etc. The current working members of the lab include research scholars, project fellows, and PG and UG students working on their academic projects. The members actively publish their works in reputed national and international conferences and journals.

The entire development of the proposed CoE was planned in three phases. The first phase consists of a desktop VR lab that consists of the high-end workstation with the latest graphics capabilities, 3D monitors, 3D vision-pro glasses, and application software such as Vizard, Blender, Google Sketch, Adobe Master Suite collection, 3ds Max and Maya. The facility will be upscale by creating an immersive studio type Virtual reality center in phases 2 and 3 which is planned in 2020-21. The proposed facility will be supported by advanced haptic devices, sensors, and force feedback systems for various real-life applications such as navigation, fly through etc.

Some important goals of proposed CoE are to develop simulations and solutions for:

Space Science and Space Technology oriented Research areas in

- Planetary exploration
- Indigenous software development
- Design of VR testbed prototype
- Virtual prototyping of space shuttle
- Remote sensing lidar data visualization in the virtual world
- Virtual walk/fly through etc.

Societal application-oriented research areas in

- Disaster modeling and simulation
- 3-d VR visualization of compounds and chemical
- For theoretical and nonlinear dynamical studies.
- Developing VR teaching simulations for a better understanding of the concepts in different key subjects of Avionics, aerospace, Physical science, and humanities etc.

Current Infrastructure:

Location: The proposed center will be housed in the Avionics Department in room R304. A research space of 120sqmt is allocated in the Avionics department for the proposed center.

Computing Resources: HP Z800 workstation 5 no., NvidiaQuadro 6000 Graphics card 5 nos. Nvidia Titan XP, Nvidia 1080, Nvidia 1060, Fujitsu workstation 10 nos.

Imaging devices: GigE Vision cameras, DSLR camera, Thermal Camera, etc.

VR/visualization Devices: Data Gloves, HTC Vive HMD, Nvidia Active stereo goggles, 3 D display monitors 5 nos., Big display Unit

Software and Tools: Visual Studio, Adobe Master Suite, Python, Unity, Blender, etc.

Featured Work: Flood flow simulation using augmented reality, computer vision tracking (Single object and multi-object), satellite Image fusion, deep learning techniques for computer vision, and image processing.

new additions: Recently HTC Vive device for virtual reality immersive experience has been added to the existing facility.

Fig. 1. The Desktop VR interface

ISRO-IIST Project: Development of Virtual Reality Model for Disaster Simulation (Phase-I of Project completed by 31 July 2020)

Key results from the above project:

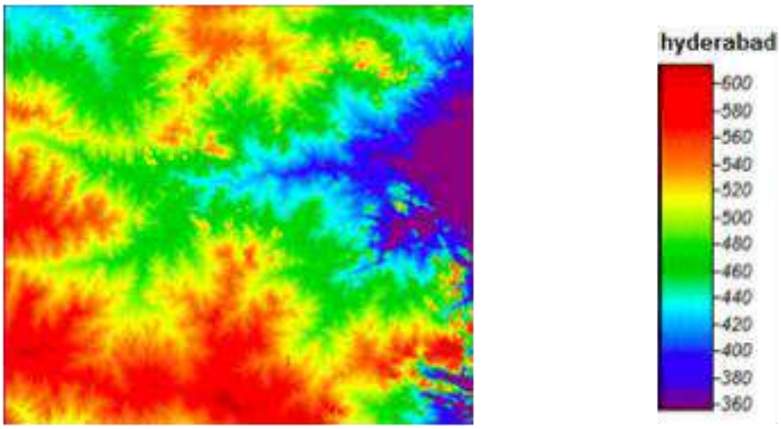


Fig 2. Hyderabad Test Location A real-world test case of Hyderabad city has been simulated. The test area is about 5721.67 sq.km. The total simulation time is set for ten hours. In the first hour rainfall has been set as 30mm/hr, second-hour rainfall has been set as 40mm/hr, the third hour it is 50 mm/hr, the fourth hour it is 20mm/hr and fifth hour it is 25mm/hr. After five hours there is no rainfall. The slope tolerance has been set as 1.65.

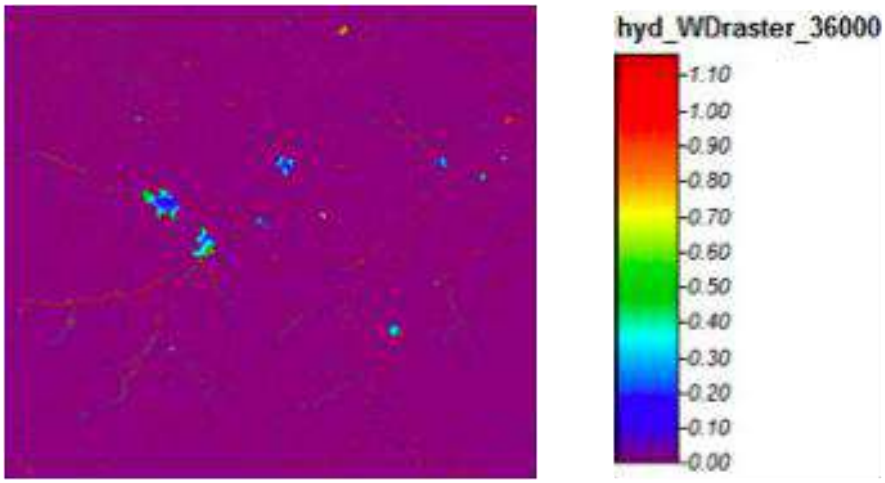


Fig 3. shows the water depth after 36000s of simulation

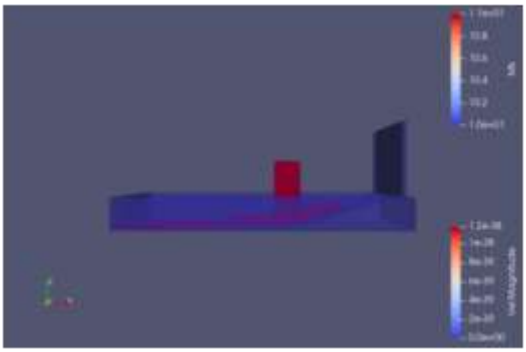


Fig. 4. A snippet of Dam Break Analysis

CVVR in news: One student who did his B.tech thesis in the lab won INAE best UG project award in the year 2019. Subsequently, two UG second-year students were mentored (in collaboration with Prof. N Selvaganesan and Dr. Deepak Mishra) to develop an Augmented reality app for the prestigious COVID-AR-2020 challenge. The team of two students was in the top 15 finalists among 300+ teams. Similarly, two students were mentored to participate in the Innocentive ideation challenge and their idea won the first prize. The proposed idea was based on Gamification that has been long recognized as a powerful approach in changing social behavior, including health-related behavior. The objective of the Challenge was to apply gamification in changing people's social behavior so as to prevent the spread of Coronavirus and other infections. Innocentive, an open innovation, and crowdsourcing company posted such an ideation challenge where teams were to come up with novel ideas for this problem statement.

Usage: The established center is used by all the students of the institute for their UG/PG/Ph.D. research work and along with carrying out research and development activities related to various funded projects.

Funding Agencies: the CVVR-CoE thankful to Indian Space Research Organization (ISRO), Department of Space (DoS), Indian Institute of Space Science and Technology (IIST) for their funding and encouragement.

4.3.5 Centre for Nanoscience and Energy Materials

(Department of Chemistry)

Centre for Nanoscience and Energy Materials was established in the Department ofChemistry to carryout focused research in the area of nanoscience and energy storage materials. The center undertakes research for the development of materials for the realization of high capacity lithium ion batteries and super capacitors. The centre also does cutting edge research on the development of nanomaterials based chemical/ electrochemical sensors, drug delivery systems, organic light emitting diode, and nanocomposites for structural and functional applications. The development of

nanomaterials for the removal of toxic chemicals and metal ions from water is another focused research under the center for nanoscience and Technology. The centre is equipped with state of the art facilities such as atomic force microscope, particle size analyzer, Glove box, electro-spinning machine, Contact angle Goniometer, HPLC, Planetary ball mill and surface area analyzer. The research work under the nanosciencecenter during the last year resulted in seven publications in peer-reviewed international journals and award of two Ph.D. degrees.

4.3.6 Multi-disciplinary Computing Center

IIST has developed an infrastructure in the interdisciplinary block for the Multi-disciplinary Computing Centre to host parallel computing clusters, servers, and workstations. The aim of the center is to become a centre of excellence in computational techniques and computer simulations for science and engineering and provide expertise in big Data Analysis, Climate Modelling, Computational Fluid Dynamics, Computational Structural Mechanics, Computation-Assisted Materials Science, Computer Vision and Virtual Reality, Machine Learning, Network Science and Engineering, Nonlinear Dynamics, Optimisation, Geoinformatics, Monte Carlo Simulations. The facility contains a server room and a workstation room. Redundant UPS power supply and Network Raceways for both UTP and fibre cables are installed in the centre. Currently, the centre has one parallel computing cluster named *Virgo* with 22 Teraflops capacity, 31 workstations, and a GPU server. There are about 150 users using this facility.

4.4. New Facilities for research

IIST had launched its first space mission on PS 4 stage of PSLV C45 on 1st April 2019. An advanced retarding potential analyser for ionospheric studies (ARIS) was designed and built by IIST faculty, project fellows and students with support from IISU and VSSC. ARIS was realized in a shorttimeof just 49 days from the first clearance. The probe functioned during the life of the mission and provided valuable data on electron and ion temperatures, density and mass distribution. A follow sensor for one of the upcoming PSLV missions is under testing and its advanced versions have been shortlisted by ISRO to fly in forthcoming missions to Mars and Venus.

4.4.1 Space Simulation Plasma Chamber/ Electric Propulsion Diagnostic Laboratory

Over the last seven years IIST has been actively supporting the electric propulsion research activity hosted by LPSC. IIST is playing a very important role in the ongoing High Thrust EPS project which is under implementation at LPSC Valiamala. IIST has been tasked to design, develop implement and utilise the diagnostics system for the upcoming large HEP facility at LPSC Valiamala. A new dedicated laboratory called

Electric Propulsion Diagnostics Laboratory is now established at IIST. Under this activity a 1 m X 1.5 m class high vacuum chamber has been installed recently and the diagnostics probes are regular tested in this chamber with the help of multiple types of plasma and ion beam sources. The full facility design was done by the EPDL team and all the plasma and ion source are also designed and fabricated by the EPDL team at IIST.

Figure 1 1m X 1.5 class High Vacuum chamber at EPDL, IIST

Space plasma simulation and its applications: As a parallel activity, a special type of plasma sources has been developed by Electric propulsion laboratory in IIST for the space plasma instrument test and calibration, which needed proper in-lab simulations of ionospheric plasma conditions at different altitudes. The produced plasma density is mainly decided by the applied mesh potentials. So, with 70 V potential at mesh1 and 450V potential at mesh 2 gives you a plasma density of 10^{6} –$10^{3}cm^{-3}$.

4.4.2 Human Space Flight Program

A proposal by Dr. K Sreejalekshmi jointly with Dr. R Hosnani of University of Agricultural Science, Dharwad, on "Spaceflight induced changes in kidney stone formation in Drosophila melanogaster" has been selected to be flown in the first development flight of Gaganyaan scheduled for the final quarter of 2020.The project 'Spaceflight-induced changes in kidney stone formation in Drosophila Melanogaster has been recommended for the first development of Gaganyaan. AnMoU between HSFC and IIST for an amount of 72 lakhs has been agreed upon and will be signed summarily. The hardware development for the program is in progress, and basic facilities to start Drosophila research like Incubator

and Stereo microscope and accessories has been procured and currently located in the Organic Chemistry lab. AnMoU between IIST and TIFR Mumbai for providing the spaceflight hardware being developed by IIST for TIFR's experiment is also under discussion.

Drosophila culture facility and Stereo microscope

Gas sensor development lab

A proposal on monitoring the gas environment in the crew module proposed by Dr.PalashKumar Basu is also approved for joint implementation with SAC and SCL. An Internet of Things (IoT) Lab for developing Ambient Assisted Living (AAL) technology was set up as part of the Systems and Networking Lab (SysNet Lab) in the Avionics department. New technologies for assisted living for ground and human space missions are being developed in this lab for experiments

4.4.3 ExoWorlds

The study of extrasolar planets is revolutionizing modern astronomy. Envisaging a giant leap forward, a pioneering ISRO mission, ExoWorlds, is proposed, which holds the promise to be the world-leading facility in the next decade for studies of planets beyond the Solar System – the Exoplanets. The efforts towards this future space telescope are led by IIST alongwith other ISRO Centres and the University of Cambridge. The mission will make major scientific breakthroughs in Exoplanet science and catapult India to the forefront of this emerging field. The proposed mission will be

- The largest dedicated Exoplanet mission in the world
- The largest astronomy mission of ISRO
- The first astronomy mission of ISRO in L2 orbit
- The only mission of its kind and capability in the next decade globally

The ExoWorlds Consortium includes researchers from the premier institutes like TIFR-Mumbai, ARIES-Nainital, PRL-Ahmedabad, IUCAA-Pune, IIA-Bangalore, IISER-Kolkata, SNBNCBS-Kolkata, St Joseph College-Bangalore, Christ University-Bangalore.

IIST hosted the first in-person Team Meet of the ExoWorlds Mission from 4 – 6 January 2019. The meeting was inaugurated by Dr. VK Dadhwal, Director, IIST, and was attended by around 40 participants. Several sessions were planned and well executed to address various aspects of the mission. Discussion and brainstorming sessions on Payload Development, Payload Operation Centre, Ancillary Science with the mission, Science Planning and Observing Strategy, Capacity building in Modelling and Theory and Observations, Data Analysis Pipeline and Workshops & Public Outreach were conducted. These sessions witnessed active and focused participation from the team members.

Participants of team Meet of ExoWorlds

4.4.4 Climate Observatory at Ponmudi

IIST has established a Climate Observatory at its Ponmudi Campus (8.76°N, 77.12°E, 1.1 km, AMSL. Over the years, many observational campaigns converinggreen house gases (GHG), meteorology, boundary layer, aerosols-cloud interactions, and radiation balance studies have been carried out by the faculty of IIST.

Student lab session in Ponmudi Climate Observatory

Ozonesonde Balloon Experiment from IIST Ponmudi

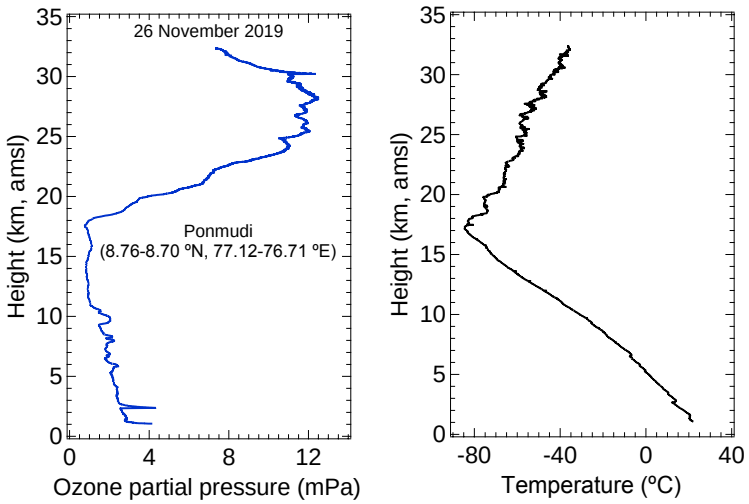
A new collaborative programme on the measurement of verticle profile of ozone along with meteorological parameters at multiple sites (Ponmudi, Hyderabad, Nagpur, Jodhpur) has been initiated under co-ordination and support of Earth & Climate Area (ECSA) of National Remote Sensing Centre (NRSC/ISRO).

As part of this study, coordinated monthly launches shall be undertaken at four sites. The Ponmudi site observation shall be undertaken by Dr. P. R. Sinha, Assistant Professor, Department of Earth and Space Sciences.

The first full altitude (upto 32 kms) launch of ozonesonde balloon was carried out from Ponmudi Climate Observatory (PCO) on 26th November, 2019. On this occasion, Director and Dean (Academics) visited the launch site, photograph of the event is given below.

(Left to Right) Prof. A. Chandrasekhar, Dean (Academics) / Outstanding Professor, Department of Earth and Space Sciences, Dr. V. K. Dadhwal, Director, Dr. P. R. Sinha, Assistant Professor, Department of Earth and Space Sciences, Mr. Aswin and Ratheesh (staff members) releasing the balloon at 1400 hrs (IST) on 26th November, 2019.

A preliminary profile of O_3 *partial pressure and concurrent radiosonde measured temperature over IISTPonmudi, Trivandrum,*is presented in the figure below.



4.5 Post Doctoral Programme

The institute offers excellent facilities for the pursuit of post doctoral program as well. The following fellows were enrolled for the Post-doctoral research in 2019-20.

Department-wise enrolment and summary output

Sl. No.	NAME	Date of Joining	Dept.	Fellowship
1.	Dr. Linza Vazhayal	09-04-2019	Chemistry	KSCSTE
2.	Dr. Santhosh B	07-11-2019	Aerospace	SERB, TARE
3.	Dr. Shaiju S Nazeer	01.01.2020	Chemistry	Ramalingaswamy Re-entry Fellow

4.6 Memorandum of Understanding

IIST has signed MOUs with various national and international universities and research organizations in the following aspects;

(i) to cooperate in the field of education, to undertake joint research, exchange of faculty and students;

(ii) with specific agencies and industries and ISRO to undertake a research project and deliver specific design or product, and

(iii) framework MOU, to participate in national and international multi-institutional research programs.

During this year new MOU signed/initiated include:

Sl. No.	University/Institute /Agency	National/ International	Relevant area	Duration
1	VSSC Thiruvananthapuram	National	Collaborative Research and Academic Activities	5 years
2	URSC Bangalore	National	Collaborative Research and Development in the area of Nanosatellite technology development and Academic co-operation	5 years
3	IIT Guwahati	National	Collaborative Research Work	5 years
4	HSFC, Bangalore	National	National Development of Science Payload for the unmanned mission of Indian human spaceflight program to study spaceflight induced change in kidney stone formation in Drosophila Melanogaster	--
5	University of Colorado, USA	International	INSPIREsat1 project Joint projects/workshops will be undertaken by Scientist/ Faculty members aided by students/staff of both institution	5 years
6	Niigata University, Japan	International	To facilitate cooperation in; a) Collaborative research in basic/applied Sciences and Engineering areas b) Academic collaborations.	5 years
7	ISAE-SUPAERO, France	International	Joint studentprogramme	5 years

4.7 Patents & IPR

IIST's policy is to protect its intellectual property and contribute to the country's industrial growth by facilitating commercial exploitation of such property through transferring technology and licensing its patents. Dean IPR & Continuing Education coordinates the Patents & IPR activities, which started formally in the year 2014.

In the year 2019-20 IIST filed 4 more patent applications.

4.7.1 Patents applied

Sl. No.	Title	Application No.	Inventors
1	Flapping Wing Mechanism and the wing design of the bionic Micro Aerial Vehicle.	201941026796	Dr. K. G. Sreejalekshmi, Mr.Mrudul C Mr. Sam Noble
2	Closed loop in-plane movable suspended gate FET(CLIP-SGFET) based accelerometer and the fabrication method thereof.	IIST/RDP/02/2019	Dr.Seena V. Ms.Anju Sebastian Dr. Naveen Kadayinti
3	A novel method for the synthesis of MoS2 hollow nano flower and its detoxification of water from toxic metal ions such as Hg(II), Pb(II) and Ag (I)	IIST/RDP/03/2019	Dr.Sandhya K. Y. Ms. Arya Nair J. S.
4	Quad Cross and Symmetrical Non-planar Beam Piezoresistive MEMS accelerometers for low cross axis sensitivity and fabrications methods thereof	IIST/RDP/04/2019	Dr.Seena V. Mr.Hari K. Mr.Rohith S

4.7.2 Patents Granted

Sl No	Title	Patent No	Inventors
1	Process for the preparation of high density carbon foams	314287	K. Prabhakaran, R. Narasimman

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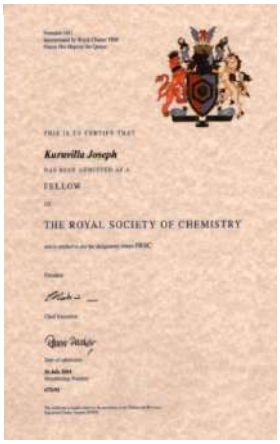
ACHIEVEMENTS & AWARDS

5. ACHIEVEMENTS & AWARDS

5.1 Faculty

Kuruvilla Joseph

Senior Professor, Department of Chemistry and Dean (Student Activities, Student Welfare & Outreach Programme), IIST was admitted as a fellow of the Royal Society of Chemistry on 26 July, 2019 for his outstanding contributions to Polymer Science and Technology, Green Chemistry etc. *Professor Kuruvilla* has citation index of more than 10,000 for his research contributions and has guided 20 Ph.D students



Sooraj V S

Received IIST Space Science Technology Excellence Certificate-Year 2019 (Team certificate for TEAM ARIS) from the First Indian Cosmonaut Wing Commander; Ashok Chakra Awardee; Shri. Rakesh Sharma, for the development and success of ARIS payload (PSLV-PS4 orbital platform mission from IIST) in PSLV-C45 Mission (launched from Sriharikota on 1st April 2019). Awarded to the team of four faculty members and four junior project fellows, on 14th September 2019.

R Sudharshan Kaarthik

Appointed as Associate Editor of IEEE on Journal of Indusy Applications.

Indian Space Research Organization (ISRO) Team Award for contributions in Advanced Retarding Potential Analyzer for Ionospheric Studies (ARIS) a scientific payload onboard PSLV-C45.

Selected for Indian National Academy of Engineering (INAE) Young Engineer Award for Electrical Power Systems Satellites, Electronic Systems and Renewable Energy.

Best Paper Award (MV Chauhan Paper Contest) at IEEE INDICON - 2019.

Awarded Space Science Technology Excellence Certificate for 2019 by the Indian Institute of Space Science and Technology for contributions in Advanced Retarding Potential Analyser for Ionospheric Studies (ARIS) a scientific payload onboard PSLV-C45.

Elevated to Senior Member, IEEE

Anoop C S

Awarded Space Science Technology Excellence Certificate for 2019 by the Indian Institute of Space Science and Technology for contributions in Advanced Retarding Potential Analyser for Ionospheric Studies (ARIS) a scientific payload onboard PSLV-C45.

Umesh R Kadhane

Awarded Space Science Technology Excellence Certificate for 2019 by the Indian Institute of Space Science and Technology for contributions in Advanced Retarding Potential Analyser for Ionospheric Studies (ARIS) a scientific payload onboard PSLV-C45.

Rajesh Joseph Abraham

He was awarded the ***ISTE's Syed Sajid National Award*** for outstanding research work in the field of renewable energy 2019 during the 49th ISTE National Annual Faculty Convention held at Siksha 'O' Anusandhan University, Bhubaneswar.

Dr. Rajesh Joseph receiving the award

Chinmoy Saha

i) Founded and nominated as the Chairman of IEEE Microwave Theory and Techniques Society, Kerala Chapter, India in July 2019.

ii) Founding Student Branch Advisor of IEEE Microwave Theory and Techniques Society, Indian Institute of Technology Student Branch, July 2019.

iii) Best Paper Award in IEEE InCAP 2019: Research paper entitled "Reconfigurable Multifunctional Vivaldi MIMO Antenna for Cognitive Radio Applications" authored by S. Keerthipriya and Dr. Chinmoy Saha has been awarded the best paper award (in NNSSRK best paper award category) in IEEE Indian Conference on Antennas and Propagation held in, Ahmedabad, India during December 18-22, 2019. The award constitutes certificate, plaque and a cash prize of Rs.5000.

iv) Best Paper Award in IEEE IMICPW (2019): Research paper entitled "Tunable Multifunctional Reconfigurable Step Profiled Dielectric resonator Antenna for Cognitive Radio Applications" authored by S.Keerthipriya and Dr. ChinmoySaha has been awarded best paper award in Technical Session T-6 of International Conference on Microwave Integrated Circuits, Photonics, and Wireless Networks (IMICPW-2019) held at NIT-Trichy during May 22-24, 2019.

v) Best Paper Award in IEEE TENGARSS (2019): Research paper entitled "Millimeter Wave Grid Array Antenna for Wireless Power Transmitter" authored by Gopika R. and Dr. ChinmoySaha has been awarded best paper award in Technical Session of IEEE Region-10 Conference on Recent Advances in Geoscience and Remote Sensing : Technologies, Standards and Applications held at Cochin, India during October 17-20, 2019.

vi) International Travel Support Award from DST (2019): Travel Support Award from Science and Engineering Research Board, Department of Science and Technology (DST), Government of India for attending and presenting papers in the 2019 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting (AP-S/URSI 2015),organized by IEEE Antennas and Propagation Society and International Union of Radio Science (URSI), held at Atlanta, Georgia, USA during July 07-12' 2019.

vii) Outstanding Teaching Award (2019): Received Outstanding Teaching Award in the department of Avionics, IIST in the year 2019 for excellent teaching feedback obtained from the students and teaching performance across various undergraduate courses over (2015-2018).

K. Sakthivel

Full Travel Grant Award from DAE/ National Board for Higher Mathematics (NBHM) to attend the International Congress on Industrial and Applied Mathematics held at Valencia, Spain during July 15-19, 2019.

Chris Prema

The UG project titled "Low Complexity Cyclostationary Feature Detection using Sub-Nyquist Samples" received the INAE student project award 2019

E. Natarajan

Partial support from Centre Internationale De RencontresMathematiques to attend a conference on Polytopal Element Methods in Science and Engineering, Marseille, France, 29 April - 3 May, 2019.
Travel support from DST-SERB to present a paper in "The Mathematics of Finite Elements and Applications, MAFELAP 2019, United Kingdom, 18 June, 2019 to 21 June, 2019".

Sarvesh Kumar

DST-SERB Research Projects (MATRICS) Title: Discontinuous virtual element approximation for non-stationary fluid flow problems Duration: 3 years , Budget: 6 lacs

Prosenjit Das

Invited to be a life-time reviewer of zbMATH (formerly Zentralblatt MATH) Reviewer Database.

Visits Abroad

Faculty members have visited countries abroad as part of their research, partially or fully funded by IIST

Sl.No	Name	Programme/ Course/ Internship	Country/ Organization visited and period of conference or workshop
1	Dr. Sheeba Rani J	Attended 30th British Machine Vision Conference (BMVC).	UK 09.09.2019 to 12.09.2019
2	Dr. N Sabu	Attended "The 2nd Mediterranean International Conference of Pure&Applied Mathematics and Related Areas (MICOPAM 2019).	France 28.08.2019 to 31.08.2019

3	Dr. Anandmayee Tej	Attented "The 2019 Thirty Meter Telescope (TMT)" Science Forum Meet and to give an invited talk on Exo Worlds and Synergy with the upcoming TMT facilities.	Xiamen University, China 03.11.2019 to 07.11.2019
4	Dr. Aravind V	Delivered invited lecture and involve in research discussions in the Institute for Energy and Powerplant Technology.	Darmstadt, Germany 28.10.2019 to 29.10.2019
5	Dr. Rajesh Joseph Abraham	Invited as an Honorary Visiting Research Fellow in the Faculty of Engineering and Informatics.	UK 04.06.2019 to 11.06.2019
6	Dr. Rama Rao Nidamanuri	Visited University of Kassel and Leibniz-Centre for Agricultural Landscape Research, Germany and for taking part in the reviews of the project from German side and to facilitate and review the experimental preparation for phase -2 of the collaborative research project.	Germany 18.06.2019 to 25.06.2019
7	Dr. Rajesh V J	Participated in JSPS-DST Japan-India Forum for advanced study in Earth Sciences.	Japan 07.03.2019 To 16.03.2019
8		Visited Niigata University, Japan as a part of bilateral research collaboration between JSPS (Japan Society for Promotion of Science) and DST (Department of Science and Technology) for delivering talks and conduct geochemical isotopic analyses of terrestrial/ planetary analogue rock/mineral samples.	Japan 01.12.2019 To 16.12.2019
9	Dr. Umesh R Kadhane	Attented the two days satellite meeting – 26th International Symposium on Ion-Atom, Collisions (ISIAC) and the 31st International Conference on photon, electron and atomic collisions (ICPEAC).	France 20.07.2019 to 30.07.2019
10	Dr. E Natarajan	Participated in the conference "Polytopal Element methods in Mathematics and Engineering" held at Marseille.	France 29.04.2019 to 03.05.2019

11		Attented International Conference on: The Mathematics of Finite Elements and Applications (MAFELAP 2019) organized by Brunel University. Presented his paper.	London, United Kingdom 18.06.2019 to 21.06.2019.
12	Dr. Resmi L	Attented the Square Kilometer Array (SKA) General Science Meeting and Key Science Workshop.	United Kingdom 08.04.2019 to 12.04.2019
13		Visited i) Prof. Bing Zhang, University of Nevada Las Vegas (UNLV). ii) Participated in a conference titled "Merging Visions: Exploring Compact – Object Binaries With Gravity and Light" to be held at Kavli Institute of Theoretical Physics, Santa Barbara. iii) Visited the group of Prof. B Sathyaprakash, Pennsylvania State University.	USA 17.06.2019 to 21.06.2019 & 24.06.2019 to 27.06.2019 & 28.06.2019 to 04.07.2019
14		Visited Anton Pannekoek Institute (API) for Astronomy and Attented the interntional conference titled "Yamada Conference LXXI: Gamma Ray Bursts in the Gravitational Wave Era 2019".	The Netherlands & Yokohama, Japan 01.09.2019 To 10.02.2020
15	Dr. Chinmoy Saha	Attented 2019 IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting AP-S/URSI 2019 and attend the chapter chair's meeting scheduled during this conference and presented two of his research papers.	USA 07.07.2019 to 12.07.2019
16	Dr. Arun C O	Attended 10th International Conference on Computational Methods (ICCM2019).	Singapore 08.07.2019 to 13.07.2019
17	Dr. Rajesh Sadanandan	Attented and present paper in 24th International Society for Air Breathing Engines (ISABE) Conference.	Australia 22.09.2019 to 27.09.2019

18	Dr. K Sakthivel	Participated in the International Congress of Industrial and Applied Mathematics (ICIAM-2019).	Spain 15.07.2019 to 19.07.2019
19	Dr. R Sudharshan Kaarthik	Attended 28th IEEE International Symposium on Industrial Electronics (ISIE 2019) & to Chair a special session during the conference and, delivered an Expert Lecture.	Concordia University, Montreal, Canada & Vancouver, Canada 11.06.2019 To 15.06.2019 & 17.06.2019
20	Dr. Immanuel Raja	Attended the Sakura Science Exchange Programm.	Japan 26.01.2020 to 01.02.2020

5.2 Students

The Abdul Kalam Prize

Ms. Garima Aggarwal, the topper of B.Tech (Aerospace Engineering) student of the 2019 pass out batch from IIST has been awarded "The Abdul Kalam Prize" for the year 2020 by California Institute of Technology, USA. The above prize is awarded by CalTech to a student in the Aerospace Engineering Master's Programme whose academic performance is exemplary and who has shown high potential for future achievements at CalTech.

Ms. Aggarwal is the seventh student from the Aerospace Engineering Department of Indian Institute of Space Science and Technology to avail Professor Satish Dhawan Endowment, a joint initiative by ISRO and CalTech that provides complete assistance to a student from IIST to pursue a Master's programme at CalTech.

Ms. Aggarwal is the fourth student from Indian Institute of Space Science and Technology to be awarded "The Abdul Kalam Prize". Shri. Chapalkar Aditya Nithin, Shri. Avinash Chandra, Shri. Padmanabha Prasanna Simha have won "The Abdul Kalam Prize" for the years 2014, 2018, 2019 and respectively .

Future Research Talent Award Winners (2020), hosted by Australian National University, Canberra, Australia

Ms. Ushasi Bhowmick, (B.Tech EP 6th Semester), ***Ms Kolencheri Jithendran Nikitha*** (DD, Master of Science in Astronomy and Astrophysics, 8th Semester), ***Mr Pratik Sharma***

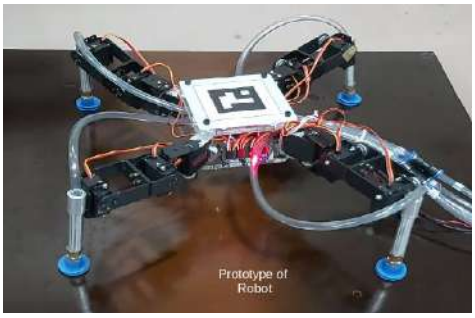
(B.Tech ECE, 6th Semester), ***Mr Gaurav Kumar***(M.Tech, ESS, 2nd Semester), ***Ms. Reema Mathew*** (DD, M.Tech, ESS, 8th Semester), ***Ms. Chinmai Sai Jureddy*** (DD, MoS, SSP, 8th Semester) have been selected by Australian National University (ANU) for their Future Research Talent (FRT) Awards for the year 2020. It may be noted here that, ANU has selected the largest contingent of Indian students from IIST this year. Last year, ANU has selected five(5) IIST students for the ANU-FRT Awards from among 51 students selected all over India spanning 19 institutions. ANU FRT provides for air travel and living expenses for each student amounting to 6000 Australian Dollars. Selected students will get to spend close to 3 months of summer internship at ANU during May-July 2020.

Dare to Dream Contest

The IIST Team consisting of ***Shri. Saurabh Chatterjee*** (PhD Scholar) and ***Shri. Abhijith Prakash*** (B.Tech Student) won the first prize in the DRDO organized "**Dare to Dream Contest**" based on the topic 'Multi Leg Mobility'. The team has designed a four legged walking robot with vacuum suction pads which is able to climb on to surfaces of aircrafts and launch vehicles and inspect them for defects. The prototype was built and demonstrated as climbing an inclined plane. DRDO organised the 'Dare to Dream Contest' to bring together entrepreneurs, academicians and individual innovators and encourage them to 'dare to dream'. The contest attracted over 3,000 entries in 12 topics of which 20 were awarded prizes. The prize distribution was done by **Hon. Defense Minister of India, *Shri. Rajnath Singh*** during the DRDO's directors conference in New Delhi on 15th Oct, 2019.

Shri. Saurabh Chatterjee receives award from Hon. Defence Minister Shri. Rajnath singh

Shri. Abhijith Prakash



Paper Presentation

i) *Ms. Neethu N,* B Tech, Dept. of Aerospace Engineering received the best paper award for her paper titled 'Comparison of Prediction Models for the Hot Deformation Behaviour of Cast Mg-Zn-Y Alloy' in the 2nd International Conference on Recent Trends in Metallurgy, Materials Science and Manufacturing - IMME 2019 - held at National Institute of Technology, Tiruchirappalli during 27 -28 Decemebr 2019.

ii) *Mr. Mallikarjun Kompella,* Dept. of Avionics has won 1st prize in MV Chauhan Student's paper contest at IEEE India Council International Conference (INDICON-2019) on 13th day of December, 2019 held at Rajkot, India. He won the prize for his technical paper tiled "Parallel Operation of Battery Chargers in Small Satellite Electrical Power Systems". The award includes a citation and a cash prize of Rs. 6000/-

iii) *Ms. S. Keerthipriya*, M.Tech , RF and Microwave Engineering, student of *Dept. of Avionics* has won NNSSRK Prasad Best Female student paper Award in InCAP-2019 (Indian Conference on Antennas and Propagation) held at Ahmedabad on December 19-22,2019 for the paper entitled "Reconfigurable Multifunctional Vivaldi MIMO Antenna for Cognitive Radio Applications". The award carries a certificate, plaque and a cash prize of Rs.5000.

iv) *S. Keerthipriya*, M.Tech (RF and Microwave Engineering), *Dept. Of Avionics* received the **International travel support** from AICTE-INAE for presenting her paper entitled "Dual Tunable Multifunctional Reconfigurable Vivaldi Antenna for Cognitive/Multi-Standard Radio Applications" in the IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, held at Atlanta, USA during July 7-12, 2019.

v) *Ms. Gopika R,* Ph.D , Electromagnetic Engineering, *Dept. Of Avionics* has won the **Best Paper Award** in Antenna Propagation Society track in TENGARSS-2019 (**IEEE Region-10 Geoscience and Remote Sensing Conference**) held at Hotel Grand Hyatt, Kochi, Kerala on October 17-20,2019 for the paper entitled "Millimeter Wave Grid Array Antenna for Wireless Power Transmitter". The award carries a certificate, plaque and a cash prize of Rs.2000.

Indian National Academy of Engineering (INAE) Innovative Student Project Awards B.Tech/M.Tech

i) Mr. Suraj, B.Tech (Avionics) has won the innovative project award for his project entitled "PS4Net: An Opportunistic Software Defined Networking Framework over PSLV Debris "

ii) Ms. Archana C M, B.Tech (Avionics) has won the innovative project award for her project entitled "Dodecagonal Voltage Space Vector Based Direct Torque Control Scheme for Open-End Winding Induction Motor with a Single DC Source"

iii) Ms. Sneha Gem Mathew B.Tech(Avionics) has won the innovative project award for her project entitled "'Low Complexity Cyclostationary Feature Detection from Sub-Nyquist Samples'"

iv) Mr. Rohit Gandikota, B.Tech (Avionics) has won the innovative project award for his project entitled"Harnessing Deep Generative Models for Multimedia Data Hiding"

v) Ms. Neethu M has won the innovative project award for her M.Tech project entitled" Actuator interface board design for momentum biased cubesat ADCS"

Internship/Conference Abroad

The research scholars and students of IIST had excellent opportunities to visit countries abroad for attending seminars/conferences or for doing research internships.

Sl. No	Name	Details of conference/workshop	Period of conference/ workshop
1.	Aalokeparno Dhar B.Tech Aerospace Engineering	For doing Internship at JPL, Caltech, USA	June , 2019 To July, 2019
2.	Dibya Kanti Golui B.Tech Aerospace Engineering	For doing internship at Physikalisch-TechnischeBundesanstalt(PTB), Braunschweig, Germany	13/05/2019 To 14/07/2019
3.	Ms. Jigyasa Nigam B.Tech Engineering Physics	For doing a project for her Master's thesis at EcolePolytechniqueFederale de Lausanne, Switzerland.	August,2019 To May,2020
4.		For doing internship programme at Australian national University, Australia	13/05/2019 To 05/08/2019
5.	Naman Jain B.Tech Engineering Physics	For doing internship programme at max plank	August, 2019 To

		Institute of Nuclear Physics, Heidelberg, Germany	April,2020
6.		For doing final year project at Max Plank Institute, Heidelberg, Germany	05/08/2019 to 04/05/2020
7.	Anant Kumar T K B.Tech Avionics	For doing summer internship at laboratory of Atmospheric and Space Physics (Lasp), for the InspireSat1 project at University of Colorado Boulder, USA	25/05/2019 To 19/07/2019
8.		To attend a small satellite conference at Utah in Logan, USA	03/08/2019 to 08/08/2019
9.	Subham Saha B.Tech Aerospace	For doing Internship at JPL, Caltech, USA	June , 2019 To July, 2019
10.	Mallikarjun Kompella B.Tech Avionics	For doing summer internship at laboratory of Atmospheric and Space Physics (Lasp), for the InspireSat1 project at University of Colorado Boulder, USA	25/05/2019 To 19/07/2019
11.	D Bhavana B.Tech Engineering Physics	For doing internship programme at Australian national University, Australia	13/05/2019 To 05/08/2019
12.	Koduri Venkatanaga Gopivikram B.Tech Engineering Physics		11/05/2019 To 05/08/2019
13.	Kannan S B.Tech Engineering Physics		13/05/2019 To 05/08/2019
14.	Jureddy Chinmai Sai B.Tech Engineering Physics	For doing Internship at JPL, Caltech, USA	June , 2019 To July, 2019

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PUBLICATIONS

6. PUBLICATIONS

With a view to increase the credibility of research and share the knowledge with the academic community and society at large, faculty members and scholars of IIST had publications in journals (142), had 127 conference papers and 9 book chapters. Members of the faculty have published 6 books in the areas of engineering, science, pedagogy and literature

6.1 Books (6)

- B S Manoj (2019). Multi-Track Modular Teaching: An Advanced Teaching-Learning Method, Published by B S Manoj
- P Chakravarthy, M Agilan, N Neethu (2019). Flux Bounded Tungsten Inert Gas Welding Process: An Introduction. CRC Press.
- Chinmoy Saha, Jawad Y Siddiqui, Y M M Antar, Multifunctional Ultrawideband Antennas: Trends, Techniques and Applications, CRC Press.
- Abhirami Girija Sriram and Babitha Marina Justin (2019) Salt and Pepper and Silver Linings Celebrating our Grandmothers, Read me Books
- Babitha Marina Justin (2019) I Cook my Own Feast, Red River
- Editors: Wilson Runcy, George Gejo, Joseph Kuruvilla (2019) Materials for Potential EMI Shielding Applications: Processing, Properties and Current Trends, Elsevier

6.2 Journal Publications (142)

In the reporting year IIST had 142 journal publications, 127 conference papers and 8 book chapters. 6 members of the faculty has published books in areas of engineering, science and literature

V. K. Dadhwal

- Athira K., Sooraj N.P., Jaishanker R., Kumar V.S., Sajeev C.R., Pillai M.S., Govind A., DADHWAL V.K. (2019) Quantitative representation of floral colors. Color Research & Application, 44(3):426-432.
- Athira K., Sooraj N.P., Jaishanker R., Kumar V.S., Sajeev C.R., Pillai M.S Govind A., Ramarao N., DADHWAL V.K. (2019) Chromatic exclusivity hypothesis and the physical basis of floral color. Ecological Informatics, 49:40-44.

- Kumar, S., Ghotekar, Y. S., Dadhwal, V. K. (2019) C-equivalent correction factor for soil organic carbon inventory by wet oxidation, dry combustion and loss on ignition methods in Himalayan region. Journal of Earth System Science, 128(3), 62.

- Kumar T., Mandal A., Dutta D., Nagaraja R., DADHWAL V.K. (2019) Discrimination and classification of mangrove forests using EO-1 Hyperion data: a case study of Indian Sundarbans. Geocarto International, 34(4):415-442.

- Mishra S.K., Nayak R.K., Mahanty P.C., Seshasai M.V.R., DADHWAL V.K. (2019) Tidal Circulation in the Hooghly Estuary and Adjacent Coastal Oceans. Journal of the Indian Society of Remote Sensing, 47(4):705-714.

- Reddy C.S., Pasha S.V., Satish K.V., Unnikrishnan A., Chavan S.B., Jha C.S., Diwakar P.G., DADHWAL V.K. (2019) Quantifying and predicting multi-decadal forest cover changes in Myanmar: a biodiversity hotspot under threat. Biodiversity and Conservation, 28(5):1129-1149.

- Sooraj N.P., Jaishanker R., Athira K., Sajeev C.R., Lijimol D., Kuma, V.S., Amini J, Pillai M.S. and DADHWAL V.K. (2019) Comparative study on the floral spectral reflectance of invasive and non-invasive plants. Ecological Informatics, 53, 100990.

- Vadrevu K.P., DADHWAL V.K., Gutman G., Justice C. (2019) Remote sensing of agriculture–South/Southeast Asia research initiative special issue.International Journal of Remote Sensing.40 (21): 8071-8075.

Department of Aerospace Engineering

- Saroj, A., Rose, K. J., Arun, C. O., & Anup, S.. (2019). Design of a bio-inspired composite using probabilistic fracture mechanics.. Journal of the Mechanical Behavior of Biomedical Materials. 95, 96-102.

- Mathiazhagan, S. and Anup, S. (2019). Effect of Interface Strength on the Mechanical Behaviour of Bio-inspired Composites: A Molecular Dynamics Study. Mechanics of materials 132, 93-100.

- Vikas Sharma, C.O. Arun, I.R. Praveen Krishna. (2019). Development and validation of a simple two degree of freedom model for predicting maximum fundamental sloshing mode wave height in a cylindrical tank. Journal of Sound and Vibration 461, 114906.

- Unnikrishnan, K. R., Praveen Krishna, I. R., Arun, C. O. (2020). Wrinkling analysis of pre-stressed rectangular membranes using element free Galerkin method. International Journal of Computational Methods , Online ready

- Prabith, K., and Krishna, I. R. P.. (2020). A Time Variational Method for the Approximate Solution of Nonlinear Systems Undergoing Multiple-frequency Excitations. ASME. J. Comput. Nonlinear Dynamics 15 (3), 031006

- Arun DI, Arun kumar, Chakravarthy P, B.S Girish, K.S Santhosh kumar and Santhosh B. (2019). Structural -modeling and experimental validation of percolation threshold for nanotube polyurethene shape memory system. Materials science and Technology 35(16), 2024-2037.
- Rajiv Panda, R.K Gupta, Animesh Mandal and P. Chakravarthy. (2019). Hot deformation behaviour of AA2024 with and without in-situ titanium diboride dispersoids. Materials performance and characterization. Materials Performance and Characterization 9(2), 188-201
- P.Neelima, S.V.S Narayana Murty and P.Chakravarthy. (2019). Comparison of prediction capabilities of flow stress by various constitutive equation models for hot deformation of aluminium metal matrix composites. Materials performance and characterization 9(2), 237-261
- VS Sooraj, Chakravarthy P, Danish H and Mohan kumar L. (2020). Investigations on the machining characteristics of silica phenolic ablative tiles bonded to a metal substrate. Materials performance and characterization 9(1), 59-71.
- N Neethu, Nahil Ahmed Hassan, Ravi Ranjan kumar, Chakravarthy P, Srinivasan A, MUhammed Rijas A. (2020). Comparison of prediction models for the hot deformatoin behaviour of cast Mg-Zn-Y alloy. Transactions of the Indian Institute of Metals 73, 1619–1628.
- N Neethu, Chakravarthy P. (2020). Development of processing maps for hot deformation : Algorithm and common errors. Metallurgical and materials transactions A 51, 3398–3402
- Arun DI, P Chakravarthy, K S SAnthosh Kumar and B Santhosh. (2019). Comparative study on electro-active shape memory nanocomposites of polyurethanecarbon black/multiwalled carbon nanotubes. AIP Conference Proceedings 2162(1), 020170
- Danish Handa, V. S. Sooraj. (2020). Performance Assessment of a Hybrid Intermittent- Progressive Grinding Strategy for Bi-Directional Carbon Fibre Reinforced Composites. Materials Today Proceedings 28(2), 865-872.
- V.S. Sooraj, P. Chakravarthy, Danish Handa, L. Mohankumar. (2020). Investigations on the machining Characteristics of Silica Phenolic Ablative Tiles Bonded to a Metal Substrate. Materials Performance and Characterization 9(1), 59-71 .
- Danish Handa, V.S. Sooraj. (2019). An eccentric sleeve grinding strategy for fibre-reinforced composites. Composites Part B: Engineering (Elsevier) 176, 107332.
- V.S. Sooraj. (2019). Contact behaviour of elastic abrasive spheres during self-centring type magneto-mechanical deployment for internal bore finishing. International Jouranal of Precision Technology 8(2-4), 158-173 .

- S. Gokul, and M. Deepu,. (2020). Fluid Flow and Heat Transfer in an Annulus with Ribs on the Rotating Inner Cylinder Surface. ASME Journal of Thermal Science and Engineering Applications 12(4), 041026
- G.P. Aravind, and M. Deepu. (2020). Numerical Studies on Convective Mass Transfer Augmentation in High-Speed Flows with Lateral Sweep Vortex Generator and Dimple Cavity. International Journal of Thermal Sciences. 153, 106379.
- P. M. Mithun Krishna, M. Deepu, and S. R. Shine. (2020). Effect of relative waviness on low Re wavy microchannel flow. Journal of The Institution of Engineers (India): Series C, 1-10
- K. M. M. Rafi, M. Deepu, and G. Rajesh. (2019). Effect of Heat Transfer and Geometry on Micro-Thruster Performance. International Journal of Thermal Sciences 146, 106063.
- A. S. Vishnu, G. P. Aravind, M. Deepu, and R. Sadanandan. (2019). Effect of heat transfer on an angled cavity placed in supersonic flow. International Journal of Heat and Mass Transfer https://doi.org/10.1016/j.ijheatmasstransfer.2019.07.058(), Vol.141.
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- Abhirami A J, Ujjval Sai V and Anup S. (Sep 20 - 21, 2019.). Finite Element Validation of Uniform Shear along Platelet-Matrix Interface in a Unidirectional Bio-

inspired Composite. ISAMPE National Conference on Composites (INCCOM 16), Thiruvananthapuram .

- Hetram Sonwani, Jayaprakash P and Anup S. (Sep 20 - 21, 2019.). Elastic stress transfer at interface during pullout in carbon fiber composites. ISAMPE National Conference on Composites (INCCOM 16), Thiruvananthapuram .
- Danish Handa, V. S. Sooraj. (December, 2019). Comparison of Conventional and Eccentric Sleeve Grinding of Unidirectional Carbon-Epoxy Composite under Dry and Wet Conditions. International Conference on Precision Meso Micro Nano Engineering (COPEN),, India.
- Danish Handa, V. S. Sooraj. (November, 2019.). Performance Assessment of a Hybrid Intermittent Progressive Grinding Strategy for Bidirectional Carbon Fibre Reinforced Composites. International Conference on Recent Advances in Materials and Manufacturing Technologies (IMMT), Dubai.
- V. S. Sooraj, P. Abhijith, P. Niharranjan et al.. (Decemeber, 2019). Demonstration of a Tele-Operated Robotic Manipulator Prototype: A Course Project in Aerospace Manufacturing and Automation. National Aerospace Manufacturing Seminar (NAMS): Challenges in Materials and Manufacturing Technologies for Human Space Programme (HSP), India.
- Danish Handa, V. S. Sooraj. (December, 2019). Minimal Damage Abrasive Machining of Fibre Reinforced Composites Via Eccentric Sleeve Grinding. National Aerospace Manufacturing Seminar (NAMS): Challenges in Materials and Manufacturing Technologies for Human Space Programme (HSP), India.
- S. Jayakrishnan and M. Deepu. (February 26-28,2020.). Numerical Study on Shock Transitions in Dual Throat Nozzles. 6th National Symposium on Shock Waves (NSSW-2020), IIT Madras.
- Sreejith K, Deepu M. and T. Jayachandran. (February 26-28,2020.). Transition of Supersonic Free Jet During Flow Separation in Top Nozzle. 6th National Symposium on Shock Waves (NSSW-2020), IIT Madras.
- V. V. Swathi, and M. Deepu. (December 28-31, 2019). Effects of the Sequential Phase Shift between Wavy Cylindrical Surfaces on the Heat Transfer Characteristics in Taylor−Couette Flows. 25th National and 3rdInternational ISHMT-ASTFE Heat and Mass Transfer Conference (IHMTC-2019), IIT Roorkee.
- G. P. Aravind, S. Gokul, and M. Deepu. (December 28-31, 2019). Mass Transfer Enhancement in Turbulent Taylor CouettePoiseuille Flow with Axial ribs. 25th National and 3rdInternational ISHMT-ASTFE Heat and Mass Transfer Conference (IHMTC-2019), IIT Roorkee.
- V. V. Swathi, S. Gokukl, G. P. Aravind and M. Deepu. (April 14-17, 2019.). Heat Transfer Characteristics of Taylor-Couette Flow in Wavy Conical Annulus. 4TH Thermal and Fluids Engineering Conference, Las Vegas, NV, USA.
- G. P. Aravind and M. Deepu. (April 14-17, 2019.). Effects of Asymmetrical Vortex Interaction by Variable Swept Vortex Generator (VSVG) on Mass Transfer

Enhancement. 4TH Thermal and Fluids Engineering Conference, Las Vegas, NV, USA.

- Kavya S S Sam Noble and Dhayalan R. (June 13-15, 2019). Designing Unmanned Aerial Vehicle for Minimum Takeoff and Landing Distance. International Conference on Applied Mechanics and Optimisation -2019, Thiruvananthapuram .
- Tandralee Chetia, Dhayalan R, Sreejalekshmi K.G. (April, 2019). Aerodynamic and Flight Dynamic Design of a Flapping Wing MAV. 3rd National Conference on Academic, Industrial, Scientific and Defence Research in Mechanical and Aeronautical Engineering Research, Chandigarh.
- Priyesh Jain and Vaidyanathan, A.. (February 26-28,2020.). Experimental Study of Plated Cavities in Supersonic Cavity Flow. 6th National Symposium on Shock Waves-IITM (NSSW-2020), IIT Madras.
- M. Chakraborty, T. Chavan and Vaidyanathan, A..(February 26-28,2020.). Liquid jet injection study in a modified pylon in supersonic flow. 6th National Symposium on Shock Waves-IITM (NSSW-2020), IIT Madras.
- Rohit Kalla, Anubhav Shukla, Pradeep Kumar P, Shine S.R. (December 28-31, 2019). Thermal System Design for Telescopic system at the second Langrange point. 25th National and 3rd International ISHMT-ASTFE Heat and Mass Transfer Conference (IHMTC-2019), IIT Roorkee, India, .
- Ashwin Ashok, Patur Ananth Vijay Sidhartha, Shine S.R. (December 5-6, 2019). Effect of various trench designs on axial compressor blade tip aerodynamics. ASME 2019 Gas Turbine India Conference, IITM, Chennai, India, GTINDIA2019-2592, .
- Aswathy, M., Arun C. O. (December 1st , 2019). Stochastic meshless method for Euler-Bernoulli beams with spatially varying Young's modulus. 64th CONGRESS OF ISTAM, IIT Bhubaneswar,December 2019.
- K. R. Unnikrishnan., I.R. Praveen Krishna., C. O. Arun. (December, 2019). Free Vibration analysis of Pre-stressed nonhomogeneous membranes using element free Galerkin Method. Seventh International Congress on Computational Mechanics and Simulations, ICCMS 2019, IIT Mandi.
- Gireeshkumar S., Arun C. O. and Robin Davis P. (July, 2019). Structural Reliability study on Concrete Gravity Dam. 4th Indian Conference on Applied Mechanics 2019(INCAM 2019), IISc.
- Vadlamani, S., Arun C. O. (July, 2019). A stochastic B-spline wavelet on the interval finite element method for elastic buckling of columns. 10th International Conference on Computational Methods, Singapore.
- K. R. Unnikrishnan., C. O. Arun., I.R. Praveen Krishna. (July, 2019). Wrinkling analysis of pre-stressed membranes using element free Galerkin method. 10th International Conference on Computational Methods, Singapore.
- Risha Raju, Jishnu Chandran R., and A. Salih.. (December, 2019). Numerical Modelling of NOx Reduction on Cu-ZSM 5 Foam Reactor. 25th National and 3rd International ISHMTASTFE Heat and Mass Transfer Conference, IIT Roorkee.

- Kavya S S Sam Noble and Dhayalan R. (June 13-15, 2019). Designing Unmanned Aerial Vehicle for Minimum Takeoff and Landing Distance. International Conference on Applied Mechanics and Optimisation -2019, Thiruvananthapuram .
- Khagesh Bhardwaj, Sam Noble. (June 13-15, 2019). Modelling and Parametric Study of Flexural Joints for Six-Axis Isolator based on Stewart Platform. International Conference on Applied Mechanics and Optimisation -2019, Thiruvananthapuram .

Department of Avionics

- Vineeth B. S.. (December, 2019). A study of Average and Peak Age-of-Information for MAC protocols in Contiki. IEEE International Conference on Advanced Networks and Telecommunications Systems, BITS GOA.
- Binoy B. and Vineeth B. S.. (December, 2019). Minimum delay scheduling under average power constraint for 802.11ax uplink. IEEE International Conference on Advanced Networks and Telecommunications Systems, BITS GOA.
- Gowri M., Vineeth B. S., and Premkumar K. (January, 2020). Optimal Downlink Scheduling and Power Allocation with Reconfiguration Delay. 13th International Conference on COMmunication Systems & NETworkS, Bangalore.
- C. Saha, J.Y. Siddiqui, and MM Yahia Antar. (March, 2019). Multifunctional Antennas for Cognitive Radio Applications. 2019 URSI Asia-Pacific Radio Science Conference (AP-RASC), New Delhi, India.
- S. Keerthipriya, and C.Saha. (May, 2019). Tunable Multifunctional Reconfigurable Step Profiled Dielectric Resonator Antenna for Cognitive Radio Applications. IEEE Microwave Integrated Circuits, Photonics and Wireless Networks (IMICPW-2019), NIT-Trichy, India.
- S. Keerthipriya, D. Ganguly, C.Saha and Y.M.M. Antar,. (May, 2019). Design of a Two-Port Composite Dielectric Resonator Antenna for UWB MIMO Application. IEEE Microwave Integrated Circuits, Photonics and Wireless Networks (IMICPW-2019), NIT-Trichy, India.
- D. Ganguly, Y.M.M. Natar, A. Somagni and C.Saha,. (July, 2019). Design of an Antipodal Bowtie Array MIMO Antenna for 5G Mobile Applications. 2019 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, Atlanta, USA.
- S. Keerthipriya, C.Saha, JY Siddiqui and Y.M.M. Antar. (01-07-2019). Dual Tunable Multifunctional Reconfigurable Vivaldi Antenna for Cognitive/Multi-Standard Radio Applications. 2019 IEEE International Symposium on Antennas and Propagation and North American Radio Science Meeting, Atlanta, USA.
- C.Saha and Elezabeth George. (October, 2019). An AMC Backed Slotted Ground Antenna for Broadside Radiation and High Gain. IEEE Region-10 Conference on Recent Advances in Geoscience and Remote Sensing : Technologies, Standards and Applications, Kochi, India.

- S. Bhattacharyya, C.Saha and JY Siddiqui,. (October, 2019). High Frequency Applications of Metamaterials and Metasurfaces. IEEE Region-10 Conference on Recent Advances in Geoscience and Remote Sensing : Technologies, Standards and Applications, Kochi, India.
- Gopika, R and C.Saha,. (October, 2019). Millimeter Wave Grid Array Antenna for Wireless Power Transmitter. IEEE Region-10 Conference on Recent Advances in Geoscience and Remote Sensing : Technologies, Standards and Applications, Kochi, India.
- C.Saha, S.A Elnanggar and Yahia Antar,. (December, 2019). Impact of Intrinsic Losses in Wireless Power Transfer using DR Loaded Split Cavity Resonator. IEEE MTT-S International Microwave Conference, IIT Bombay, India.
- C.Saha and S. Keerthipriya,. (01-12-2019). Reconfigurable Multifunctional Vivaldi MIMO Antenna for Cognitive Radio Applications. IEEE Indian Conference on Antennas and Propagation, Ahmedabad,India.
- C.Saha. (01-02-2020). Challenges, Design and Realization of Photoconductive Antennas for THz Applications. 2020 URSI Regional Conference on Radio Science (URSI-RCRS), IIT-BHU, Varanasi, India.
- A. Kumar. R, C. Saha and S. R. (February, 2020). Dual Band Energy Harvester Based on Metasurface Absorber. 2020 URSI Regional Conference on Radio Science (URSI-RCRS), IIT-BHU, Varanasi, India.
- V. Adhikar, A. Karmakar and C. Saha. (February, 2020). Systematic Investigation of Silicon Micromachined Waveguide Structure & Designing Passive Components out of it for THz Application. 2020 URSI Regional Conference on Radio Science (URSI-RCRS), IIT-BHU, Varanasi, India.
- Ajin Ghosh K K, Pradeep Kumar P, Bijudas C R, V. Seena. (April, 2020). PERFORMANCE STUDY OF VALVELESS TRAVELINGWAVE PIEZOELECTRIC PUMP IN MICROCHANNELS. 5th Thermal and Fluids Engineering Conference (TFEC), New Orleans, LA, USA.
- B.S. Tina, K. HarshaNikhita, Z. Joel, and V. Seena. (December, 2019). Parylene-C Based Nanomechanical Membrane-Flexure Sensor for Biochemical Sensing Applications. , XXth International Workshop on Physics of Semiconductor Devices: IWPSD 2019, Kolkata, India.
- Nisanth . A., Shivani Bhatia , Suja K. J , V. Seena2Optimisation. (December, 2019). Optimisation of a Membrane Based Piezoelectric Vibrational Energy Harvester for Low Frequency Applications. , XXth International Workshop on Physics of Semiconductor Devices: IWPSD 2019, Kolkata, India.
- Shubham Chauhan, Rohith S., V.Seena. (December, 2019). Development of 3-Axis Silicon Accelerometer with Piezoresistive ITO and Reduced Cross Axis Sensitivity. , XXth International Workshop on Physics of Semiconductor Devices: IWPSD 2019, Kolkata, India.
- Shahan, Sheeba Rani J. (January 2020). FPGA based convolution and memory architecture for Convolutional Neural Network. IEEE VLSID 2020, Bangalore, India.

- Minha Mubarak, Thomas James Thomas, Sheeba Rani J, Deepak Mishra. (September, 2019). Tensor Based Dictionary Learning for Compressive Sensing MRI Reconstruction. IAPR International Conference on Computer Vision Image Processing (CVIP 2019), Jaipur, India.
- Soumya Sara John,, Deepak Mishra,, and Sheeba Rani J,. (December, 2019). Retraining conditions: How much to retrain a network after pruning?. 8th International conference on Pattern Recognition and Machine Intelligence COnference PREMI 2019, Tezpur, India.
- Minha Mubarak, Thomas James Thomas, Sheeba Rani J. (Septemper 2019). Higher order dictionary learning for Compressed Sensing based Dynamic MRI reconstruction. British Machine Vision Conference BMVC 2019,, Cardiff, UK.
- Manasvi Gudiseva, Abhishek Chakraborty, and B. S. Manoj. (January 2020). Social Network Aware Dynamic Edge Server Placement for Next-Generation Cellular Networks. Proceedins of COMSNETS 2020
- Suraj R, Sarath Babu, Debabrata Dalai, and B. S. Manoj,. (December 2019). DebriNet: An Opportunistic Software Defined Networking Framework over PSLV Debris. Proceedins of IEEE ANTS 2019,
- K. V. Niranjan Sai, B. Thanudas, S. Sreelal, Abhishek Chakraborty, and B. S. Manoj. (October 2019.). MACA-I: A Malware Detection Technique using Memory Management API Call Mining. Proceedings of IEEE TENCON 2019,
- Sarath Babu, P. Rathod, and B. S. Manoj. (October 2019). On Optimizing Information Gathering in Shanty Town Emergency Response. Proceedings of IEEE TENCON 2019
- Siri Gadipudi, Rajeevan PP and R. Sudharshan Kaarthik. (January, 2020). A Grid Connected Open-end Winding Induction Generator System with Series Compensation. IEEE International Conference on Power Electronics, Smart Grid and Renewable Energy (PESGRE-2020), Kochi, India.
- Srikara Reddy and R. Sudharshan Kaarthik. (January, 2020). A 24-step Modulation Scheme for Dodecagonal Space Vector Structure with Six Concentric Dodecagons using Reference Phase Voltages. IEEE International Conference on Power Electronics, Smart Grid and Renewable Energy (PESGRE-2020), Kochi, India.
- Vidya V and R. Sudharshan Kaarthik. (January, 2020). A Control Scheme for Integrated Battery Charger With Split-Phase Machine. IEEE International Conference on Power Electronics, Smart Grid and Renewable Energy (PESGRE-2020), Kochi, India.
- Mallikarjun Kompella, R. Sudharshan Kaarthik, Priyadarshnam and Harsh Simha. (December, 2019). Parallel Operation of Battery Chargers in Small Satellite Electrical Power Systems. IEEE India Council International Conference (INDICON2019), Rajkot, India.
- K. Sairam, Srikara Reddy G, and R. Sudharshan Kaarthik. (December, 2019). Decoupled Control of Series Connected Split-Phase Synchronous Motors with

Open Circuit Fault with Eight-legged Inverter. IEEE International Conference on Transportation Electrification - 2019 (iTEC-2019), Bangalore, India.

- Vidya V, and R. Sudharshan Kaarthik. (December, 2019). Mathematical Modeling of Split Phase Machine based Integrated Battery Charger. IEEE International Conference on Transportation Electrification - 2019 (iTEC-2019), Bangalore, India.
- Pragya Yadav, Vidya V, and R. Sudharshan Kaarthik. (December, 2019). A Voltage Sensor-less Single-Phase Unity Power Factor AC-DC Front-End Converter. IEEE International Conference on Transportation Electrification - 2019 (iTEC-2019), Bangalore, India.
- Ranjith S and R. Sudharshan Kaarthik. (June, 2019). Linearization of Over-Modulation in Dodecagonal Space Vector PWM. IEEE 28th International Symposium on Industrial Electronics (ISIE), Vancouver, BC, Canada.
- S Selvam, Deepak Mishra. (December, 2019). Multi-scale Attention Aided Multi-Resolution Network for Human Pose Estimation. International Conference on Pattern Recognition and Machine Intelligence, Tezpur.
- R Gandikota, Deepak Mishra. (December, 2019). Hiding Audio in Images: A Deep Learning Approach. International Conference on Pattern Recognition and Machine Intelligence, Tezpur.
- R Gandikota, Deepak Mishra. (October, 2019). How You See Me: Understanding Convolutional Neural Networks, TENCON 2019-2019 IEEE Region 10 Conference (TENCON), 2069-2073, Kochi.
- A Roy, D Mishra. (October, 2019). ECNN: Activity Recognition Using Ensembled Convolutional Neural Networks. TENCON 2019-2019 IEEE Region 10 Conference (TENCON), Kochi
- K Pooja, RR Nidamanuri, D Mishra. (September, 2019). Multi-Scale Dilated Residual Convolutional Neural Network for Hyperspectral Image Classification, 10th Workshop on Hyperspectral Imaging and Signal Processing: Evolution, Amsterdam, Netherlands,
- MMN Sahal, D Mishra, N Gupta, R Sadanandan. (March, 2019). Application of Digital Image Processing Method for Spray Characterization. 6th International Conference on Signal Processing and Integrated Network, Noida.
- Pratik Ratadiya and Deepak Mishra. (November, 2019). An attention ensemble based approach for multilabel profanity detection. IEEE ICDM workshop , China.
- Minha, M, Sheeba Rani, Thomas J, Deepak Mishra. (September, 2019). Higher order Dictionary Learning for Compressed Sensing based Dynamic MRI reconstruction. BMVC 2019 , UK.
- Soumya Sara John, Deepak Mishra, Sheeba Rani. (December, 2019). Retraining Conditions: How Much to Retrain a Network After Pruning? International Conference on Pattern Recognition and Machine IntelligencePReMI 2019, Tezpur.
- Pinaki Ranjan Sarkar, Priya Prabhakar, Deepak Mishra, Gorthi Rama Krishna Sai Subrahmanyam. (October, 2019). Towards Automated Breast Mass Classification

using Deep Learning Framework. 2019 IEEE International Conference on Data Science and Advanced Analytics (DSAA), USA.

- Akshay Racahakonda Shri Rama, Rajesh Joseph Abraham. (January, 2020). Bilateral load following with a STATCOM and Battery Energy Storage. 2020 IEEE International Conference on Power Electronics, Smart Grid and Renewable Energy (PESGRE2020), Kochi.

Department of Chemistry

- Tandralee Chetia, Dhayalan and KG Sreejalekshmi. (April, 2019). Aerodynamic and Flight Dynamic Design of a Flapping Wing MAV. 3rd National Conference on Academic, Industrial, Scientific and Defence Research in Mechanical and Aeronautical Engineering Research organized by Society of Aeronautical Engineers, Government Museum, Chandigarh.
- Chithra R Nair, Sarah Titus and KG Sreejalekshmi. (November, 2019). Molecular Design for Dendrimer based Nanotheranostics: Conjugation of heterocycles as a viable strategy. International Conference NANOBIOTEK, Aerocity, New Delhi.
- Aditya Gohad, Athira S. Vijayan, Chithra R. Nair, KG Sreejalekshmi. (December, 2019). Nonionic surfactants with solid and solution state emissions: Synthesis, characterisation and photophysical property evaluations. National Conference on Recent Trends in Materials Science and Technology (NCMST 2019), IIST, TVM.
- Jasmine P. Jacob, Muskan Bhatnagar, Chithra R. Nair, KG Sreejalekshmi. (December, 2019). Adamantyl thiazoles as a versatile building block for diamondoid nanostructures: Synthesis, characterisation and property evaluations. National Conference on Recent Trends in Materials Science and Technology (NCMST 2019), IIST, TVM.
- Neema PM, Jobin Cyriac. (August, 2019). Acidified Molybdenum Disulphide Nanohybrid Material as Chemical Sensor for Quantification of Glucose in Blood Samples (Best oral presentation). Indian Analytical Science Congress 2019, Thiruvananthapuram, Kerala.
- Neema PM, Jobin Cyriac. (December, 2019). A Facile Fluorescent Approach for the Detection of Trinitrophenol Using WS2 Quantum Dots. National Conference on Recent Trends in Materials Science and Technology (NCMST 2019), IIST Thiruvananthapuram, Kerala.
- Annmary Tomy, Jobin Cyriac. (December, 2019). Ligand Induced Eching of Pt-Ni Mixed Clusters. National Conference on Recent Trends in Materials Science and Technology (NCMST 2019), IIST Thiruvananthapuram, Kerala.
- Annmary Tomy, Jobin Cyriac. (January, 2020). Ligand protected metal clusters. International Conference on Science and Technology of Advanced Materials (STAM 20), Mar Athanasius College, Kothamangalam.
- Sanu Xavier and Nirmala Rachel James. (August, 2019). Tunable TADF- PLED, A theoretical approach. 4th International TADF Conference Kyushu University, Kyushu University Fukuoka Japan.

- Sanu Xavier and Nirmala Rachel James. (December, 2019). Molecular Design Strategy for Blue TADF-PLED: A theoretical approach. National Conference on Recent Trends in Materials Science and Technology (NCMST 2019), IIST, TVPM.
- Haritha, H., and Mary Gladis, J.. (December, 2019). Ion-selective PEDOT:PSS coated functional separator for effective suppression of polysulfide shuttle effect in lithium-sulfur batteries. National Conference on Recent Trends in Materials Science and Technology (NCMST 2019), IIST Thiruvananthapuram,.
- Haritha, H., and Mary Gladis, J.. (January, 2020). Inhibiting the shuttle effect in lithium-sulfur batteries using a carboxylate anchored permselective separator,. National Convention of Electrochemists (NCE-21), VIT Chennai Campus, Chennai.
- Aiswarya Samridh, Bibin John, Mercy T D, J Mary Gladis. (December, 2019). Chitosan- Styrene butadiene blends as binder for Silicon-graphite composite anode for Lithium-ion cells. National Conference on Recent Trends in Materials Science and Technology (NCMST 2019), IIST Thiruvananthapuram,.
- Sreekala K., Haritha, H., and Mary Gladis, J. ,. (December, 2019). High performance Graphene -sufur- lithium cobalt vanadate composite cathode for lithium-sulfur battery,. International Conference on Energy and Environment (ICEE), TKM college, Kollam,.
- Sreekala K., Haritha, H., and Mary Gladis, J.. (December, 2019). Graphene- sulfur-lithium cobalt vanadate nanocomposite as a superior cathode material for lithium sulfur batteries,. National Conference on Materials Science And Technology (NCMST-2019),, IIST Thiruvananthapuram,.
- Sreekala K., Haritha, H., and Mary Gladis, J.,. (January, 2020). Lithium cobalt vanadate nanocomposite cathode material for high performance lithium sulfur batteries. National Convention of Electrochemists (NCE-21),, VIT Chennai Campus, Chennai,.
- P. .Wilson; S.Vijayan; K. Prabhakaran. (December, 2019). Lightweight, compressible and thermally insulating heterostructured SiCNW-SiC foam. National Conference on Recent Trends in Materials Science and technology, .
- A. Chithra, P.Wilson, Sujith Vijayan, R. Rajeev and K. Prabhakaran. (December, 2019). Natural Cotton Derived Carbon composite foam for thermal insulation. National Conference on Recent Trends in Materials Science and technolog, .
- A. Chithra, P.Wilson, R. Rajeev and K. Prabhakaran. (September, 2019). Effective heavy metal (Cr6+) adsorption on black gram derived nitrogen doped porous carbon. Indian Analytical Science Congress, .
- Rekha Krishnan G , K. Prabhakaran and Benny K. George. (December, 2019). Zeolitic Imidazolate Frameworks: A promising candidate for the removal of perchlorate from water. National Conference on Recent Trends in Materials Science and technology, .
- Rekha Krishnan G, K. Prabhakaran; Benny K. George. (September, 2019). Nano hydroxyapatite: A potential adsorbent for perchlorate from water,. Indian Analytical Science Congress, .

- B.D.S.Deeraj and Dr. Kuruvilla Joseph. (March 5-7, 2020.). Studies on Electromagnetic Interference shielding capability of Zirconia incorporated carbon nanofiber mats/Epoxy composites. International Conference on Nano Science and Technology. ICONSAT 2020, S.N. Bose Institute, Kolkata, 2020.
- B.D.S.Deeraj and Dr. Kuruvilla Joseph. (December 18-20, 2020). Studies on Electrospun Fiber Mats Reinforced Epoxy Composites,. National Conference on Recent Trends in Materials Science and Technology NCMST 2019, IIST Trivandrum.
- B.D.S.Deeraj and Dr. Kuruvilla Joseph. (December 12-14, 2019). Studies on electrospun fiber incorporated epoxy composites. International Conference on Energy and Environment iCEE 2k19, , 2019, T.K.M College of Arts and Science, Kollam.

Department of Earth and Space Science

- Mohammed Suhail K and A Chandrasekar. (December, 2019). Impact of Flood Events on Land Surface and Atmospheric Variables: A Case Study on August 2008 Kosi River Flood in Bihar, India. TROPMET 2019, Andhra University, Visakhapatnam.
- Aneesha U. and Samir Mandal. (April, 2019). Unification of the outbursts evolution of GX 339-4. RETCO-IV, IUCAA, Pune.
- Samir Mandal. (November, 2019). Black Hole X-ray Transients – Challenges in Accretion Physics. Transient Astronomy, URSC, Bangalore.
- Samir Mandal and Aneesha U.. (February, 2020). Study of black hole X-ray transients to understand accretion dynamics. 38th ASI Meeting, IISER Tirupati.
- Jagadheep D. Pandian. (January, 2020). Multi-line studies of massive star forming regions. ISAA meeting, Raman Research Institute, Bangalore.
- Kutty Govindan. (December, 2019). Predictability aspects of weather events in Bay of Bengal. Tropmet 2019, Andhra University, Visakhapatnam.
- Sarita Vig. (October, 2019). Infrared View of Early Phases in Massive Star Formation. Infrared Astronomy And Astrophysical Dust, IUCAA, Pune.
- Sarita Vig. (December, 2019). Understanding massive star formation environment. Science with Subaru, An Indian Perspective, TIFR, Mumbai.
- Sarita Vig. (January, 2020). Study of Infrared Dark Clouds. ISAA Meeting, Raman Research Institute, Bangalore.
- Sarita Vig. (Februray 2020). Making of Astronomy Online courses. 38th ASI meeting, IISER, Tirupati.
- A Tej. (Februray 2020). ExoWorlds - An ISRO Exoplanet Mission (Invited Talk). 38th ASI Meeting, IISER, Tirupati.
- Rajesh, V.J.. (November, 2019). Petrology: A Powerful Tool to Understand the Evolution of Lunar Rocks (Invited Talk). 3rd National Workshop on Petrology - Petros, Department of Geology, University of Kerala.

- Rajesh, V.J.. (November, 2019). A journey into the geology of the Red Planet Mars. National Seminar on New Perspectives in Learner's Geology, Department of Geology, University College, Thiruvananthapuram.
- Rajesh, V.J.. (December, 2019). Exploration of our Earth's Moon: Role of Geology (Invited Talk). National Seminar on Recent Trends in Geosciences, Government College, Kasargod.
- Rajesh, V.J. and Thesniya P.M. (February, 2020). Understanding Planetary Processes through Laboratory stuy of Terrestrial analogues (Invited talk). Indian Planetary Science Conference (IPSC), Physical Research Laboratory, Ahmedabad.
- Thesniya P. M. and Rajesh V. J.. (October, 2019). Compositional analysis of lunar spinels using Chandrayaan-2 data (Invited Talk). Chandrayaan-2 Data user's meet, DOS Branch Secretariat, New Delhi .
- Thesniya, P. M., Jappji Meher, Rajesh, V.J.. (February, 2020). Unravelling the stratigraphy and geological history of das crater on the farside of the moon based on morphology, mineralogy and ejecta emplacement dynamics. Indian Planetary Science Conference (IPSC), Physical Research Laboratory, Ahmedabad.
- Shreya Natarajan, Kuljeet Marhas and Rajesh V.J.. (February, 2020). Study of aqueous alterations in carbonaceous meteorite parent body using FTIR spectroscopy. Indian Planetary Science Conference (IPSC), Physical Research Laboratory, Ahmedabad.

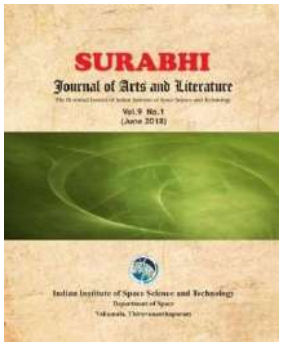
Department of Humanities

- Deepu T S and V.Ravi. (19th February 2020). Prioritization of Customer and Design requirements for an Information Technology enabled Electronics Supply Chain. International Conference on Research, Innovation, Knowledge Management & Technology Application for Business Sustainability (INBUSH-2020), Amity University.
- Dr. Shaijumon C S. (16-18 January 2020). "Economic Slowdown of India: A Theoratical Explanation". National Seminar on "India's Economic Slowdown: Cyclical or Structural", Department of Economics, Governement Arts College, Trivandrum.
- Dr. Shaijumon C S. (24-25 September 2019). "Role of Women for Achieving Inclusive Growth of India". National Seminar on "Women Empowerment: Issues, Challenges and Prospects, Department of Economics, NSS Hindu College, Changanasserry.

Department of Mathematics

- Prosenjit Das. (2-6 July 2019) Structure of A2-fibrations over Noetherian domains containing Q, CAAG-2019,IISER - Bhopal.

6.5 Institute Publications



Surabhi: Journal of Arts and Literature is a bi-annual art and creative journal published by Indian Institute of Space Science and Technology. It publishes creative and literary articles written by students, staff and faculty of IIST as well as employees from various centres of Department of Space. It also publishes interviews of interesting and talented personalities from DOS.

(Last year 2 Volumes are published, June 2019 and Dec. 2019)

6.6 In-house Publications

The Sounding Rocket (TSR) is the biannual student newsletter composed and designed by students at IIST chronicling life and times at the institute.

6.7 IIST Newsletter

IIST publishes a bi-annual newsletter which covers all the major events happening in the institute. Currently the 5th volume is published.

(Last year 2 Volumes are published, July 2019 and Jan. 2020)

6.8 Literay Publications

- Nikhil Eyeroor, " Can Stories Transform Our Mind? " Surabhi magazine, IIST Journal of Arts and Literature. Vol.11, No.1, June 2019, pp 14-16.
- Nikhil Eyeroor, " Are You Nostalgic? " Surabhi magazine, IIST Journal of Arts and Literature. Vol.12, No.2, December 2019, pp 16-17.

FACILITIES, INFRASTRUCTURE & OTHER UNITS

7. FACILITIES, INFRASTRUCTURE & OTHER UNITS

7.1 Facilities

7.1.1 Library & Information Services

Library has continued to develop print and electronic resources and provided various information services to support academic, research and administrative requirements of the Institute. Details of library collection and expenditure for various resources during 2019-20 is given below:

Sl No	Resources	New Addition During 2019-20	Amount Spent During 2019-20	Total No. as on 31st March 2020
1	Books	746	38.94 lakh	33157
2	E-Books	4443	Antariksh Gyaan Consortium	5402
3	Print Journals	16	45.57 lakh	92
4	Online Journals	1	19.46 lakh	10
5	Online Databases	1	164.60 lakh	14 (Total No. of Online Journals 5000+)
6	Similarity Detecting Tool		4.79 lakh	1
7	Online Services		Antariskh Gyaan Consortium	2
8	Bound Volumes	171		941
9	CD / DVD	11		1039
10	Maps			122
11	Reports	50		1005

Library provided various services such as IIST Virtual Library (IVL) for remote access of e-resources, Books on Desk Service, Book Grant Service, Text Book Bank, Documentation Service, Similarity Checking Service, Content Scanning, Portal Management, Social Media Management, Shodhganga Co-ordination, NDL Co-ordination, Multimedia Library, Graphic Designing, Reprographic Service and Binding Service. Inter library loan facility extended to all ISRO / DoS libraries to facilitate resource sharing with all ISRO/DoS libraries. A software module has been developed with the help of software supporting group to manage book grant submissions.

During lockdown period, online resources were connected to the academic community through IVL and shared other open source academic contents with classified links. Trial access were enabled for various e-databases of journals, books and a grammar checking tool. Enabled access to 'Urkund – Similarity checking software, recommended by UGC. Two webinars on 'How to publish in Scientific Journals' and two webinars on 'Urkund tool' were organised for the academic community. CCTV implemented in the library for security purpose.

Library continued to acts as the publishing centre of the institute by bringing out newsletter, magazine, annual report, convocation speech, workshop / conference materials etc.

National library week was celebrated with many programmes such as lectures, book fest, 'exhibition of books on and by Dr APJ Abdul Kalam' and 'Donate a book: a read and share initiative' to support Govt. school / college libraries. Director, IIST has inaugurated the official social media pages of IIST on the first day of celebration. Lectures on Space Science and its applications (Dr. YVN Krishna Murthy), Stress management through reading (Smt. Devi R Das), Means for effective technical presentation (Dr. Gigy J Alex) and How to avoid plagiarism in publications (Shri. A Abdunnasar) were arranged as part of the programme.

Orientatoin programmes were arranged for new students to familiarise library resources, procedures and practices. A special two days hindi workshop was arranged for the library staff. Nine L&IS PG students undergone internship training programme in IIST Library during the reporting period.

7.1.2 Software Support Group

Software Support Group (SSG), lead by a team of IT professionals provides various software services and technical assistance in Indian Institute of Space Science and Technology.

SSG implement software support and services to the various departments such as Academics, Administration, Transport, Canteen, Purchase, Stores, Accounts and Placement in the Institute. SSG has designed, implemented, customized, tailored and updated many web applications within short time span without compromising accuracy. SSG plays an important role in providing software solutions based on Institute demand.

SSG Activities – A quick walk through

During the reporting year, the major accomplishments of SSG include the release of software namely, Thesis Submission and Evaluation Portal, Canteen Booking System and Medical Record Management System; that offered key benefits to the students and staff of IIST.

Thesis Submission and Evaluation Portal – This portal served as a common platform to all the final year students for submitting their thesis online for review and evaluation. This eased the review and evaluation process which will be archived for future reference.

Canteen Booking System – This application offered couponless online booking and cancelation of breakfast/lunch/dinner services anywhere at any time.

Medical Record Management System – A systematic record keeping of consultation summary and medicine stock was set up using this software for the IIST Health Services.

Apart from go live and software enhancements, online payment integration was done for the Postgraduate and Ph.D. admissions.

7.1.3 Computer Services Group (CSG)

Computer and Networking infrastructure of IIST are setup and maintained by CSG, and operated from the Server & Network Operating Centre on a 24x7 basis.

In the year 2019-20, IT and non-IT services listed below have been facilitated to students, faculty and staff, in 4 academic blocks, 5 administrative facilities and 11 residential hostel buildings located across IIST campus.

1. Networking &Wireless Internet services
2. Server Hosting &Software Licensing services
3. Computer Maintenance and Technical Support services
4. Web, Mail, ePayment and SMS services
5. Access Control & Identity Card services

6. Audio-Visual & Multimedia services
7. Video Conferencing services
8. Network Video Surveillance services
9. Printer/Copier Maintenance and Cartridge & Consumable services
10. Telephone and Satellite Communication services

7.1.4 Medical Facilities

a. Permanent staff

Permanent staff are covered under Complementary Health Service Scheme (CHSS)of DOS.

b. Students

As a residentialcampus, health care of students is extended at the MedicalFacilities functioning at HostelDhanishta where two Doctors, four Nurses areengaged on contract. The students are also covered under Group MediClaimInsurance Policy and Accident Insurance Policy.

For specialized treatment, labexaminations etc., students are referred to outside hospitals recognized under theInsurance agency. Conveyance facility including a fully equipped Ambulance and alight vehicle are available to meet emergency situations.

c. Manpower engaged on contract

Those engaged on contract are covered under Employees' State Insurance Scheme which is managed by the manpower supply agencies. Those persons engaged under contract directly under IIST are advised to take medical insurance coverage, the premium of which is paid by IIST.

Counseling Facilities

A well experienced professional counselor engaged on contract by IIST provides support and guidance for students with personal issues or challenges. The counseling services is open also to parents and teachers in required cases.

7.1.5 Halls of Residence

The residential facilities for students are spread across 11 Hostels (08 for Men & 03 for Women) inside the campus. They are named after mythological-constellations (Nakshatras) viz. Dhruva, Dhanista, Chitra, Revathi, Rohini, Ashwini, Ardra, Phalguni, Anuradha, Arundathi&Vishaka. Around 800 students stay in the hostels which are provided with separate reading rooms,national and vernacular newspapers,LCD television with satellite connection,safe drinking water (both hot and cold) and 24 hruninterrupted power supply with generator backup. Neat and tidy upkeep of the hostel rooms are the responsibilities of the students. All hostels are Wi-Fi enabled with high speed access to the internet, digital library and other digital learning resources.

Two Laundry Huts are made available inside the campus separately for men and women with provision for installing their personal washing machines and also for manual washing of cloths. Services of a laundry service provider engaged on contract are also available.

7.1.6 Canteen Services

Canteen Services of IIST caters to the need of more than 800 students residing at the hostels of the institute. In addition we have more than 300 users of canteen facility comprising of faculties, officers, staffs and research scholars respectively. Dining Hall - Student Activity Centre (Mess-1) has a capacity of 420. Menu is finalized by the Canteen Advisory Committee which also includes student's representation. In addition to this, Canteen Management Committee, Canteen Procurement Committee and Canteen Accounting Committee are constituted to facilitate smooth functioning of Canteen Services. We use latest kitchen equipments such as Cook wok, Self cooking centre, automatic chappathy machine, etc. to run our canteen and provide hygienic, tasty and quality food for all canteen users.

7.2 Infrastructure

7.2.1 Construction and Maintanance Division (CMD)

Additional Infrastructure and Creation of Laboratories during the financial year 2019-20 are summerised below:

1. **Multipurpose Hall (MPH) in the SAC building**

- Total Built up Area : 636 m^2
- Cost of Building : 1.29 Cr
- Seating capacity : 450

2. Students' Activity Centre (SAC Building)

- Total Built up Area : 3543 m^2
- Cost of completion : 7.34 Cr

3. Mess I & Kitchen

- Total Built up Area : 1098 m^2
- Cost of completion : 2.59 Cr
- Dining Capacity : 450
- Put to use from : 05.01.2020

4. Water treatment plant

- Capacity : 82.5 Lakh Litres
- Completion cost : Rs. 31.23 lakhs
- Date of commissioning : Aug 2019

- Saving an amount of Rs. 5.42 lakhs/month on water charges.

5. Ultra Filtration System

- Completion cost : Rs. 10.36 lakhs
- Date of commissioning : Aug 2019

6. Labs in Interdisciplinary Block

i. High Performance Computing Lab (HPC Lab)

- Completion cost – 43.8 lakhs

ii. Electric Propulsion Lab

- Completion cost – 7.02 lakhs

iii. **Language Lab**

- Completion cost -11.05 lakhs

iv. **Computational Physics Lab**

- Completion cost – 1.53 lakhs

v. **M.Tech Instruction Lab**

- Completion cost – 8.57 lakhs

7. Labs in Avionics Block

i. **Gas Sensor Lab**

- Completion cost – 10.29 lakhs

ii. **Digital Signal Processing Lab**

- Completion cost – 5.33 lakhs

iii. **Analog Electronics Lab**

- Completion cost – 7.23 lakhs

iv. **Digital Microprocessor Lab**

- Completion cost – 1.67 lakhs

v. **Digital Communication Lab**

- Completion cost – 5.52 lakhs

vi. **Power Electronics Distribution Systems(PEDS) Lab & Power Electronics UG Lab**

- Completion cost – 3.54 lakhs

8. Providing tea-kiosk near S-road

- Built up area : 36.00sqm
- Completion cost : Rs. 15.38 Lakhs
- Date of commissioning : 30.03.2019

7.3 Administration and Other Units

7.3.1 Administration

Academics

Dr. Vinay Kumar Dadhwal	Director

Deans

Dr. A Chandrasekar	Academics, Continuing Education
Dr. Raju K George	Research and Development & IPR
Dr. Kuruvilla Joseph	Students Activities, Student Welfare & Outreach

Officers

Prof. YVN Krishna Murthy	Registrar
Dr. Sennaraj V	Deputy Registrar (Academics)
Shri. R Hari Prasad	Deputy Registrar (Finance)
Smt. Bindya K R	Deputy Registrar (Administration)
Shri. Mohan Sukumar	Scientist/Engineer 'SF' (Computer System Group)
Shri. Ramanathan S	Senior Administrative Officer
Shri. Subash Chandran M B	Deputy Registrar (Purchase)
Shri. Rakesh R Menon	Senior Purchase & Stores Officer
Shri. Vinod Kaimal K P	Senior Manager- Canteen Services
Shri. Pradeep Kumar K R	Administrative Officer (In Charge of Hostel & Transport)
Smt. Rajeena Beegam S	Senior Accounts Officers
Smt. Reny Thomas	
Shri. Jayapal R	Senior Hindi Officer
Shri. Abdunnasar A	Library Officer-D

7.3.2 Bank / Financial Services

The Institute houses the Union Bank of India along with its ATM, near the student residential area for easy access for students.

7.3.3 Hindi Section And Official Language Implementation

IIST has a full fledged Hindi Section which not only caters to the Constitutional and Statutory requirements regarding the Official Language, Hindi, but also creates a conducive environment for the officials of the Institute to learn Hindi and work in Hindi. During the year, efforts were made for implementing the provisions of Official Languages Act, Rules made there under and orders/ instructions issued by the Department of Official Language from time to time regarding progressive use of Hindi.

MAJOR ACTIVITIES RELATED TO POLICY IMPLEMENTATION

- Four Hindi Workshops were conducted on **13th and 14th June, 2019** for the Employees and officers of Technical areas, on **September 23rd, 2019** for the faculty members, on **12th& 13thDecember, 2019** for the Employees of Administrative areas and on **17th and 18th February, 2020** for the Employees and officers of Technical areas.

- Three Quarterly meetings of the OLIC were conducted on (19.06.2019, 30.09.2019, 24.12.2019) in order to review the progress in the implementation of OL Policy and four Quarterly Progress Reports regarding progressive use of Hindi in the Institute were sent to the Department of Official Language.

- Spoken Hindi Classes were conducted for the library staff on May 28 and 29, 2019. Sr. Hindi Officer, IIST and Shri. A. Somadetan, Assistant Director, Rajbhasha, (retired), Income Tax Department conducted one session each of one and a half hour duration.

- As per the instructions received from the Registrar, IIST Hindi Essay Writing, Hindi Elocution and Patriotic Song competitions were conducted for the students of IIST in connection with the Independence Day Celebrations. Merit certificates and cash prizes were awarded to the winners of Hindi Competitions during the Independence Day Celebrations on 15th August, 2019.

- **Hindi Fortnight Celebrations** were conducted in the institute during the second half of September.During this fortnight, a Hindi Day lecture was delivered by Dr. B. Ashok Kumar, Head, Dept. of Hindi, University College, Thiruvananthapuram on 17th September, 2019 highlighting the importance of Hindi Day. Various competitions like Hindi Typing, Hindi Essay Writing, Noting, Drafting, and Terminology competitions were conducted for staff members and Versification, Translation of Technical and Scientific Matter, Essay Writing were conducted for the students of IIST. Merit certificates and cash prizes were awarded to the winners of Hindi Competitions.

- In connection with the **World Hindi Day Celebrations - 2020** in IIST Hindi Essay Writing competitions were conducted for the students and staff members on 7th January, 2020. A special lecture was delivered by Dr. Shamili M.M, Assistant Professor and Head, Department of Hindi, Government College, Nedumangad on 10th January, 2020 on the topic "World Language Hindi". Thereafter, Dr. Shamili the chief guest distributed merit certificates and cash prizes to the winners of the Hindi Essay Writing Competitions.

- Hindi Word Processing Training under the auspices of Town Official Language Implementation Committee, Thiruvananthapuram (Office – 2) for the officials of the member offices of TOLIC was organized in our institute on 12th June 2019. The training programme was formally inaugurated by our Director. Shri. R. Jayapal, Sr. Hindi Officer conducted the training session. Thirty employees from various Departments and offices attended this training. Smt. Mini Kumari R.G, Senior Project Assistant attended the training from our institute.

- Telephone Directory, Course Record, Record of Degrees conferred, Provisional Certificates, Degree Certificates and all other certificates such as certificate of participation/ certificate of merit etc., were prepared, printed and issued in bilingual format (both Hindi and English). Institute Brochure, Annual Report 2018-2019 were printed in Hindi.

- Standard forms used in various Administrative Departments and Academics were bilingualised, visiting cards, name boards and rubber stamps were prepared in bilingual format.

- In order to ensure the compliance of Official Languages Act, 1963, Official Languages Rules, 1976 and relevant orders issued by the Dept. of Official Language time to time check Points were re- established.

- In order to encourage the progressive use of Hindi **the incentive scheme for doing official work in Hindi** was continued.

- Sr. Hindi Officer, IIST provided faculty assistance for the conduct of OL workshops in viz. VSSC, IISU, MVIT, CTCRI and Trainers training programme conducted under TOLIC.

7.3.4 Gender Sensitization Cell

Institute has a Gender Sensitization Cell which has members from Faculty, Staff and Students. The Cell organisers awareness programs and workshops regarding sexual harassment at workplace.

FACILITIES AND POLICIES FOR PERSONS WITH DISABILITY

8. FACILITIES AND POLICIES FOR PERSONS WITH DISABILITY

8.1 Facilities

Buildings have disabled access ramp, lifts, accessible toilets etc., for the convenience of persons with reduced mobility. All the academic blocks, Administrative building and Library are provided with ramp and lifts and toilet for Divyangjan. Student Activity Centre, Hostels and mess building are also provided with accessible toilets and ramps.


AKSHAYA
CANTEEN
RAMP
RAMP
TRANSPORT


TRANSPORT FACILITY
RAMP
TRANSPORT
TRANSPORT
RAMP

8.2 Budget allocation

Separate budget is not earmarked but activities for implementation of Rights of Persons with Disability Act, 2016 is accorded top priority and expenditure incurred in the general budget.

8.3 Affirmative action

Indian Institute of Space Science and Technology admits PwD students to UG & PG programmes as per Government of India guidelines with 5% reservation on horizontal level. 2019 UG Admission: 14% seats were filled. (7 seats were reserved out of Total 140 seats)

2019 PG Admission: 0% seat is filled. (5 seats were reserved out of total 90 seats)

The details of the policies and actions for implementation of the Rights of Persons with Disability Act, 2016 are described as a separate chapter from the annual report of 2019-20.

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EVENTS, VISITS & OUTREACH

9. EVENTS, VISITS & OUTREACH

Seminars, Conferences and Workshops were organized to disseminateresearch findings as well as to provide opportunity for IIST students and scholars toparticipate and learn from such events. In addition, a large number of nationalfestivals and other earmarked days were celebrated with great fervor.

9.1 Launch of Advanced Retarding potential analyser for Ionospheric Studies(ARIS)

1st April 2019 was a very important day for Indian institute of Space Science and T e c h n o l o g y ,Thiruvananthapuram. It was on this day that the first space mission by IIST was realised. An ionospheric probe called Advanced Retarding potential analyser for Ionospheric Studies(ARIS), which measures the prevailing plasma parameters in the ionosphere was launched on the PS4 operational platform on PSLVC45. ARIS was realised underactive inter-department R&D team comprising of D r .Umesh R Kadhane (Physics), Dr C S Anoop, Dr R Sudharshan Karthik(Avionics) and Dr V S Sooraj(Aerospace). Research on this probe for laboratory-based research was going on for several years at IIST in Dr.Umesh's laboratory. With that experience, IIST is actively working on making payloads for future Mars and Venus missions by ISRO. On the basis of home grown know-how,IIST built a probe specifically configured for earth's ionospheric conditions. The payload was realised and qualified in a very short time of just 49 days. This was possible only due to the combined efforts and generous support of many faculty,scientists and engineers from IIST, IISU and VSSC. Swift and coordinated actions were taken under the guidance of Prof . Dhekane, Satish Dhawan Professor, IIST and every procedure was expedited by Dr. Y. V. N. Krishna Murthy, Registrar, IIST.

Four faculty members and four project fellows from IIST directly contributed to the design, simulations, realisation and testingof the payload. The electronics team designed a very efficient COTS based electronics main board with open architecture. The front end circuits were built to handle sensor current as low as 10 pA. A very innovative combination of analog electronics and digital logic unit was used to achieve high sensitivity and at the same time very large dynamic range. IISU and VSSC teams played asignificant role in getting the PCB design made and qualified swiftly. Due to the experience of these teams there was no repetition of any process and the work could be completed in a single stretch. The preliminary mechanical design and vibration simulations were done at IIST. But due to the time constraint, amulti prototype development was not feasible. Hence the mechanical design team at IISU was roped in and with their help a design was finalised in

one step and within the required weight limit. IISU workshop took up expeditious fabrication and in a shortspan of just 4 days, the payload chassis and the internal hardware were ready and received the clearance for quality control. The payload reached its destined orbit of 485 km and was turned on at 12.27pm on 1st April 2019. The analysis of the data received showed the probe is in perfect condition and performing the scientific experiments exactly as programmed. The data received was analysed for the in situ ionospheric conditions and the measured values were found to be in agreement with the expected results. The probe remained active till the PS4 OP was functional and we have received data worth more than 300 orbits out of total 843 orbits. Dueto lack of on-board storage, the data was received only during to be used thus resulting in the difference in thequantity of data vis a vis number of orbits.

Important highlights of the mission:

1) First ever space mission of IIST and achieved better than expected performance
2) Complete in-house know how and development
3) Realisation of full hardware in just 49 days
4) Excellent team work across multiple ISRO centres and IIST
5) Multiple innovations in the electronics:
    (a) Current measurement for a high dynamic range (104) for very low currents of 100 nA to 10 pA
    (b) Bias current offset correction for improving accuracy of low current measurement
    (c) High frequency noise/interference rejection implemented in measurement scheme
    (d) Dynamic ranging and scaling of the data acquisition unit
    (e) Hardware was qualified for -20 degrees to +60 degrees Celsius operation

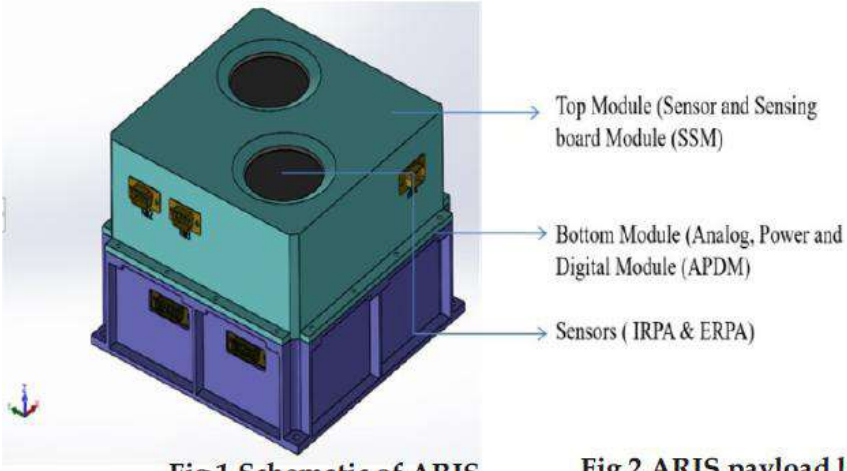


Fig.1 Schematic of ARIS

Fig.2 ARIS payload launched in PSLV C-45 flight

From Left: Dr. Anoop C.S (Faculty), Aarathi Sathi Nair, Dr. Sooraj V.S (Faculty), Prof. M.V. Dhekane (Prof. Satish Dhawan Professor, IIST), Dr. Umesh R. Kadhane (Faculty), Dr. B.N. Suresh (Chancellor,IIST), Dr. K. Sivan(Chairman,ISRO & Secretary,DOS), Dr. Y. V. N. Krishna Murthy (Registrar, IIST), Dr. V. K. Dadhwal (Director, IIST), Dr. R. Sudharshan Kaarthik (Faculty), Pranjal Gupta, Naveen S. and Sreehari B. Nair.

ARIS Team with ISRO Chairman at SHAR

9.2 Dr. APJ ABDUL KALAM LECTURE SERIES

Dr. APJ Abdul Kalam Lecture series was launched by IIST in April 2018 in the fond memory of its 1st Chancellor, Dr. APJ Abdul Kalam.

4th Dr. APJ Abdul Kalam Lecture

Prof. V. Ramgopal Rao, Director IIT Delhi delivered the 4th Dr. APJ AbdulKalam Lecture titled "Connecting Academic R&D with ProductInnovation: A few case studies and away forward" at IIST on 1st May 2019.

The lecture started by mentioning our nation's great contribution to theworld's R&D, especially in areas like Nanotechnology where, India is among the top 3 countries in the world in terms of research publications and patent filings which seems to make the researchers in the country proud. Prof. Raoremarked that researchers in India are contributing well to fundamental R&D and are publishing in good journals for the amount of money invested in the country for the research. He cautioned that these findings have

hardly resulted in anymajor technological breakthrough of significant commercial value. Prof. Rao further elaborated about the case studies of translational research conducted in his research group at Centre of Excellence in Nanoelectronics at IIT Bombay which ultimately resulted in incubation of two companies catering to societal needs in the country. He presented the MEMS and Nanotechnology based sensor platforms for applications in homeland security and agriculture and stressed upon the need for product innovation.

Finally, he concluded the talk by discussing the multitude of initiatives contemplated and launched by Govt. of India at the national level in order tomake the Indian research competitive and sustainable in terms of innovation and product development.

Prof. V. Ramgopal Rao delivering the lecture

Fifth Dr. APJ Abdul Kalam Lecture

The fifth Dr APJ Abdul Kalam Lecture was delivered by Wing Commander Rakesh Sharma AC (Retd), Research Cosmonaut on 13th September 2019. The topic of the talk was 'Making of A Professional'. He shared his experiences of space travel with the audience and answered their questions. He mentioned that if he were part of Gaganyaan, he could have been sure of being a 'career astronaut', because it would not have ended in one flight. He also spoke about the Chandrayaan 2 mission and said that it was a wonderful mission and all are proud of what we have achieved.

Wing Commander Rakesh Sharma delivering the lecture

Ten Years of IIST – Caltech / JPL Collaboration - Special Lecture

As part pf 150 Years of Celebrating the Mahatma, 100th Year Birth Anniversary of *Dr. Vikram Sarabhai* and 10 Years of IIST – Caltech / JPL collaboration, a special lecture *by Prof. Ares J Rosakis*, Theodore Von Kármán, Professor of Aeronautics; Mechanical Engineering, Caltechwas organized on 13th September 2019 at 2pm in the Student Activity Center. The title of the lecture was 'Caltech/JPL – IISc, NAL, ISRO, IIST stories – One Hundred Years of Friendship. *Professor Rosakis* gave an excellent account of *Dr. Vikram Sarabhai's* contributions to India's space program and the relationship between ISRO and Caltech since *Professor Sathish Dhawan* days. He chronologically put the dates and explained about various happenings during his talk. He spoke about 10 years of IIST/JPL collaborations and about *Sathish Dhawan* postgraduate fellowships to IIST students.

A memoir of 10 years of IIST – Caltech / JPL Collaboration was released jointly by Hon. Chancellor, IIST, Director, IIST, Provost Caltech and Deputy Director, JPL. The memoir contains experiences shared by the students of Caltech / JPL programmes. Prof. A. Chandrasekar, Outstanding Professor & Dean, Academics, IIST gave a brief report on 'Evolution of the ten year long IIST-Caltech/JPL Collaboration'.

Professor Rosakis delivering the special lecture

9.3 Short Term Courses/ Programs organized by IIST

Short Term Course for Armed Force Officers

A short term course 'Introduction to Space Technology' was conducted by Department of Aerospace Engineering, IIST. The course wasconducted for two weeks during June 10th, 2019 to June 21st ,2019. The participants were the armed force officers (Army, Air Force and Navy) deputed to Defence Satellite Controlcentre (DSCC) of Bhopal and to Defence Image Processing and Analysis Centre (DIPAC) of New Delhi. The course covered the topics Related to satellite in orbit operations, propulsion system, structures and materials and aerodynamics. Dr. R V. Ramanan coordinated the course and also was the main resource person.

Dr. Ramanan and Director, IIST are flanked by armed forces officers

Young Talent Nurture Programme

The Department of Mathematics has been conducting "Young Talent Nurture (YTN)" programme indifferent levels since 2013, as a part of outreach programme of IIST. This is a two week programme, which is usually conducted during summer vacation in every year. This intensive training programme aims to nurture young mathematical talents through the promotion of pathological questioning, logical and critical thinking and problem-solving, inorder to strengthen their mathematical ability and encourage them for understanding the higher aspects of Mathematics. Through this programme, many graduate and post graduate students having Mathematics as one of their subjects participate from various Indian colleges/ universities/ institutes. YTN programme was conducted from 20th May to 1st June.

Participants with faculty of Dept. of Mathematics and Registrar

National Conference on Stochastic Differential Equations and Applications

Department of Mathematics, IIST jointly with Indian Institute of Technology, Roorkee conducted a National Conference on Stochastic Differential Equations and Applications at IIST during June 6-7,2019. The National Board for Higher Mathematics (NBHM/DAE) and SERB/DST generously supported this conference along with IIST for all local facilities. The research area of stochastic differential equations (SDEs) has been one of the primary areas of applied mathematics for the last several decades, providing the fundamental tools for understanding the complex physical system sarising, for instance in, fluid dynamics, mathematical physics, statistical mechanics, finance, etc.,whose dynamics are subject torandomfluctuations. One has tocome up with most sophisticated tools from probability theory, functional analysis, differential equations, etc., to understand the dynamical behaviorof these systems. This conference covered various areas of SDEs including solvability of SDEs, control and stability analysis, ergodic theory, large deviation theory

and numerical analysis of SDEs. Out of 120 students and faculty registered 40 participants were selected from different institutes and universities based on their background and interest. Nine eminent speakers on the theme of the conference were invited from IITs, IISERs, TIFR, and universities. Prof. Raju K. George, Dean R&D, IIST welcomed the gathering and Dr. V. K. Dadhwal, Director, IIST inaugurated the conference. In the key note address, Prof. S. S. Sritharan, Vice-Chancellor, M. S. Ramaiah University of Applied Sciences, Bangalore emphasized the synergy between the applied mathematicians and R&D institutions in governmentand private sector.

(Left to Right) Dr. V. K. Dadhwal, Prof. Raju K George, Prof. S. S. Sritharan (Vice-Chancellor, M.S.Ramaiah University of Applied Sciences, Bangalore), Dr. K. Sakthivel

NuMATS @ IIST

IIST and SCERT Kerala jointly organized NuMATS, a five-days Mathematics residential camp for higher secondary students, during 14th - 18th June 2019 in IIST campus. NuMATS is an innovative programme designed to identify and nurture mathematical talents in students. Around sixty students, who were given training in Mathematics right from their sixth standard, were participated in this camp. These students were the first and second batches who attended the NuMATS camp in its initial years. The present camp was aimed to hone the mathematical skills of the young talents who are going to step out of the school system and venture out into the world of challenges and opportunities. Crosssections of the children from all the fourteen districts of the Kerala State were selected through various levels of tests at the age of 11. The programme was designed in such a way that a cycle of the camp will be completed in 7 years. The first

cycle of the program was started in 2012 and will be completed in 2019, along with completion of 10+2 course of the students.

NuMATS Batch-I Students, Faculties and Staffs

Colloquia

Prof C Retna Raj, Dept. of Chemistry, IIT, Kharagpur, delivereda talk on Functional materials for Electrochemicalenergy Conversion and Storage on 25.04.2019 in Dept. of Chemistry.

IEEE MTT-S IIST Student Chapters and One Day Workshop on Microwave Theory Techniques and Application (MTTA 2019), July 29, 2019,

IEEE Microwave Theory and Techniques society (IEEE MTT-S), Kerala Chapter and IEEE MTT-S Student Branch, IIST was inaugurated at Indian Institute of Space Science and Technology, Thiruvananthapuram on July 29, 2019 in presence of MTT-S R-10 coordinator Prof. Shibon Koul, IIT Delhi, India and Adcom member *Dr.Goutam Chattopadhyya*, JPL, NASA, USA. *Dr. B S Manoj*, IIST and *Dr. Chinmoy Saha*, IIST delivered the welcome address.

Inaugural function of IEEE MTT-S

IEEE Distinguished Lecture (DL) and One Day Workshop on Recent Advances in Wireless and Space Antennas, 24th Dec 2019

The IEEE-Distinguished Lecture and one day workshop on recent advances in wireless space antennas was conducted on 24th December, 2019 in SP Grand Days Hotel, Trivandrum. This meet was a joint initiative of IEEE IIST APS Student branch, IEEE IIST MTT-S student branch and Kerala chapter of IEEE MTT-S and APS society. The workshop featured speakers namely, *Dr. Sudhakar Rao* (IEEE Life Fellow, Northrop Grumman was invited as the APS Distinguished Lecturer), *Dr. DC Pande*, Outstanding scientist LRDE Bangalore, DRDO, *Prof C K Anandan* CUSAT, Cochin, *Ms. Sherly Joy*, VSSC, *Prof. S. Raghavan*. NIT, Trichy and *Dr.T.J.Apren*, SFO Technologies.

National Conference on Materials Science and Technology 2019

Department of Chemistry has organised the sixth conference in the Materials Conference series 'National Conference on Recent Trends in Materials Science and Technology' NCMST 2019 at IIST campus during December 18-20, 2019. The conference witnessed a grand inaugural function with welcome address by Dr V K Dadhwal, (Director, IIST), Presided over by Dr B N Suresh (Chancellor, IIST), Guest of Honor Dr K N Moorthy (Director, IISER-Tvm), Inaugural Address by Dr. S Somanath (Director, VSSC), Felicitation by Dr YVN Krishna Murthy (Registrar, IIST), and vote of thanks by the convener of the conference Dr Kuruvilla Joseph (Dean, SA, SW & OP).

OSA TRAVELING LECTURE

Professor Christopher Dainty **,Past President of Optical Society of America(OSA),** and Senior Researcher, University College, London and Retired Professor from Imperial College, London, U.K visited IIST for four days under IIST/OSA student Chapter. His visit was sponsored by Optical Society of America (OSA), with a travel under the OSA Traveling Lecturer Program. Professor Dainty, delivered a technical talk on "An Introduction of smart Adaptive Optics" on 5thNovember 2019 at seminar hall. On 6th November 2019 he delivered a talk on "The fundamental limits of mobile phone cameras."

Professor *Chris Dainty* Delivering his lecture (Left) and with Director and Senior Faculty (Right)

SPIE , USA TRAVELING LECTURER PROGRAMME

Professor Toyohiko Yatagai, Former President SPIE, USA, Emeritus Professor, CORE, Utsunomiya University, Japan has visited IIST for four days (December 4 to 8, 2019) under SPIE-IIST student chapter's Visiting lecturer programme. His visit was sponsored by The International Society for Optics and Photonics (SPIE) under the SPIE Travelling Lecturer Program. He delivered a talk in IIST on "Holographic memory for cold data storage in data centres" in Swayamprabha Hallon 4th Dec, 2019.

Satellite Oceanography and Meteorology (STORM)

The Atmospheric Science group of the Department of Earth and Space Sciences conducted a three day school on Satellite Oceanography and Meteorology from December 4 - 6, 2019 for 30 MSc and B.Tech students selected from across the country. The participants were given an overview and training on the latest operational and research satellite missions and the use of satellite observations for understanding the weather and climate of the Earth's atmosphere. The program consisted of lectures in the forenoon sessions followed by hands-on training in the afternoon.

Annual Astronomy School

Faculty and participants of annual Astronomy and Astrophysics school held at IIST, December 4-13, 2019

The Astronomy & Astrophysics group of the Department of Earth & Space Sciences conducted its annual 10 day long school from December 4 – 13, 2019. The school was meant to acquaint undergraduate and post-graduate students of science with a wide range of introductory topics in astrophysics and data analysis. Forty-five students from universities across the country participated in this school. The lectures and data analysis

activities were handled by astrophysics faculty from the department with support from students and staff. This was for the eighth consecutive year that the astrophysics school was organized at IIST, with over 300 students benefitting from this program till date.

GeoSmart 2019


The DST-NRDMS Sponsored, three day workshop "**orientation programme on geospatial technologies for decision makers**" was organized by the Department of Earth and Space Sciences during 28 – 30 Nov. 2019. With a focus on advanced remote sensing technology for smart cities, the workshop contained multiple invited lectures and hands-on sessions using high resolution optical and LiDAR data. The participants, faculty from different institutions, are fully supported financially by the grant from DST-NRDMS.

Workshop on "Synthetic Aperture Radar Data Processing and Analysis"


Marking the Inauguration of the IEEE Geoscience and Remote Sensing Society Kerala Chapter on 16 october, 2019, the Department of Earth and Space Sciences and IEEE organized a one day workshop on "**Synthetic aperture radar data processing and analysis**" which included expert lecture by the IEEE Distinguished Lecture (DL) by Prof. Alejandro C Frery, Universidade Federal de Alagoas, Brazil, former President, IEEE Geoscience and Remote Sensing Society. With more than 40 participants of Masters, PhD and faculty members from different institutions, the workshop showcased evolving methods of SAR data modeling and analysis perspectives.

Human Space Programme @ IIST

In response to the Announcement of Opportunity (AO) for Low Earth Orbit based Microgravity Experiments, 8 proposals were submitted by IIST faculty among whicha proposal 'Spaceflight-induced changes in kidneystone formation in *Drosophila Melanogaster*' in the spacelife sciences category jointly submitted by *Dr. K G Sreejalekshmi and Dr. Ravikumar Hosamani* (UASD, Dharwad) got recommended for the first development flight of Gaganyaan. As part of the activities related to HS @ IIST, ***Dr. Sharmila Bhattacharya***, Chief Scientist for Astrobionics and Director, Biomodel Performance and Behavior Laboratory at NASA Ames ResearchCenter, California visited the campus on 23.05.2019, delivered a lecture on using Brewer's yeast as a 'canaryin the coal mine' to prepare for long term human exploration of deep space and interacted with faculty and students of IIST.

Dr. Sharmila Bhattacharya, NASA Ames Research Centre delivering lecture

ExoWorlds : Proposed Astronomy Missioin

The study of extrasolar planets is revolutionizing modern astronomy. Envisaging a giant leap forward, a pioneering ISRO mission, ExoWorlds, is proposed which holds the promise to be the world-leading facility in the next decade forstudies of planets beyond the Solar System – the Exoplanets. The efforts towards this future spacetelescope is led by IIST alongwith other ISRO Centres and the University of Cambridge. The mission will make major scientific breakthroughs in Exoplanet science and catapult India to the fore front of this emerging field. IIST hosted the first in-person Team Meet of the ExoWorlds Mission from 4 – 6 January 2019. The meeting was inaugurated by Dr. VK Dadhwal, Director, IIST and was attended by around 40 participants. Several sessions were planned and well executed to address various aspects of the mission. Discussion and brain storming

sessions on Payload Development, Payload Operation Centre, Ancillary Science with the mission, Science Planning and Observing Strategy, Capacity building in Modelling and Theory and Observations, Data Analysis Pipeline and Workshops & Public Outreach were conducted.

Participants of Team Meet of ExoWorlds

9.4 Day Celebrations

International Yoga Day

On 21st June 2019, the fifth International day of Yoga was celebrated in the Seminar Hall, Aerospace Block in Indian Institute of Space Science and Technology from 07:15 am onwards, emphasizing the importance of yoga in daily life. The event comprised of various activities such as yoga practice & demonstration sessions and talk on yoga's importance for the students and staff of the college. Dr. V. K. Dadhwal, Director, IIST has inaugurated the International Yoga Day Celebration at 10:00 am. Dr. YVN Krishna Murthy, Registrar, IIST delivered the welcome speech and Prof. Kuruvilla Joseph, Dean Student Activities delivered the felicitation address.

Independence Day Celebrations, 15th August 2019

Seventy third Independence Day was celebrated in IIST on 15th August 2019. The function started with unfurling of national flag by Dr. V K Dadhwal, Director, IIST in front of the administrative building, which was synchronized with the singing of National Anthem. It was followed by Guard of Honour by the CISF personnel. Students, faculty, staff and family members participated in large numbers with patriotic fervor. Director delivered the Independence Day speech after hoisting national flag. In his speech, he highlighted the sacrifices of our forefathers in getting independence for India, especially the freedom fighters and soldiers who safeguard the country in adverse weather conditions. He

mentioned about various new initiatives and changes taken place in IIST during last year and highlighted the achievements of students and faculty. He elaborated the new upcoming infrastructure developments like Students Activities Center (SAC), under passage, front gate via LPSC. Independence day speech was followed by cultural programmes by students and CISF personnel.

Dr. V K Dadhwal, Director unfurls the national flag

IIST Foundation Day Events

In connection with IIST Foundation Day, a series of programmes such as 150 Years of Celebrating the Mahatma, Vikram Sarbhai Centenary Celebration, 5th Dr. APJ Abdul Kalam Lecture, IIST Open Day, 10 Years of IIST – Caltech / JPL Collaboration, 2nd IIST Alumni Meet and Felicitation to *Dr. B. N. Suresh* were organisedduring 13th – 14th September 2019.

(Left to Right) Wing Cdr. Rakesh Sharma, Dr. V K Dadhwal, Dr. B N Suresh and Dr. YVN Krishnamurthy

IIST Open Day 2019

IIST has organized 'Open Day' for school children on 14th September 2019. The program wasorganised as part of the celebrations of 13th foundation day of IIST, 150th birth anniversary of the Father of the Nation, Mahatma Gandhi and 100th birth anniversary of the Father of Indian Space Program, Dr. Vikram Sarabhai. The labs and other facilities of IIST were kept open to the school children from 11.30 am to 4 pm. The day started with the memorable experience of listening the lecture and interaction of school children with Wg. Cdr. Rakesh Sharma and was followed by department level exhibitions in various buildings. All the academic departments and librarywere actively participated in this programme by organizing various exhibits, streaming videos, live experiments and demonstrations. An exhibition about the 'life of Dr. Vikram Sarabhai' and 'Mapping of the Historical Life time of Mahatma Gandhi by Using Geospatial Technology' were also

organised as part of the Open Day. About 600 schools students and 80 teachers from 16 schools have been enthusiastically participated in the program.


School students visiting labs on open day

National Library Week Celebration

National Library Week was celebrated in IIST during 14-20 November 2019 with various programmes. As part of celebration, Dr. V. K. Dadhwal, Director, IIST has inaugurated the 'Book Fest' and official social media pages of IIST. A special 'Exhibition of Books on and by Dr. APJ Abdul Kalam' was organised for one week. 'Donate A Book: A Read & Share Initiative' was organised during the week to support other Govt. school / college libraries. Students from Govt. Higher Secondary School, Kamaleswaram visited the library on 14th September 2019. Dr. YVN Krishna Murthy, Sr. Professor & Registrar, IIST gave a talk on 'Space Science and its Applications' and Smt. Devi R Das, Counsellor, IIST talked on 'Stress Management through Reading'. Talks on 'Means for Effective Technical Presentations' by Dr. Gijy J Alex, Asst. Professor, IIST and 'How to Avoid Plagiarism in Publications' by Shri. Abdunnasar. A, Library Officer-D, IIST were arranged for students from University of Kerala. A training on IEEE Xplore by Shri. Nanda Lal, T.S, Sr. Training Manager, EBSCO-IEEE followed by an 'online quiz' was organised for students. Prof. A. Chandrasekar, Outstanding Professor & Dean, Academics distributed prizes for winners.


Inauguration of social media pages of IIST by the Director, IIST

Observance of Constitution Day in IIST

Dr. YVN Krishna Murthy, Sr. Professor and Registrar, IIST and Shri. M V Dhekane, Prof. Satish Dhawan Professor, IIST administrated the pledge to faculty, staff and students of IIST as part of the observance of Constitution Day on 26.11.2019.

Vigilance Awareness Week in IIST

IIST observed 'Vigilance Awareness Week' during Oct 28 - Nov 2, 2019 with the theme - 'Integrity : A Way of Life' . Observance of vigilance week was commenced with the integrity pledge taken by faculty, staff and students of IIST. Dr. V. K. Dadhwal, Director, IISTadministered the pledge. All staff were advised to take e-pledge and get online certificate of commitment from CVC. As part of the programme, Shri. H. Venkatesh IPS, Inspector General of Police, Vigilance and Anti-corruption Bureau, Thiruvananthapuram will be delivering an invited talk on 'Integrity : A Way of Life on October 30, 2019.

Republic Day Celebrations, 26th January 2020

IIST celebrated India's 71st Republic Day on Friday, 26 January 2020 with great eclat. Director, IIST hoisted the National Flag and spoke about various aspects of India becoming republic on 26th January 1950. In his speech he highlighted achievements made by IIST academic community and new collaborations of IIST with other Institutes and organisations.

Director inspecting the guard of honour

Women's Day Celebrations

Gender Sensitization Committee and Internal Complaints Committee organized International Women's Day celebrations on 10th March, 2020. The gathering was welcomed by Dr. Nirmala Rachel James, Chairperson, Gender Sensitization Committee. The function was presided over by Dr. V K Dadhwal, Director, IIST. Ms. Aiswhariya Dongre IPS (Assistant Commissioner of Police, Shanghumugham) was the Chief Guest and Ms. Khyrunnisa A (Writer and academician) was the Guest of Honour. Ms. AiswhariyaDongre, by narrating several anecdotes from her own life and career inspired the audience to be bold and stressed upon the need to be aware of the existing laws and to be cautious while interacting in the social spaces. Ms. Khyrunnisa A narrated the history of the celebration of the women's day, and also drew special attention towards the significance of celebrating such days. She exhorted the audience to celebrate every woman in their life. Dr. Y V N Krishna Murthy offered the felicitations by remembering those women who had inspired him, those women employees of the Department of Space who are serving in the Antarctic regions of the Southern Hemisphere. The meeting was formally concluded by Vote of thanks delivered by Dr.Sheeba Rani J, Chairperson, Internal Complaints Committee.

Address by Ms.Aiswhariya Dongre IPS

Address by Ms.Khyrunnisa A

9.5 Other Events

Felicitation to Dr. B N Suresh, Chancellor, IIST

IIST students, faculty, staff and alumni (First 3 batches whom he had taught during 2007-2010) have organized a felicitation programmeon 14th September to honour Dr. B N Suresh, Hon. Chancellor and Founding Director, IIST for completing 75 years of age and almost 50 years of continuous contributions to ISRO/DOS. The program started with Director's welcome and introductory speech about Dr. Suresh's continuing contributions to IIST. After that Prof. Narayanamurthy, Prof. Kuruvilla Joseph, Prof. A. Chandrasekar, Prof Raju K George, Prof. Anandmayee Tej, Dr. Shaijumon, Shri. K V S V Ch Mallikarjuna Rao, representatives of non-teaching staff and alumnispoke briefly about their association with Dr. Suresh and his contributions to IIST since its inception in 2007. In his acceptance speech Dr. Suresh told about his experiences in building IIST and how he is happy now to see the growth of IIST as a world class space institute and IIST alumni doing well in various ISRO centers. Faculty, staff and alumni presented mementos to Dr. B. N. Suresh.

IIST Alumni Meet 2019

The second IIST Alumni Meet was conducted on the Alumni Day, 14th September, 2019. The date was particularly important due to three major reasons. Firstly, it coincided with the 13th Foundation day of the institute which was started in the year 2007. Moreover, the year 2019 marks the 150th Birth Anniversary of the Father of the Nation, Mahatma Gandhi and 100th Birth Anniversary of the Father of the Indian Space Programme, Dr. Vikram Sarabhai. The meet attracted a good turnout and around 100 alumni gathered for the occasion. In the meeting Elected office bearers of National IIST Alumni Executive Committee has taken over respective charges; Mr. Prakhar Aggarwal as National President, Mr. Parth Sharma as Vice President, Ms. Surbhi Baghotia as Secretary, Mr. Manish Kumar Mishra as Joint Secretary, Mr. Jayakrishna M as Treasurer, Dr. Bhaskar Dubey as Ph D representative, Mr. Parthiban as M.Tech representative, Dr. Deepthi Sivadhas as representative of ISRO sponsored candidates, Mr. Madhav Nakani and Mr. Prabodh Sreedhar Katti as executive members and Mr. Ananya Ray as nominated member. As part of the program, an alumni interaction was organized from 10.30 am to 11.30 am, in which the alumni discussed about the mission and purpose of IIST alumni association and the future programs. An interaction session with Wg. Cdr. Rakesh Sharma was arranged from 11.30 am, in which he shared about his experiences of space flight and discussed about future Indian space missions. He urged the alumni to involve deeply in the future space developmental programs of ISRO. The official inauguration of IIST Alumni association was held at 12 noon by the Hon. Chancellor Dr. B N Suresh by lighting the lamp. Director IIST Dr. V K Dadhwal has addressed the alumni and explained about his expectations and role of IIST alumni association. Dr. YVN Krishna Murthy, Registrar and

Dr. Kuruvilla Joseph, Dean, IIST felicitated the occasion. Chancellor IIST has made a special address to and interaction with alumni from 12 noon to 1.30 pm. IIST Alumni has also participated in the felicitation function organized for honoring IIST Chancellor Dr. B N Suresh from 2pm to 3pm. Director IIST Dr. V K Dadhwal has made a special address to IIST Alumni in which he briefed about the changes in the curriculum, the infrastructure and extra-curricular activities that have been brought about in the college over the past few years. Additionally, the alumni were briefed about placement/ absorption of graduating students. A meeting with IIST students was also organized from 4pm onwards. The second IIST Alumni meet has ended at 5.30 pm with a High Tea from Director IIST.


Alumni interaction during the meet

Parliamentary Standing Committee Visit

Parliamentary Standing Committee on Science & Technology, Environment, Forests and Climate Change under the Chairmanship of Shri. Jayaram Ramesh, M. P visited Indian Institute of Space Science and Technology on 26th December 2019. Other Distinguished Members of the Committee, who have visited IIST, were Shri. Anurag Sharma, Dr. Jayanta Kumar Roy, Shri. Kotha Prabhakar Reddy, Shri. Sudarshan Bhagat, Shri. Nekkanti Bhaskar Rao, Shri. Guharam Ajgalley, Shri. Rajiv Saxena, Shri. Ranjan Singh Rajkumar, Shri. Shatabdi Roy Banarjee and Shri. Ram Shiromani. Dr. V K Dadhwal, Director, IIST along with IIST officials, received the distinguished members. Director briefed the Committee about IIST and its activities. The parliamentary committee, after its return, had submitted its report to Chairman Rajya Sabha by recommending that IIST should be made as an Institute of National Importance.


Director with parliamentary committee members at IIST library

Swachh Bharat Programme

The SwachhtaPakwada campaign organised from 01.02.2020 – 18.02.2020 with various programmes such as plogging, collection of plastic waste, promoting glass bottles instead of plastic bottles and avoiding flux boards in campus. Haritha Karma Sena of Nedumangad Municipal Corporation collected cleaned plastic wastes from the campus. IIST Students and faculty visited 'Ayalkoottam' to spread awareness about harmfulness of plastic wastes. Quiz was conducted at VK Kanj High School, Nedumangad as part of the Swachh Bharat activities. IIST Students and faculty visited two colonies near the campus and made a comprehensive study. Nirman group of the institute organisedprogrammes to educate students on Swachh Bharat Abhiyaan.

Efforts are progressing to find alternatives for single use plastic in the campus. Cleaning drive was organised to clean all building in the campus. As part of scientific waste management, IIST has implemented dustbins for segregation of waste, Vermicompost pits and Bio gas plant. Fumigation and pest control measures were done according to the schedule. IIST has implemented dual flushing system in toilets, push cock flush, combing water taps, recycled water from STP, sensor urinals and rain water harvesting mechanism. All the activities towards a Swachh Campus were updated in the social media pages of the institute.

ISRO Sub Committee for Inspection & Evaluation of Centres visited IIST campus on 3rd March 2020 to evaluate the various measures initiated in the institute towards building a clean environment. IIST Swachh Bharat Committee Chairman made a brief presentation on the various measures implemented by the Institute towards a Swachh campus. The evaluation committee complemented the efforts of the institute and advised to continuously monitor the activities and new innovative measures implemented.

9.6 Foreign Visitos

Sl No.	Name and Address	Date of visit	Purpose of visit
1	Dr. Rabin Gilles francis France	17th May 2019	To establish a partnership on the Space Technology domain
2	Dr. Fouquet Thomas Valeri Nicolas France		
3	Weiss Mathieu Joseph France		
4	Sivaguru S Sritharan (USA) Vice - Chancellor M.S Ramaiah University of Applied Sciences, Bangalore	06th& 07thJune 2019	To attend a National Conference at IIST
5	Dr.GoutamChattopadhyay Jet Population Laboratory USA	29th July 2019	For inaugural talk about Microwave theory and technique Society
6	Gautier Koenig Jacomex, France	30thJuly 2019	Technical Discussion with Dr.PalashkumarBasu
7	Mr.MarijusKestauska Lithuania	20th and 23rd August2019	For repair of Nano second pulsed laser system
8	Prof. Kirk Kiaran David Dean, ANU College of Science, Australia	09th September 2019	Academic and Research Collaboration between IIST and ANU
9	Dr. Ward Robert Lawrence Department of Quantun Science, ANU Research School of Physics and Engineering, Australia		
10	Prof. Brothers Penelope Jane Director, ANU Research School of Chemistry, (New Zealand)		
11	Prof. Bouwknegt Pier Gerard Director, ANU Mathematical sciences Institute, Australia		
12	Mr.PoriaJayant International Relations and Partnerships, ANU		
13	Dr.Tirrell David A JPL/Caltech	13th September 2019	Commemoration Event 10 years of IIST- CalTech Collaboration
14	Dr. James Larry Dean JPL/CalTech		
15	Prof. SarohiaVirendra JPL/CalTech		
16	Dr.Rosakis Ares John JPL/CalTech		

17	Dr. Madonna Richard General JPL/CalTech		
18	Dr. Pellegrino Sergio JPL/CalTech		
19	Dr.HajimiriSeyed Ali JPL/CalTech		
20	Prof. Martinelli Marcelo University of Sao Paulo, Brazil	19th September 2019	Interact with faculties
21	Prof. Alejandro C Frery Federal university of Alagoas, Brazil	16th October 2019	Delivering lecture in connection withh IEEE kerala section's IEEE Geoscience and Remote Sensing Society Chapter at IIST
22	Mr. Hug Sebastien, CEO/Consul General, Switzerland	24th October 2019	Meeting with director, IIST
23	Dainty John Christopher Consultant, Professor Emeritus, National University of Ireland, Galway	03rd to 08th November 2019	Deliver a talk and to interact with IIST students
24	MajewskiWojciech Engineer, Vision Asia Technology Pte Ltd, Gambas Crescent #09-08, ARK @ Gambas, Singapore	14th and 15thNovember 2019	Discussion on PIV system
25	Gue Anne Marie Jeanne Directrice de Recherche, CNRS.LAAS-CNRS, Toulouse, France	18th and 19thNovember 2019	Collaboration Project (DST-CNRS) with CNRS as part of CEFIPRA Program
26	BoireauWilfridHerve Directeur de Recherche, CNRS, FEMTO-ST, Besancon, France		
27	Dr.Camon Henri Louis Marie, Sr. Scientist, CNRS-LAAS, France	19thNovember 2019	Discussion on Optical Gas sensors
28	Yatagai Toyohiko Professor, Utsunomiya University, Japan	03rd to 06thDecember 2019	Deliver a lecture and interaction with students
29	Fall Balla (Senegal) MG University, Kottayam	17th to 21st December 2019	To attend NCMST - 2019 at IIST
30	Gueye Amadou Belal (Senegal) MG University, Kottayam		
31	Prof. Butcher Eric Allen University of Arizona, USA	06th January 2020	For discussion with faculty members and students on Navigation, Guidance and Control of spacecraft with regards to constellation of satellites
32	Prof. Spray John Graham Director, Planetary and Space Science	28th January 2020	For delivering a lecture on "Early Earth and Meteorite

	Centre, University of New Brunswick, Canada		Impacts"
33	Baker Daniel Neil Director, University of Colorado, Boulder, USA	28th to 30th January 2020	To attend INSPIRE partners meeting at IIST.
34	Kohnert Richard Alan Small Satellite Program Lead, University of Colorado, Boulder, USA	27th to 30th January 2020	
35	Schwab Bennet David Graduate Research Assistant, University of Colorado, Boulder, USA		
36	Boyajian Spencer Craig Mechanical Engineer, University of Colorado, Boulder, USA		
37	Chang Cheewei Loren Associate Professor, Graduate Institute of Space Science and Engineering, National Central University, Taiwan		
38	Meftah Mustapha Research Scientist, LATMOS/CNRS/UVSQ/Paris Saclay University/SU, France	29th to 30th January 2020	
39	MC Grath Michael Thomas, Senior Advisor, University of Colorado, Boulder, USA		
40	Keckhut Philippe Director, LATMOS/UVSQ/Paris Saclay University/SU, France		
41	Al ShidhaniSaleh Said Hamed, Vice President, Sky innovations LLC, P O Box 2537,P Code 132, ALKhoud, Oman		
42	Segert Tom Director, Berlin Space Technology, Germany		
43	Dr. Kaufmann Martin Physicist, Staff Scientist, Institute of Energy and Climate Research (IEK-7), Germany		
44	Dr.Riese Martin Physicist, Director, Institute of Energy and Climate Research (IEK-7), Germany		

9.7 Invited Talks by IIST Faculty

V. K. Dadhwal

- 'Earth observations from Space' at YUVIKA Program of ISRO, VSSC, Thiruvananthapuram, on 23 May 2019
- 'Emerging Trends in Earth Observations and Indian Scenario' in ISRO Structured Training Program at IIRS, Dehradun on 28 May 2019
- Keynote address at 'Science Awareness Day Programme' at Sathyabama Univeristy, Chennai, on 22nd June, 2019
- Address at INAE-NAEK workshop at Hyderabad on 16th July, 2019
- Address at IEEE-TENCON and TENGRAS at Hotel Grand Hyatt, Cochin held during 17th 18th and 19th October, 2019
- Keynote Lecture and Session Moderator for 'Geosmart Agriculture: Connecting Farms and Technologies' in 20th session "Geosmart India" at HICC, Hyderabad on 02nd December, 2019
- Inaugural Address in 'International conference on Communication Network' at Mar Ivanious College, Thiruvananthapuram on 12th December, 2020
- Keynote Address in 'International conference on Politics and Economics of climate Change' at Mar Athanasius College, Kothamangalam, Cochin on 07th January, 2020
- Chief Guest and Inaugural Lecturein'AGMET-2020:National seminar on Agrometeorological Interventions for Enhancing Farmer's Income'at Kerala Agricultural University, Thrissur on 20th January, 2020
- Chief Guest and Keynote address for 'Anveshan: Student Research Convention' at JagranLakecity University, Bhopal on 06th February, 2020

Department of Aerospace Engineering

Chakravarthy P

- 'Activated TIG welding processes', Buddha college of engineering, Alleppey, July, 2019.
- 'Deformation processing of metal matrix composites', Mascot Hotel, Trivandrum, September, 2019.
- 'Shape memory materials for aerospace and commercial applications', St.Joseph's college of enginnering, Chennai, December, 2019.
- 'Overview of smart materials with specific focus to shape memory materials', GovtEnggcollege, Calicut, January, 2020.

Raveendranath

- 'Satellite Communication Systems: From Apollo to Chandrayaan', Kerala State Council for Science and Technology, Trivandrum, July, 2019.

Prathap C

- 'Introduction to Combustion towards IC Engine applications', Marian Engineering College, Trivandrum, June, 2019.

Deepu

- 'Heat transfer enhancement in microchannels', ISHMT and St Thomas Institute for Science and Technology, February, 2019.
- 'Application of heat transfer in propulsion systems', ISHMT and St.Joseph's College of Engg and Technology, Palai.,March, 2019.

Aravind V

- 'Exploring elliptical and circular jets at sub to supercritical conditions in multi-component and single component systems', TU Darmstadt and Univ of Stuttgart, Germany, October, 2019.

Shine S R

- 'Heat Transfer in Space Applications', ISHMT and St Thomas Institute for Science and Technology, February, 2019.
- 'Thermoregulation of human body and Modelling aspects', Annual colloquium on Space System Heat Transfer by IEI and ISHMT, AGNI-2019, Trivandrum.

A Salih

- 'Solution of Inviscid Burgers Equation: Method of Characteristics and Numerical Methods', National Institute of Technology Calicut, May, 2019.

Pradeep Kumar P

- 'Dynamics of two-phase Flows- A glimpse on the usual modeling Perspectives', Institution of Engineers -TVM, February, 2020.

Department of Avionics

Palash Kumar Basu

- 'Optically activated gas sensor for critical application', IITB, November, 2019.

Chinmoy Saha

- 'Engineering Electromagnetics: Concept, Methodology and Techniques for High Impact Learning and Teaching', Webinar: IEEE MTT-S ,June, 2020.
- 'GHz to THz Antennas: Trends Techniques and Next Generation Requirements in

Wireless Communication ', Webinar: IEEE APS, June, 2020.

- 'Engineering Electromagnetics: Concept, Methodology and Techniques for High Impact Learning and Teaching', Webinar: IEEE MTT-S Kerala, May, 2020.
- 'An Overview of Metamaterials and Applications (Part-2)', NIT-Trichy, TN,India, February, 2020.
- 'An Overview of Metamaterials and Applications (Part-1)', NIT-Trichy, TN,India, February, 2020.
- 'Challenges, Design and Realization of Multifunctional Antennas, Photoconductive Antennas and Associated System Components for Microwave to Terahertz Applications', Global Webinar by IEEE MTT-S, February, 2020.
- 'Challenges, Design and Realization of Photo Conductive Antennas (PCA) for THz Applications', IIT-BHU, Varanasi, February, 2020.
- Multifunctional Ultrawideband Antennas: Trends, Techniques and Applications', Taj Gateway, Kolkata, India, Dec 18-19, 2019.
- 'GHz to THz Radios: Trends Techniques and Next Generation Requirements in Wireless Communications from an Antenna Engineer's Perspectives ', IIT Delhi (IEEE MTT-S), October, 2020.
- 'GHz to THz Radios: Trends Techniques and Next Generation Requirements in Wireless Communications from an Antenna Engineer's Perspectives ', Grand Hyatt, Kochi, Kerala,India, Oct 17-20, 2019.
- 'Challenges, Design and Realization of Photo Conductive Antennas (PCA) for MM Wave and THz Applications', NIT-Trichy, TN,India, May 22-24, 2020.
- 'Challenges, Design and Realization of Photo Conductive Antennas (PCA) for MM Wave and THz Applications', IIT Palakkad, March, 2019.
- 'GHz to THz Radios: Trends Techniques and Next Generation Requirements in Wireless Communications from an Antenna Engineer,s Perspectives', St. Xaviers College, Nagercoil, TN, India, March 7-8, 2019.

Vineeth. B. S.

- 'Setting up a teaching environment for machine learning ', Govt. College of Engineering, Barton Hilland IIST, January 2020.
- 'Three ideas in point to point digital communication', College of Engineering, Barton Hill ,January, 2020.

Seena V

- 'Microsystems with Active & Passive Transduction for Terrestrial to Space Applications', IIT Bombay, November 25-27, 2020.
- 'MEMS/Microsystems with Active & Passive Transduction', NPOL, DRDO, December, 2019.
- 'MEMS and Microsystems :Design, Fabrication and Case Studies on Environmental & Inertial Sensors', College of Engineering, Chengannur, Decembr 9,2019.
- 'Polymer MEMS with Integrated Ceramic Thin Films: An Ultra-sensitive Platform for Environmental Sensing', VellorIntitute of Technology (VIT), October, 2019.
- 'MEMS and Microsystem Technologies: Design, Technological Aspects & Case

Studies', NIT Calicut, June, 2019.

Sheeba Rani J

- 'Design andPerformance Evaluation of Hardware Solutions for Signal and Image Processing Techniques', SCT College of Engineering, Thiruvananthapuram, September, 2019.
- 'Image Processing/ Video Processing using FPGA- Case studies', PSG, Coimbatore, 22nd June 2019.

Sudharshan Kaarthik

- 'Integrated Battery Chargers for Electric Vehicles', IEEE Industry Applications Society, Montreal Chapter, June, 2019.
- 'Digital Control of Power Electronic Converter for Drives and Renewable Energy System', National Institute of Technology, Nagpur, 15-16 July 2019.
- 'Resilient Operation of Electronically Coupled Systems in Electrical Power Grid', National Institute of Engineering, Mysore, July, 2019.
- 'Modern Trends in Power Electronics and Drives', College of Engineering, Thiruvananthapuram, July, 2019.
- 'Decoupled Control if Multi-Machine Multi-Phase Drives using a Single Inverter', IEEE Industry Applications SB Chapter, College of Engineering, Thiruvananthapuram, June, 2020.
- 'Integrated Battery Chargers for Electric Vehicles', IEEE IA/IE/PELS Chapter, Kerala Section, April, 2020.
- 'Solutions for Battery Charging Systems for Electric Vehicles', Renewable Powered EVCharging Station-Challenges in Converter Design and Storage (RPECS 2020).

Department of Chemistry

K G Sreejalekshmi

- 'Supramolecular Chemistry: The Tale of Tailored Intermolecular Interactions', SD College, Aleppey ,July, 2019.
- 'Sanitation and hygiene – Practices for a healthy environment.', IIST, TVM, July, 2019.
- 'Supramolecular Chemistry and Devices Built on Self Assembly Principles', MG College, Thiruvananthapuram, August, 2019.
- 'A World of Smart Materials', St. John's College, Anchal, October, 2019.
- 'मानवअंतरिक्षकार्यक्रम (एचएसपी): चुनौतियांऔरअनुसंधानकेअवसर (भाग 2): अंतरिक्षविकिरणऔरअंतरिक्षयात्रीकेस्वास्थ्यपरइसकाप्रभाव', IISU, TVM, October, 2019.
- 'Dynamic Combinatorial Chemistry & Combinatorial Technologies: Lecture (Part 1)', Kannur University, Kannur, December, 2019.
- 'Combinatorial Methods and High Throughput Screening - in materials research: Lecture (Part 2)', Kannur University, Kannur, December, 2019.
- 'Functional Materials', St. Joseph's College for Women, Alappuzha, February, 2020.

- 'Molecules, Materials, Systems', KINFRA Hitech Park, Kochi, February, 2020.
- 'Organic Functional Materials', SN College, Kollam, February, 2020.

Jobin Cyriac

- 'Ion soft landing: Instrumentation and Performance', Mahatma Gandhi University Kottayam, December, 2019.
- 'Mass Spectrometry in Materials Science', University of Calicut, January, 2020.

J. Mary Gladis

- 'Lithium- Sulphur Batteries - A Potential Energy Storage Device', AnnaiVelankanni College, Tholayavattom, Kanyakumari, December, 2019.
- 'Sustainable Materials for Energy Storage Devices', December, 2019.
- 'Lithium-Sulfur Batteries: A High Performance Energy Storage System', Scott Christian College (Autonomous), Nagercoil, December, 2019.
- 'Story of batteries - Path of innovations', Nazareth Home English Medium School, Balaramapuram, TVM, January, 2020.
- 'Lithium-Sulfur Batteries: A Futuristic Energy Storage System', ManonmaniamSundaranar University, Tirunelveli, January, 2020.
- 'Scientific Research- An Enthusiastic Pathway, ',SanthomMalankara Arts And Science College, Manchavilakam, TVM, .

Nirmala Rachel James

- 'Hydrogel Scaffold for 3D liver spheroid culture', ST Hindu College, Tamil Nadu, February, 2019.

Kuruvilla Joseph

- 'Micro to Nano: Challenges and Possibilities', Mangalam College of Engineering, Kottayamon.,April, 2019.
- 'Surface Engineered Nanosystemsfor Bio-Medical Applications', NIT, Calicut, June, 2019.
- 'Surface Engineered Epoxy-Nanocomposites for Srtuctural Applications', IIT, Kharagpur, September, 2019.
- 'Challenges and Possibilities/Exploring the quality of Research', Calicut University, December, 2019.
- 'Plenary Speaker', AnnaiVelankanni College,Tholayavattom, Nagercoil, Tamilnadu, December, 2019.
- 'Beyond the Sky', St. Marys College, Sulthanbethery, Wayanadu, Kerala, December 22,2019.
- 'Fascination of Science', Central University of Kerala, Kasaragode, Kerala, December 23,2019.

- 'Surface Engineered Epoxy-Nanocomposites for SrtucturalApplications ', MGM College of Engineering & Technology, Muvattupuzha, June, 2019.
- ' New Generation Composite materilas', S H College, Thevara, Ernakulam, 28-29 Jan 2020.
- 'Surface Engineered Nanosystems for Bio-Medical Applications', Mar Athanasius College (Autonomous), Kothamangalam, Kerala, India, 14-16 January, 2020.
- 'Micro to Nano: Challenges and Possibilities', Stella Mary's College of Engineering, Nagercoil, Tamilnadu, April, 2019.
- 'Micro to Nano: Challenges and Possibilities', ManonmaniamSundranar University, Thirunelveli, Tamilnadu,, 30-31January, 2020.

Department of Earth and space Science

A Chandrasekar

- 'Impacts of the August 2008 Kosi river flood over Bihar, India on the regional weather: A coupled land-atmosphere study', IISER Pune, September, 2019.

Jagadheep D

- 'Insights on cosmology: the 2019 Nobel Prize in Physics', Priyadarshini Planetarium, Trivandrum, November, 2019.
- 'Star Formation', SrinivasaRamanujan Institute of Basic Sciences, January, 2020.
- 'The physics of high-mass star formation: A fragmentation study of ATLASGAL dust clumps', SrinivasaRamanujan Institute of Basic Sciences, January, 2020.
- 'Insights on cosmology: the 2019 Nobel Prize in Physics', Regional Science Centre and Planetarium, Kozhikode, January, 2020.

Ramiya A M

- 'LiDAR Remote Sensing for Architectural applications', College of Architecture, Trivandum, February, 2020.

Govindan Kutty

- 'Ensemble based analysis for extreme events over Indian subcontinent ', NCMRWF, Noids, February, 2020.

Sarita Vig

- 'Stars and Stellar Systems', Swayam platform under Annual Refresher ProgrammeIn Teaching (ARPIT), MHRD, August, 2019.
- 'Observations of Stars', Astronomy Oympiad Resource Generation Camp, April, 2019.

- 'Wonders of Cosmos', Shastra-Patham by KSCSTE, IISER-Trivandrum, June, 2019.
- 'Fifty years of Human footprint on Moon', Priyadarshini Planetarium, Trivandrum, July, 2019.
- 'Imaging the supermassive black-hole M87', Model Engineering College, Ernakulam, September, 2019.
- 'The Cosmic Party', Priyadarshini Planetarium, Trivandrum, November, 2019.
- 'The Cosmic Party', Devmatha College, Kottayam, December, 2019.
- 'Mechanics of Cosmos', IISER, Trivandrum (Kerala Teacher Training Program), December, 2019.
- 'Wonders of Cosmos', Payyanur Govt. College, Payyanur, December, 2019.
- 'Wonders of Cosmos', Sri Chithra Engineering College, Trivandrum, February 2020.
- 'Role of Women in understanding Fundamental properties of Stars', Kerala University, February, 2020.

A Tej

- 'A journey to the stars: Unravelling the mysteries', Pantheon 2019, BIT, Mesra, September, 2019.

Anand Narayanan

- 'Stellar Feedback on Diffuse Gas Within and Outside of Galaxies', School of Pure and Applied Physics, Mahatma Gandhi University, Kottayam, January, 2020.
- 'Discovery of Exoplanets and the Search For Habitable Worlds', Cochin University of Science and Technology, October, 2019.
- 'Exoplanets: The Story So Far', University of Calicut, November, 2019.
- 'Exoplanets and the Search for Habitable Worlds', Manipal Academy of Higher Education, February, 2020.

Rajesh V. J.

- 'Earth's Moon: Geology, recent trends and significant discoveries from India's Chandrayan Mission', International Science Week celebrations, H.H.M.S.P.B NSS COLLEGE FOR WOMEN , NEERAMANKARA, Trivandrum, November, 2019.
- 'A journey into the geology of Red planet Mars', National Seminar on Recent Advances in Physics-2019 (NRAP-2019), Govt. College, Nedumangadu, Trivandrum, November, 2019.
- 'Origin, Evolution, and Exploration of Our Earth's Moon', DST Inspire Science Camp St Mary's College SulthanBatheryWayanad, December, 2019.
- 'The formation, evolution and exploration of our Earth's Moon', Present-day Advancements in Geosciences (PAGe 2020), Dept. of Marine Geology & Geophysics , February, 2020.
- 'Exploration of our Earth's Moon: Role of Geology', Higher Secondary School Teacher Transformation Programme, University of Kerala, February, 2020.

Department of Mathematics

Prosenjit Das

- 'Few applications of the theory of groups', HRDC, University of Kerala, Trivandrum., 1-2 Nov 2019.

Kaushik Mukherjee

- 'Multivariable Calculus', HRDC, University of Kerala, Trivandrum, Nov 17-30, 2019.
- 'System of Linear Equations', IIST, Thiruvananthapuram, Kerala, June 14-18, 2019.

Sumithra S

- 'Introduction to Machine Learning.', Department of Computer Science and Research Centre, University of Kerala, Kariavattom, Thiruvananthapuram, January, 2020.

K S S Moosath

- 'Non-Euclidean Geometry', NSS College Karamana, Trivandrum, August, 2019.
- 'Surfaces to Manifolds', HRDC, University of Kerala, Trivandrum, September, 2019.
- 'Poincare Disc Model', IISER Trivandrum, December, 2019.
- 'Manifolds and Graphs in the context of non-Euclidean data.', Dept. of Mathematics, University of Kerala, December, 2019.
- 'Analysis on Manifolds and Graphs', Dept. of Mathematics, University of Calicut, December, 2019.
- 'Real Analysis', IISER Trivandrum, 16, 19, 20 December 2019.
- 'Linear Algebra', Amrita VishwavidyaPeetham, 26-31 December 2019.
- 'Real Number System', M. G. College, Trivandrum, January, 2020.
- 'Geometry of our living space', St. Domenic CollegeKanjirappally, January, 2020.

K. Sakthivel

- 'Ergodicity of Stochastic Navier-Stokes Equations with Levy Noise', Valencia, Spain, July 15-19, 2019.
- 'Inverse Problem for a Cahn-Hilliard Type System by Boundary Measurements', Periyar University, Salem, March 5-6, 2020.
- 'Four lectures on Stochastic Differential Equations', Periyar University, Salem, March 3-4, 2020.
- 'Five lectures on Weak Solutions for Elliptic Equations', Central University of Kerala, December 22-24, 2019.
- 'Ergodicity of Navier-Stokes Equations with Levy Noise', Bharathiar University, Coimbatore, December 5-7, 2019.
- 'Ergodicity of Stochastic Navier-Stokes Equations', NIT Puducherry, April 5-6, 2019.

Sarvesh Kumar

- 'Mixed formulations in poroelastiity', BITS-PiLani, 28-30 December, 2019.

- 'Two mixed finite element formulations for poroeasticity,', BITS-Goa, November 07, 2019,.
- 'Applcations of finite element methods in porous material', VBS Purvanchal University, November 16-18. 2019.
- 'Numerical Integration ', IIST, Thiruvananthapuram, Kerala, June 14-18, 2019.

T.G.Deepak

- 'Introduction to Probability', IIST, Thiruvananthapuram, Kerala, June 14-18, 2019.
- 'On Some Functions of Phase Type Variates', Dept of Statistics, University of Kerala, Trivandrum, June 27-29,2019.
- 'Dynamic Programming', Dept of Computer Science, Kamaraj College, Thoothukudi, August 9-10,2019.
- 'Probability Theory', Govt. College, Chittur, Palakkad, October, 2019.
- 'Probability Theory', Panampilly Memorial Govt. College, Chalakkudy, October, 2019.

E. Natarajan

- 'Virtual element method for the nonlinear PDE', DIT University, Dehradun, 17-19 October 2019.
- 'Computational Mathematics', Government Arts College Ooty, Tamilnadu., 22-27, November, 2019.
- 'Virtual element method for fluid problems', NIT, Trichy, December 2-6, 2019.
- 'Virtual element method: A new tool', Anna University, Coimbatore, December 5-7, 2019.
- 'Genesis of Numerical Linear Algebra', Karpagam Academy of Higher Education, Coimbatore, 6th January 2020.
- 'Virtual element methods for nonlinear time dependent problems', Alagappa University, Karaikudi, January 22-24, 2020. .

Department of Humanities

V. Ravi

- 'Introduction to Operations Research', National Institute of Technology Tiruchirappalli, 25th October 2019.
- 'Supply Chain and Logistics Management', Faculty Development Programme, College of Engineering Perumon, Kollam, 3rd December 2019.
- 'Reverse Logistics', Faculty Development Programme, College of Engineering Perumon, Kollam, 3rd December 2019.
- 'Applications of Operations Research', National Institute of Technology Tiruchirappalli, 6th December 2019.

Shaijumon C S

- 'Role of 'Big Banks' in the future growth of Indian Economy', Department of

Economics, DB College Sasthamkotta, 29th January 2020.

- 'How to Write Fundable Research Project Proposals', IQAC Fatima Mata National College, Kollam, 17th October 2019.
- 'Dream Before your Dreams can Come True', Govt. HSS Kadakkal, 15th October 2019.
- 'Challenges and Policy Options of Indian Economy for Achieving Inclusive Growth', Department of Commerce, University of Kerala, Karyavattom Campus, 21st June 2019.
- 'How to Build a Proper Career during the Changing Indian Economy', University College, Trivandrum, 17th May 2019.

Gigy J Alex

- 'The Cultural Politics of Culinary Representations in Indian Food Narratives', Annai Women's College. Karur, Tamilnadu, 28th February,2020.
- 'Teaching Literature and Culture: Technology and Techniques', Newman College. Thodupuzha , 5-6 March 2020.

Department of Physics

Jinesh.K.B.

- 'Nano-materials for Artificial Intelligence; National Conference on Nano Materials; Cochin University of Science and Technology (January 2020)', Cochin University of Science and Technology, January, 2020.
- 'Material Perspectives of Next Generation Memory and Computation', St. Thomas College, December, 2020.
- 'Electronic Memory technology: ReRAMs', Crescent University of Science and Technology, September, 2020.
- 'Physics of artificial intelligence', Government Engineering College, August, 2020.

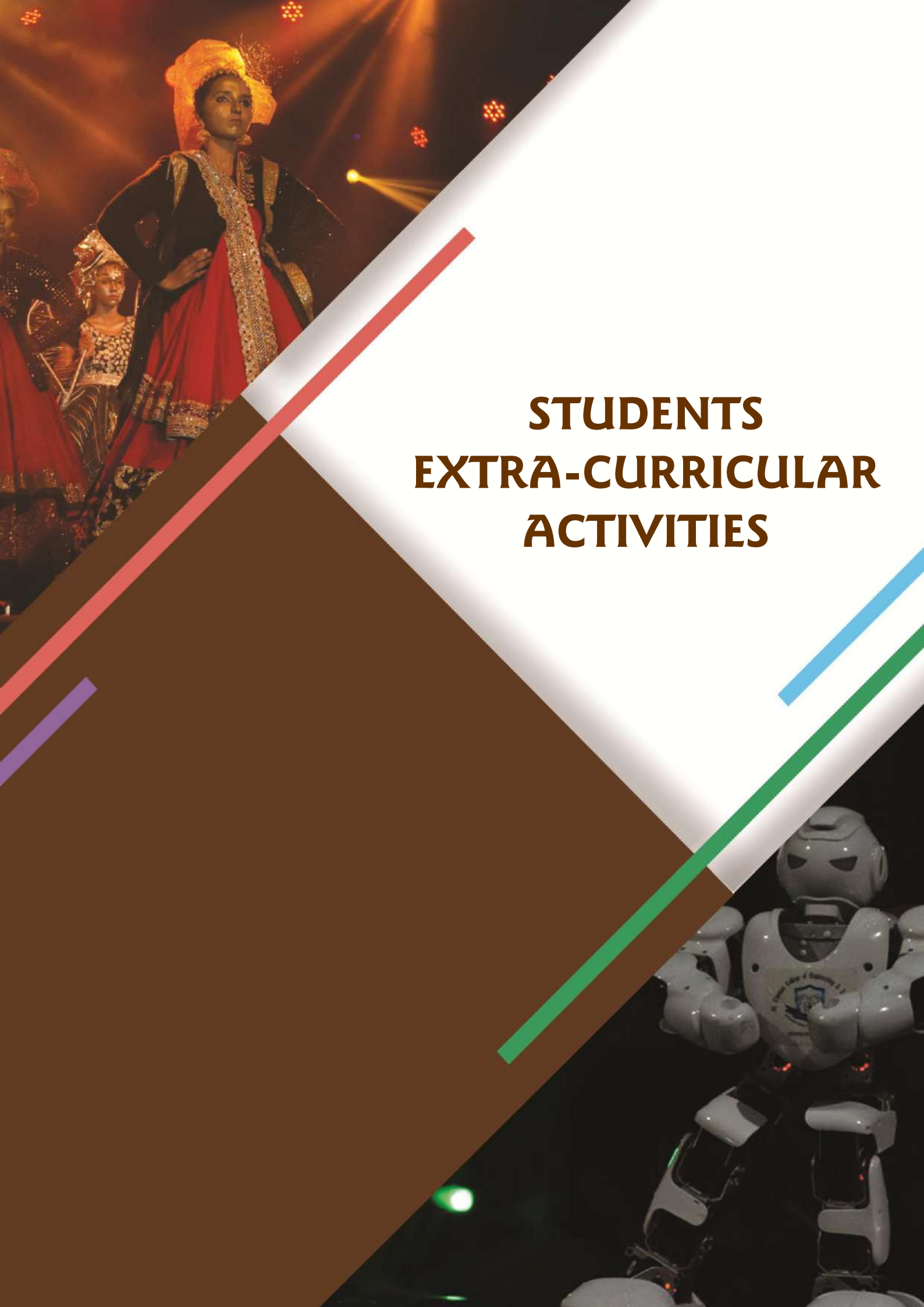
J Solomon Ivan

- 'Some aspects of Gaussian channels', IISER Kolkata, Jun-July 2019.

Sudheesh Chethil

- 'Quantum Tomography', IISER Kolkata, June-July 2019.
- 'Recent Advances in Quantum Information and Quantum Technology', Govt. College, Nedumangadu, November, 2019.

STUDENTS EXTRA-CURRICULAR ACTIVITIES



P.C. : Arnav Tamrakar

10. STUDENTS EXTRA-CURRICULAR ACTIVITIES

IIST has evolved into a culture which embodies the spirit of holistic education. Academics and extracurricular activities complement each other for the all round development of a student. A Student Activity Board (SAB) oversees all activities of students of IIST. Dean (Student Activities and Welfare) heads the Student Activity Board (SAB) which also consists of the Registrar, Head of all departments, Chairman of various institute committees- Sports, Technical, Cultural, Hostel and Canteen committee. Each of these committees has faculty and student representatives. The student representatives provide feedback and suggestions on all aspects concerning student issues on campus (curricular and co-curricular). The board meets once a month or as and when needs arises. SAB organize and manage the inter-collegiate cultural fest -"Dhanak", the inter-collegiate technology fest- "Conscientia", the sports day of IIST and all other activities of the students. The various students clubs of IIST also comes under SAB. Mentoring system of IIST is also manned by SAB.

10.1 Conscientia

The 2020 edition of Conscientia, IIST's technological and astronomy fest, was held for three days from 29th Feb to 2nd March 2020. The event was inaugurated by Dr. D. Sam Dayala Dev, Director, IISU and he inspired the participants with a speech emphasizing on the technology developments in sore for a modern engineer. This year's theme, titled *'Hack into the Future'*,brought out the essential aspects of technology for tomorrow –

including but not limited to innovation, adaptability, safety and reliability. Close to 400 people from other colleges took part in a multitude of events, with a few participants coming from places as far as Delhi. Conscientia's workshops, which have a long standing history of facilitating students to learn skills required for today's technological world, were conducted on interesting topics such as Augmented reality, Rrobotics, Biomimicryetc,. They witnessed 200 curious minds at work, a significant majority of which were IIST's first year students. The Lecture Series were graced by the presence of influential dignitaries including the Director of Human Space Programme *Dr. V R Lalithambika,* who imparted invaluable points on technical leadership from her 30+ years' experience of working in ISRO.The Tech Expo displayed a myriad collection of innovation from various fields of engineering and notable among them include models of ISRO's latest SSLVs and their thrusting systems, a demonstration on holographic technology, IIST's own exhibit on Nano-satellite fabrications and student projects. A very cute and groovy dancing robot named 'Nova' won many hearts while leaving the minds puzzled about its spectacular performance. Further, merciless *Robowars* proved to be the most engrossing event of the fest for spectators and participants alike. A total of 20+ robots battled for the title, breaking the silence of the late night with clanking metal and deafening cheer. The prestigious 3-Minute Project Thesis Presentation competition went on full swing, with participation from 35 teams.The Line Follower event glimpsed the unbreakable spirit of innovation and engineering amidst utter chaos, as teams worked tirelessly till the last minute to tinker their models and code. RC Car Racing and Amphibot too witnessed a large gathering of spectators awestruck by the engineering ingenuity of participants. Finally, ***Conscientia 2020*** witnessed a power-packed end with a grand DJ Night where IISTians, students from other colleges and organisers alike, danced to the beats which gave them a well-deserved relaxation, after 3 days of brainstorming.

(Left to Right) Prof. Kuruvilla Joseph, Dr. V K Dadhwal, Dr. D. Sam Dayala Dev and Dr. YVN Krishna Murthy on the dias during inauguration of Conscientia 2020

10.2 Dhanak

The eleventh edition of IIST's student cultural festival 'Dhanak' was conducted from the 27th to 30th September 2019. The cultural festival was inaugurated by Mr. Bose Krishnamachari, renowned painter, curator, and director of the Kochi Muziris Biennale. The festival spread over three days saw a large number of student participation for competitions in dance and music from colleges across the country. The festival also featured a professional musical night by the band NRJ PROJECT, accompanied by AbhayaHiranmayi and the music director, Gopi Sunder.

Shri. Bose Krishnamachari inaugurating Dhanak

During Dhanak

10.3 Sports

10.3.1 Annual Sports meet

The annual sports meet for the academic year 2019-20 held on 31st January (Friday) and 1st February (Saturday), 2020 at the Magudagiri ground (IIST Plot-2). This was the second time we are conducting the sports meet on our home ground, which was inaugurated by the Director IIST on 15th February 2019. It was the grandest and the most awaited event in the college calendar.

The sports event was open with 3000 meters for boys on January 25 and track and field events trials on January 31 afternoon.

Dr. G. Kishore, Principal & Regional Director, SAI-LNCPE Thiruvananthapuram was the Chief Guest of the event. Dr. V. K. Dadhwal (Director, IIST) was presiding over the function. Prof. Kuruvilla Joseph (Sr. Professor and Dean (Students Activities) IIST) give welcome the gathering and Dr. Y V N Krishna Murthy (Sr Professor and Registrar, IIST) was felicitated the occasion.

Flag of IIST was then hosted by the Director IIST, followed by lighting of torch by the chief guest and other dignitaries. After lighting of torch Dr. J Solomon Ivan (Chairman, sports council) requested chief guest to come on podium for saluting the march past of different houses. After March past honorable chief addressed the gathering and declared annual sports meet 2019-20 opened.

(Left to Right) Prof. YVN Krishna Murthy, Dr. V K Dadhwal, Dr. G Kishore (Cheif Guest) and Prof. A. Chandrasekar

With the meet declared open the first event were 100 mtrs finals for boys and girls, followed by various other track and field events. Faculty-Staff and their kids also participated. Prize distribution was also done in between by faculty and head of departments.

All the events go on smoothly and on time, students enjoyed very much and the spirit of students was very high. There was huge participation in almost all the events and all the athletes showed true sportsman ship. All the events were over by 2.00 pm on 1StFeb 2020.

10.3.2 Sports Achievements

i) Students of IIST participated in All Kerala Open Chess Tournament on 05th March 2019(NEXUZ-19), which is organized by Mar Baselious College of Engineering Trivandrum. The IIST chess team has won the Best College in Trivandrum award and *Abhishek A* (3rd year - EP) won the Tournament's Championship.

ii) Mr. Abhishek A (3rd year Engineering Physics) participated in All Kerala Chess Tournament on 19th October 2019, which is organized by NIT Calicut. He won **Second position** in the TATHVA event.

IIST Chess team with Dr. V K Dadhwal, Director and
Prof. Kuruvilla Joseph, Dean (SA, SW, OR)

10.4 Model United Nations - MUN 2019

Dr. V K Dadhwal, Director inaugurating MUN 19

The 9th edition of IIST MUN, IIST MUN 2019 was held during the dates April 6-7 and had simulated the committees – UNCOPUOS (United Nations Council on the Peaceful Uses of OuterSpace) and UNHRC (United Nations Human Rights Council). This edition witnessed large andenthusiastic participation from both outside as well as IIST students.This event challenged the students to broaden their outlook, undertake responsibility, and holistically develop their skills. Special emphasis was given to deliberate upon international relations in the space sector and further the delegates' knowledge and awareness in this field.This event attracted the smartest, most eloquent students across the country who possess the talent to debate and also tackle some of the most pressing global issues from the perspective of adelegate representing a member to the United Nations. Student delegates took on roles ofinternational diplomats and ambassadors in various organizations and agencies of theUN.The event was inaugurated by Director, Dr. V K Dadhwal. With total prize money of INR 20,000 and around 50 participants from various institutes the main event was held in two sessions in two days.

10.5 Clubs

Guided and supported by faculty members of IIST, the following clubs function in IIST

- Mathematics Club
- FOSS
- Aero club

- Computer Club
- Robotics Club
- IEEE students chapter
- Astronomy club
- IIST Quiz Club
- Photography club
- Movie and Performing Arts Club
- Physics Club
- Eco club

Nirmaan

Nirmaan is the social outreach club of Indian Institute of Space science and Technology. Recent activities of NIRMAAN are as follows:

i) **School Sessions** - Aimed to ignite the scientific curiosity among high school kids in government schools, NIRMAAN had chosen the VKK government high school, Panacode. The sessions included explaining the science behind everyday activities, astronomy, optics, rocket science, value education andcareer guidance

ii) **Orphanage Visit**- Team Nirmaan celebrated the joyous festival of lights. Diwali with the less fortunate. The team visited a government institution, AshaBhavan for men, a shelter for for the care and protection of mentally cured patients and Saigramam, global village for the orphans managed by the Sathyasai orphanage trust. Sweets, cakes and apples were distributed to the inmates. Many of them came forward to sing songs and dance to peppy tracks.

iii) **Flood relief activities –** When the floods hit kerala again last August, team nirmaan wasted no time in jumping into action. A collection drive was organised and almost fifty thousand rupees was collected in a very short period of time from IISTians. Necessary items such as clothes, sanitary items, food items were transported to various collection points in the city for further transportation and distribution to the affected areas.

iv) **Beach cleaning drive –** In collaboration with an NGO from Thiruvananthapuram ,Nirmaan took part in a Beach Cleaning drive on 30/11/2019 , thanks to DrBabitha Marina Justin who introduced the team to the NGO. Together the members cleared some area of Sanghumugham Beach and collected tons of plastic and other waste. Awareness about the damaging effects of plastic was also spread in the form of distribution of pamphlets to the local vendors in the beach. An oath was taken to ban the use of single use plastic.

v) **Bi-Annual paper collection drive –** Sticking to tradition, Nirmaan hosted this semester's paper collection drive as part of which boxes were kept in front of every hostel with the inmates requested to drop off their unwanted books and notebooks for recycling. These boxes were then taken to a second hand book shop and then to a local recycling point in Nedumangad. The money thus received will go to Nirmaan's funds which will be used for its further endeavors.

Glimpses of NIRMAAN activities

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AUDIT REPORT

2019-2020

SAMSUTHEEN & CO.
Chartered Accountants

Ref:

Date 06.11.2020

INDEPENDENT AUDITOR'S REPORT

We have audited the accompanying financial statements of **INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY, Valiamala P.O., Thiruvananthapuram – 695 547** which comprise the **Balance Sheet** as at **31 March 2020** and the Income and Expenditure Statement for the year then ended, and a summary of significant accounting policies and other explanatory information.

Management's Responsibility for the Financial Statements

Management is responsible for the preparation of these financial statements that give a true and fair view of the financial position & financial performance of the Institute in accordance with the Accounting Standards issued by the Institute of Chartered Accountants of India. This responsibility includes the design, implementation and maintenance of internal control relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

Auditor Responsibility

Our responsibility is to express an opinion on these financial statements based on our audit. We conducted our audit in accordance with the Standards on auditing issued by the Institute of Chartered Accountants of India. Those Standards require that we comply with ethical requirements and plan and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risks of material misstatement of the financial statements, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the Institute's preparation and fair presentation of the financial statements in order to design audit procedures that are appropriate in the circumstances. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of the accounting estimates made by management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

TC 27/997 (1) & (2), Ground Floor, Vanchiyoor Towers, Vanchiyoor P.O., Thiruvananthapuram-695035
Phone : 0471-2470499, Fax : 0471-2470189, Mob: 94471-31638 E-mail : samsutheenm@gmail.com

Basis of Qualified Opinion.

1. **Reconciliation of Fixed Assets with regard to quantity, location, cost is pending.**

2. **The balances in Sundry Creditors, Loans and advances and other personal accounts are subject to confirmation by respective parties.**

3. During the financial year 2019-20, the Institute made provision for gratuity, pension and leave encashment in the accounts based on 10% above the retirement benefits charged in the I & E A/c of the FY 2018-19 instead of Actuarial Valuation prescribed in the Accounting Standard -15 issued by the Institute of Chartered Accountants of India, **but it is not funded yet.**

Qualified Opinion

In our opinion and to the best of our information and according to the explanations given to us, **subject to the above mentioned opinion,** the financial statements give the information required by the Act in the manner so required and give a true and fair view in conformity with the accounting principles generally accepted in India.

i) in the case of the balance sheet, of the state of affairs of the Institute as at **31st March 2020.**

ii) in the case of the Income and Expenditure statement, of the **deficit** for the year ended on that date.

Place: Thiruvananthapuram
Date: 06/11/2020.

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

BALANCE SHEET AS AT 31ST MARCH, 2020

(Amount in Rs.)

	Schedule	As at 31.03.2020	As at 31.03.2019
CORPUS/CAPITAL FUND AND LIABILITIES			
Corpus / Capital Fund	1	2,09,97,63,396	2,14,13,34,763
Reserves and Surplus		2	2
Earmarked Funds / Endowment Funds	2	4,20,11,176	4,91,80,678
Long Term Liabilities and Provisions	3	33,00,78,837	31,34,97,216
Current Liabilities and Provisions	4	13,50,01,903	13,34,59,692
TOTAL		**2,60,68,55,314**	**2,63,74,72,351**
ASSETS			
Fixed Assets	5	2,00,79,91,394	2,00,12,40,511
Long Term Assets, Loans, Advances etc	6	13,59,00,519	13,22,17,815
Current Assets, Loans, Advances etc	7	46,29,63,401	50,40,14,026
TOTAL		**2,60,68,55,314**	**2,63,74,72,351**
Significant Accounting Policies & Notes on Accounts	18		

As per our report of even date attached.

For Samsutheen & Co.
Chartered Accountants
FRN : 013162S

C.A. M. Samsutheen
(Proprietor, Mem No. 200384)

For and on behalf of
Indian Institute of Space Science and Technology (IIST)

Dr. V. K. Dadhwal
Director

R. Hari Prasad
Finance Officer

Place : Thiruvananthapuram
Date : 6th November, 2020

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020

(Amount in Rs.)

	Schedule	2019-20	2018-19
INCOME			
Grants / Subsidies	8	64,25,00,000	70,03,65,000
Fees / Subscriptions	9	3,82,87,905	2,19,60,904
Interest Income of IIST	10	79,95,906	78,94,521
Interest Earned on Grant & Retirement Funds	11	1,83,43,118	2,34,37,971
Other Income	12	42,82,554	38,85,326
Gross Surplus/Deficit of Canteen Accounting Committee		20,29,185	31,09,571
TOTAL (A)		**71,34,38,668**	**76,06,53,293**
EXPENDITURE			
Establishment Expenses - Regular	13	32,88,68,491	30,32,50,162
Establishment Expenses - Support Services	14	16,93,80,803	16,85,85,525
Academic & Other Student Expenses	15	13,10,00,787	12,56,64,801
Other Administrative Expenses	16	13,75,80,831	12,26,29,041
Interest Refundable by IIST	17	1,83,43,118	2,34,37,971
Depreciation	5	22,91,16,189	24,05,67,177
TOTAL (B)		**1,01,42,90,219**	**98,41,34,677**
Excess of Income over Expenditure (A-B)		(30,08,51,551)	(22,34,81,384)
Less : Prior Period Items		**7,19,816**	**3,57,18,486**
Balance being Surplus/(Deficit) carried over to Corpus/Capital Fund		**(30,15,71,367)**	**(25,91,99,870)**
Significant Accounting Policies & Notes on Accounts	18		

As per our report of even date attached.

For Samsutheen & Co.
Chartered Accountants
FRN : 013162S

C.A. M. Samsutheen
(Proprietor, Mem No. 200384)

For and on behalf of
Indian Institute of Space Science and Technology (IIST)

Dr. V. K. Dadhwal
Director

R. Hari Prasad
Finance Officer

Place : Thiruvananthapuram
Date : 6th November, 2020

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

(Amount in Rs.)

	As at 31.03.2020	As at 31.03.2019
Schedule 1 :: CORPUS / CAPITAL FUND		
Total Grant Received - Capital and Revenue (A)		
Opening Balance of Total Grant Received	8,35,13,09,987	7,53,92,24,987
Add : Grant received during the year	90,25,00,000	81,20,85,000
	9,25,38,09,987	8,35,13,09,987
Total transfer to Revenue Grant (B)		
Opening Balance of amount transferred to Revenue Grant	3,89,50,37,442	3,19,46,72,442
Add : Transfer to Revenue Grant of 2019-20	64,25,00,000	-
Add : Transfer to Revenue Grant of 2018-19	-	70,03,65,000
	4,53,75,37,442	3,89,50,37,442
Surplus / Deficit transferred from Income & Expenditure Account (C)		
Opening Balance of net income / (expenditure)	(2,31,49,37,782)	(1,85,30,48,698)
Deduct: Provision for retirement benefits upto 31.03.18	-	20,26,89,214
Add/Deduct : - Current Year Surplus / (Deficit)	(30,15,71,367)	(25,91,99,870)
	(2,61,65,09,149)	(2,31,49,37,782)
Balance at the year end (A - B + C)	**2,09,97,63,396**	**2,14,13,34,763**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS	1 DOS - Dr. Palash - HSP - Real TIme Gas Sensor	2 DOS - MOM2 - RPA - Dr. Ambili KM	3 DOS-SAC- Dr. Rajesh V J	4 DOS - Dr. Rajesh V J (Spectral)	5 VSSC - Dr. Natarajan E	6 IISU - Dr. Umesh Kadhane - Proj Assistant	7 IISU - Perf. of Ball Bearings - Dr. Jinesh KB
a) Opening balance of the funds	0	5,07,469	2,39,168	1,01,599	5,616	2,84,884	33,96,427
b) Additions to the Fund							
i) Donation/Grants	0	0	0	5,10,534	2,27,500	0	4,80,000
ii) Income from Investment made on account of Funds	0	0	0	0	0	0	0
iii) Other additions	0	0	0	0	0	0	0
Total (a + b)	0	5,07,469	2,39,168	6,12,133	2,33,116	2,84,884	38,76,427
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	10,34,025	40,089	0	0	0	0	32,20,665
- Others	0	0	0	0	0	0	0
Sub Total	10,34,025	40,089	0	0	0	0	32,20,665
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	0	7,34,855	0	3,77,086	0	1,81,225	4,19,161
- Rent/Consumables	0	2,13,655	0	0	0	0	0
- Other Administrative Expenses	0	13,494	0	33,662	0	8,621	9,219
Sub Total	0	9,62,004	0	4,10,748	0	1,89,846	4,28,380
iii) Fund Returned to the Funding Agency	0	0	0	0	0	0	0
Total (c)	10,34,025	10,02,093	0	4,10,748	0	1,89,846	36,49,045
Net Balance payable as at the year-end (a+b-c)	**0**	**0**	**2,39,168**	**2,01,385**	**2,33,116**	**95,038**	**2,27,382**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 8*	**10,34,025**	**4,94,624**	**0**	**0**	**0**	**0**	**0**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	8 IPRC - Dr. Palash - 2018 - Hydrogen Sensor	9 ISRO-GBP - ABLN & C Project	10 ISRO -Dr. K G Sreejalekshmi - Gaganyaan	11 ISRO - MOM - Dr. Rajesh VJ	12 LPSC - Dr Dinesh N Naik	13 LPSC - Dr.Jinesh K B - Laser Ignition System	14 LPSC - Dr. Jinesh K B - SDS
a) Opening balance of the funds	9,65,911	7,23,170	0	2,10,521	0	29,16,000	20,66,000
b) Additions to the Fund							
i) Donation/Grants	0	0	0	5,47,006	14,26,200	1,82,000	0
ii) Income from Investment made on account of Funds	0	0	0	0	0	0	0
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	9,65,911	7,23,170	0	7,57,527	14,26,200	30,98,000	20,66,000
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	6,25,997	0	0	0	0	1,40,918	15,46,752
- Others	0	0	0	0	0	0	0
Sub Total	6,25,997	0	0	0	0	1,40,918	15,46,752
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	2,61,067	0	46,252	1,68,402	0	79,934	0
- Rent/Consumables	10,314	0	0	1,335	0	2,32,241	3,990
- Other Administrative Expenses	3,000	0	4,112	5,908	0	2,965	0
Sub Total	2,74,381	0	50,364	1,75,645	0	3,15,140	3,990
iii) Fund Returned to the Funding Agency	0	0	0	0	0	0	0
Total (c)	9,00,378	0	50,364	1,75,645	0	4,56,058	15,50,742
Net Balance payable as at the year-end (a+b-c)	**65,533**	**7,23,170**	**0**	**5,81,882**	**14,26,200**	**26,41,942**	**5,15,258**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 7*	**0**	**0**	**50,364**	**0**	**0**	**0**	**0**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	15	16	17	18	19	20	21
	LPSC - Dr. Umesh K - Monte Carlo Model	LPSC - Dr. Umesh Kadhane	LPSC Dr. Umesh K - Plasma Thruster	LPSC - High Thrust EPS - Dr. Umesh K	SAC - NavIC (IRNSS) Gagan	DBT - Dr. Palash - 2017-Liquid Biopsy for Cancer	DBT - Dr. Shaiju - Ramalingaswami Fellowship
a) Opening balance of the funds	123	2,92,830	21,579	88,37,395	7,81,085	14,83,247	0
b) Additions to the Fund							
i) Donation/Grants	1,00,000	0	0	56,00,000	0	0	24,72,000
ii) Income from Investment made on account of Funds	0	0	0	0	0	1,28,715	0
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	1,00,123	2,92,830	21,579	1,44,37,395	7,81,085	16,11,962	24,72,000
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	0	0	0	73,19,119	0	7,96,552	0
- Others	0	0	0	0	0	0	0
Sub Total	0	0	0	73,19,119	0	7,96,552	0
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	1,06,452	0	1,35,333	5,13,902	4,06,266	2,88,067	2,37,000
- Rent/Consumables	0	0	0	9,54,089	0	3,71,095	0
- Other Administrative Expenses	0	0	0	16,002	35,971	1,10,098	0
Sub Total	1,06,452	0	1,35,333	14,83,993	4,42,237	7,69,260	2,37,000
iii) Fund Returned to the Funding Agency	0	0	0	0	0	0	0
Total (c)	1,06,452	0	1,35,333	88,03,112	4,42,237	15,65,812	2,37,000
Net Balance payable as at the year-end (a+b-c)	**0**	**2,92,830**	**0**	**56,34,283**	**3,38,848**	**46,150**	**22,35,000**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 7*	**6,329**	**0**	**1,13,754**	**0**	**0**	**0**	**0**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	22 DBT - Dr. Rama Rao N	23 DRDO - ARMREB - Dr. K. Prabhakaran	24 DRDO - SASE - Dr. Govindankutty M	25 DST - Dr. Rama Rao N	26 DST - CNRS - Dr. Palash Basu - 2020 - Biomarker	27 ICSSR - Dr. Shaijumon - 2020 - Tele Medicine Units	28 Mangrove Cell - Dr. Gnanappazham - 2018
a) Opening balance of the funds	46,62,847	3,87,824	1,60,490	(60,300)	0	0	38,22,992
b) Additions to the Fund							
i) Donation/Grants	0	6,18,600	0	11,22,330	8,42,015	5,20,000	13,59,000
ii) Income from Investment made on account of Funds	4,24,716	0	0	8,00,060	0	0	0
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	50,87,563	10,06,424	1,60,490	18,62,090	8,42,015	5,20,000	51,81,992
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	0	1,88,719	0	0	0	0	3,93,750
- Others	0	0	0	0	0	0	26,95,537
Sub Total	0	1,88,719	0	0	0	0	30,89,287
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	4,90,682	3,47,033	0	6,79,367	0	0	3,99,813
- Rent/Consumables	37,616	0	0	0	0	0	0
- Other Administrative Expenses	8,09,679	1,21,975	0	1,88,026	0	0	2,99,375
Sub Total	13,37,977	4,69,008	0	8,67,393	0	0	6,99,188
iii) Fund Returned to the Funding Agency	0	0	0	0	0	0	0
Total (c)	13,37,977	6,57,727	0	8,67,393	0	0	37,88,475
Net Balance payable as at the year-end (a+b-c)	**37,49,586**	**3,48,697**	**1,60,490**	**9,94,697**	**8,42,015**	**5,20,000**	**13,93,517**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 7*	**0**	**0**	**0**	**0**	**0**	**0**	**0**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	29 Max-Planck - Dr. Jagadheep - 2017	30 MeitY SAMEER - Dr. Priyadarshnam	31 SERB - Dr. Rakesh Kumar Singh	32 SERB - 2018 - Dr. Anand N. - Baryons	33 SERB - Dr. Ashok - Quantum Communicatio	34 SERB - Dr. Chinmoy Saha - 2020 - 5G Antenna	35 SERB - Dr. Resmi L - 2017 - Gamma Rays
a) Opening balance of the funds	31,33,737	33,24,559	85,215	5,19,929	0	0	5,05,349
b) Additions to the Fund							
i) Donation/Grants	10,12,570	6,91,897	0	3,00,000	20,93,437	27,30,000	3,00,000
ii) Income from Investment made on account of Funds	0	4,87,646	0	39,671	0	0	89,404
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	41,46,307	45,04,102	85,215	8,59,600	20,93,437	27,30,000	8,94,753
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	99,750	15,98,070	0	0	0	0	0
- Others	0	0	0	0	0	0	0
Sub Total	99,750	15,98,070	0	0	0	0	0
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	5,90,722	11,07,825	0	0	0	0	1,49,802
- Rent/Consumables	68,646	74,778	0	2,20,877	0	0	8,627
- Other Administrative Expenses	37,022	2,50,292	0	53,908	0	0	85,706
Sub Total	6,96,390	14,32,895	0	2,74,785	0	0	2,44,135
iii) Fund Returned to the Funding Agency	0	0	85,215	0	0	0	0
Total (c)	7,96,140	30,30,965	85,215	2,74,785	0	0	2,44,135
Net Balance payable as at the year-end (a+b-c)	**33,50,167**	**14,73,137**	**0**	**5,84,815**	**20,93,437**	**27,30,000**	**6,50,618**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 7*	**0**	**0**	**0**	**0**	**0**	**0**	**0**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	36 SERB - Dr. Sarita Vig - 2019 - Young Massive Stars	37 SERB - Dr. Sarvesh - 2020 - Virtual Element	38 SERB - Dr. Seena V - Nanomechanical Sensor	39 SERB - Dr. Jayanthi S	40 SERB - 2018 - Dr. Umesh K. - PAH	41 SERB - Dr. Roymon Joseph	42 SERB - Dr. Seena V
a) Opening balance of the funds	0	0	30,56,294	(3,38,784)	32,60,000	2,48,472	(8,981)
b) Additions to the Fund							
i) Donation/Grants	10,10,000	2,20,000	0	4,95,708	0	0	0
ii) Income from Investment made on account of Funds	0	0	5,16,735	0	2,21,029	0	0
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	10,10,000	2,20,000	35,73,029	1,56,924	34,81,029	2,48,472	(8,981)
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	0	0	21,01,297	0	0	0	0
- Others	0	0	0	0	0	0	0
Sub Total	0	0	21,01,297	0	0	0	0
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	0	0	3,47,167	25,000	2,17,237	2,20,000	0
- Rent/Consumables	0	0	4,47,098	0	0	6,623	0
- Other Administrative Expenses	0	0	27,277	1,22,467	1,21,860	21,849	0
Sub Total	0	0	8,21,542	1,47,467	3,39,097	2,48,472	0
iii) Fund Returned to the Funding Agency	0	0	0	0	0	0	0
Total (c)	0	0	29,22,839	1,47,467	3,39,097	2,48,472	0
Net Balance payable as at the year-end (a+b-c)	**10,10,000**	**2,20,000**	**6,50,190**	**9,457**	**31,41,932**	**0**	**0**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 7*	**0**	**0**	**0**	**0**	**0**	**0**	**8,981**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	43 SERB - 2019 - Dr. Vineeth B S - Wireless ReLod	44 UGC - DAE - Dr. Kuntala B	45 DST Inspire - Dr. Basudev M	46 AICTE - INAE - Aswathy RV - 2017	47 AICTE - INAE - 2018 Batch	48 SERB - PDF - Dr. Krishnaswamy R - 2017	49 SERB - PDF - Dr. Linsha Vazhayal - 2017
a) Opening balance of the funds	8,76,540	71,143	7,00,000	9,677	98,708	3,55,077	1,76,124
b) Additions to the Fund							
i) Donation/Grants	0	4,26,257	0	1,90,000	7,60,000	0	0
ii) Income from Investment made on account of Funds	38,273	0	0	0	0	0	0
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	9,14,813	4,97,400	7,00,000	1,99,677	8,58,708	3,55,077	1,76,124
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	2,88,851	0	0	0	0	0	0
- Others	0	0	0	0	0	0	0
Sub Total	2,88,851	0	0	0	0	0	0
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	2,31,934	28,000	0	1,35,000	7,18,548	1,65,000	64,167
- Rent/Consumables	13,255	0	0	0	0	0	0
- Other Administrative Expenses	67,356	0	0	0	0	3,778	94,990
Sub Total	3,12,545	28,000	0	1,35,000	7,18,548	1,68,778	1,59,157
iii) Fund Returned to the Funding Agency	0	0	0	0	0	0	16,967
Total (c)	6,01,396	28,000	0	1,35,000	7,18,548	1,68,778	1,76,124
Net Balance payable as at the year-end (a+b-c)	**3,13,417**	**4,69,400**	**7,00,000**	**64,677**	**1,40,160**	**1,86,299**	**0**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 7*	**0**	**0**	**0**	**0**	**0**	**0**	**0**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	50 SERB - PDF - Dr. Priyanka B - 2017	51 KSCSTE - PDF - Dr. Prescilla - 2018	52 KSCSTE - PhD - Elizabeth George - 2018	53 KSCSTE - PhD - Haritha A - 2018	54 AICTE - INAE - 2019 - Nisha	55 KSCSTE - PDF - Dr. Linsha V - 2019	56 SERB - TARE - Dr. Santhosh B
a) Opening balance of the funds	1,14,147	3,361	1,33,194	1,47,281	0	0	0
b) Additions to the Fund							
i) Donation/Grants	1,176	4,63,791	0	0	1,35,000	4,72,400	3,35,000
ii) Income from Investment made on account of Funds	0	4,784	0	0	0	0	0
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	1,15,323	4,71,936	1,33,194	1,47,281	1,35,000	4,72,400	3,35,000
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	0	0	0	0	0	0	0
- Others	0	0	0	0	0	0	0
Sub Total	0	0	0	0	0	0	0
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	1,15,323	3,87,200	1,18,633	1,10,000	1,10,806	3,77,813	0
- Rent/Consumables	0	0	10,900	0	0	0	25,137
- Other Administrative Expenses	0	44,752	0	0	0	4,620	0
Sub Total	1,15,323	4,31,952	1,29,533	1,10,000	1,10,806	3,82,433	25,137
iii) Fund Returned to the Funding Agency	0	0	0	0	0	0	0
Total (c)	1,15,323	4,31,952	1,29,533	1,10,000	1,10,806	3,82,433	25,137
Net Balance payable as at the year-end (a+b-c)	**0**	**39,984**	**3,661**	**37,281**	**24,194**	**89,967**	**3,09,863**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 7*	**0**	**0**	**0**	**0**	**0**	**0**	**0**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	57 DST - NRDMS - Dr. Ramarao N.	58 DAE - NBHM - CSDEA - Dr. Sakthivel	59 SERB - DST - National Conference - Dr. Sakthivel	60 Antrix Corporation - Colloquium Sponsorship	61 DAE - ICIAM - Dr. Sakthivel (Travel)	62 SERB - DST - Dr. Deepak TG (Travel)	63 SERB - PhD - Aravind G P (Travel)
a) Opening balance of the funds	2,00,000	0	1,50,000	4,626	0	1,13,009	0
b) Additions to the Fund							
i) Donation/Grants	0	2,00,000	0	0	1,92,677	0	1,45,560
ii) Income from Investment made on account of Funds	9,242	0	0	0	0	0	0
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	2,09,242	2,00,000	1,50,000	4,626	1,92,677	1,13,009	1,45,560
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	0	0	0	0	0	0	0
- Others	0	0	0	0	0	0	0
Sub Total	0	0	0	0	0	0	0
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	0	0	0	0	0	0	0
- Rent/Consumables	0	0	0	0	0	0	0
- Other Administrative Expenses	2,23,581	1,82,511	1,30,333	0	1,92,677	1,13,009	1,45,560
Sub Total	2,23,581	1,82,511	1,30,333	0	1,92,677	1,13,009	1,45,560
iii) Fund Returned to the Funding Agency	0	17,489	19,667	0	0	0	0
Total (c)	2,23,581	2,00,000	1,50,000	0	1,92,677	1,13,009	1,45,560
Net Balance payable as at the year-end (a+b-c)	**0**	**0**	**0**	**4,626**	**0**	**0**	**0**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 7*	**14,339**	**0**	**0**	**0**	**0**	**0**	**0**

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SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

Schedule 2 :: EARMARKED/ENDOWMENT FUNDS (contd.)	64	65	66	67	68	TOTAL	
	SERB - PhD - Aryadutt Oamjee (Travel)	SERB - Dr. Chinmoy Saha (Travel)	SERB - PhD - Shashank V (Travel)	TIFR - Dr. Resmi L (Travel)	DST Inspire - Dr. Mahesh S	2019-20	2018-19
a) Opening balance of the funds	0	0	0	0	27,059	4,87,72,613	4,04,70,219
b) Additions to the Fund							
i) Donation/Grants	1,24,461	1,40,546	65,331	1,80,648	0	2,86,93,644	4,27,12,340
ii) Income from Investment made on account of Funds	0	0	0	0	0	27,60,275	11,678
iii) Other additions (Specify Nature)	0	0	0	0	0	0	0
Total (a + b)	1,24,461	1,40,546	65,331	1,80,648	27,059	8,02,26,532	8,31,94,237
c) Utilisation/Expenditure towards objective of funds							
i) Capital Expenditure							
- Fixed Assets	0	0	0	0	0	1,93,94,554	1,31,50,758
- Others	0	0	0	0	0	26,95,537	26,040
Sub Total	0	0	0	0	0	2,20,90,091	1,31,76,798
ii) Revenue Expenditure							
- Salaries, Wages & Allowance	0	0	0	0	0	1,10,92,074	1,12,49,353
- Rent/Consumables	0	0	0	0	0	27,00,276	23,77,302
- Other Administrative Expenses	1,24,461	1,40,546	65,331	0	0	39,15,993	66,27,079
Sub Total	1,24,461	1,40,546	65,331	0	0	1,77,08,343	2,02,53,734
iii) Fund Returned to the Funding Agency	0	0	0	0	0	1,39,338	9,91,092
Total (c)	1,24,461	1,40,546	65,331	0	0	3,99,37,772	3,44,21,624
Net Balance payable as at the year-end (a+b-c)	**0**	**0**	**0**	**1,80,648**	**27,059**	**4,20,11,176**	**4,91,80,678**
Net Balance receivable as at the year-end (c-a-b) *Note : Classified under Current Assets under Sch 7*	**0**	**0**	**0**	**0**	**0**	**17,22,416**	**4,08,065**

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SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

(Amount in Rs.)

	As at 31.03.2020	As at 31.03.2019
Schedule 3 :: LONG TERM LIABILITIES AND PROVISIONS		
a) Employee Provident Funds and Retirement Benefits		
- General Provident Fund	4,63,67,806	3,91,42,748
- Contributory Provident Fund	73,26,729	62,25,459
- New Pension Scheme	46,876	-
- Retirement Benefits - Provision	21,06,43,767	20,66,08,845
- Retirement Benefits - Funds Received including Interest	5,71,89,453	5,32,13,958
Sub Total (a)	**32,15,74,631**	**30,51,91,010**
b) Caution Deposit		
- Caution Deposit from Students	85,04,206	83,06,206
Sub Total (b)	**85,04,206**	**83,06,206**
TOTAL	**33,00,78,837**	**31,34,97,216**
Schedule 4 :: CURRENT LIABILITIES AND PROVISIONS		
a) Current Liabilities		
1. Sundry Creditors		
- For Goods		
Capital Goods	1,20,81,998	3,95,92,338
Revenue Expenditure	-	-
- For Services	1,79,21,675	2,30,54,006
2. Statutory Liabilities		
- Overdue	-	-
- Others	28,72,734	23,50,343
3. Other Current Liabilities		
- Interest refundable to DOS (received)	2,89,14,157	1,61,03,136
- Interest refundable to DOS (accrued)	7,98,962	19,91,837
- B.Tech Fees refundable to DOS	5,02,54,928	3,11,21,088
- Others	2,21,57,449	1,92,46,944
Sub Total (a)	**13,50,01,903**	**13,34,59,692**
TOTAL	**13,50,01,903**	**13,34,59,692**

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SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

(Amount in Rs.)

Schedule 5 :: FIXED ASSETS

Particulars	Gross Block (at cost) as at 01.4.2019	Additions		Transfer to Installed from Uninstalled	Deletions	Gross Block (at cost) as at 31.03.2020	Rate of Deprec-iation	Depreciation					Net Block as at 31.3.2020	Net Block as at 31.3.2019
		Installed	Under Installation					As at 01.04.2019	For the year	Prior Period	Deletions	As at 31.3.2020		
Land	3,32,52,002	0	0	0	0	3,32,52,002-	0.00%	0	0	0	0	0	3,32,52,002	3,32,52,002
Building	1,87,25,14,838	7,05,32,931	0	0	0	1,94,30,47,769	10.00%	81,56,67,277	11,27,38,051	0	0	92,84,05,328	1,01,46,42,441	1,05,68,47,561
Plant & Machinery	1,06,15,50,072	5,95,43,678	0	0	0	1,12,10,93,750	15.00%	57,63,09,624	8,17,15,364	15,045	0	65,80,40,033	46,30,53,717	48,52,40,448
Furniture & Fittings	17,79,15,791	1,17,50,030	0	0	0	18,96,65,821	10.00%	9,29,91,185	96,67,463	0	0	10,26,58,648	8,70,07,173	8,49,24,606
Ambulance	8,80,644	0	0	0	0	8,80,644	15.00%	5,98,330	42,347	0	0	6,40,677	2,39,967	2,82,314
Motor Cars & Bikes	1,67,45,834	0	0	0	0	1,67,45,834	15.00%	1,02,53,419	9,73,862	0	0	1,12,27,281	55,18,553	64,92,415
Motor Buses & Truck	1,07,70,031	0	0	0	0	1,07,70,031	15.00%	61,21,960	6,97,211	0	0	68,19,171	39,50,860	46,48,071
Computers	11,57,33,809	86,68,610	0	0	6,28,099	12,36,74,320	40.00%	10,09,73,686	91,80,749	0	2,51,240	10,99,03,195	1,37,71,125	1,47,60,123
Software	8,91,38,167	75,84,459	0	0	0	9,67,22,626	40.00%	7,86,21,733	74,78,257	0	0	8,60,99,990	1,06,22,636	1,05,16,434
Library Books	6,08,64,848	32,18,860	0	0	0	6,40,83,708	60.00%	5,83,28,978	34,52,838	0	0	6,17,81,816	23,01,892	25,35,870
Campus networking	4,74,40,346	0	0	0	0	4,74,40,346	40.00%	4,25,27,571	19,65,110	0	0	4,44,92,681	29,47,665	49,12,775
Canteen Equipments	1,92,85,285	20,37,004	0	0	0	2,13,22,289	15.00%	1,32,89,371	12,04,937	0	0	1,44,94,308	68,27,981	59,95,914
Soft Furnishing	10,43,023	0	0	0	0	10,43,023	100.00%	10,43,023	0	0	0	10,43,023	0	0
Uninstalled Assets														
Plant & Machinery	34,75,333	0	17,33,908	28,40,985	0	23,68,256	0.00%	0	0	0	0	0	23,68,256	34,75,333
Vehicle	0	0	28,30,000	0	0	28,30,000	0.00%	0	0	0	0	0	28,30,000	0
TOTAL	**3,51,06,10,023**	**16,32,35,572**	**45,63,908**	**28,40,985**	**6,28,099**	**3,67,49,40,419**		**1,79,67,26,157**	**22,91,16,189**	**15,045**	**2,51,240**	**2,02,56,06,151**	**1,64,93,34,268**	**1,71,38,83,866**
Previous Year	**3,36,55,35,990**	**19,58,64,363**	**28,10,083**	**5,34,98,123**	**1,02,290**	**3,51,06,10,023**		**1,52,01,37,359**	**24,05,67,177**	**3,60,95,319**	**73,698**	**1,79,67,26,157**	**1,71,38,83,866**	**1,84,53,98,631**
Capital Work in progress	**28,73,56,645**	**0**	**15,32,05,322**	**8,19,04,841**	**0**	**35,86,57,126**		**0**	**0**	**0**	**0**	**0**	**35,86,57,126**	**28,73,56,645**
TOTAL													**2,00,79,91,394**	**2,00,12,40,511**

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SCHEDULES TO BALANCE SHEET AS AT 31ST MARCH, 2020

(Amount in Rs.)

	As at 31.03.2020	As at 31.03.2019
Schedule 6 :: LONG TERM ASSETS, LOANS, ADVANCES ETC		
a) Loans		
- Staff	63,07,560	28,46,026
b) Advances and other amounts on capital account recoverable in cash or in kind or for value to be received		
- Interim Advance to SPCL	12,43,00,000	12,43,00,000
c) Security Deposits	52,92,959	50,71,789
TOTAL	**13,59,00,519**	**13,22,17,815**
Schedule 7 :: CURRENT ASSETS, LOANS, ADVANCES ETC		
a) Current Assets		
1. Inventories		
- Canteen inventories	6,52,891	7,68,326
2. Sundry Debtors		
- Debtors outstanding for a period exceeding six months		
- Others		
3. Cash Balances in hand (including cheques/drafts and imprest)	1,30,655	55,351
4. Bank Balances		
a) With Scheduled Banks		
- On Current Accounts	68,92,166	2,22,72,101
- On Deposit Accounts	24,24,39,005	27,22,99,687
- On Earmarked & Retirement Benefits Accounts	15,98,28,089	15,12,58,047
Sub Total (a)	**40,99,42,807**	**44,66,53,512**
b) Loans, Advances and Other Assets		
1. Advances and other amounts recoverable in cash or in kind or for value to be received		
- On Capital Account	3,59,444	28,13,935
- Prepayments	3,90,71,071	3,95,90,381
- Others	97,25,254	94,05,569
2. Income Accrued		
- On Bank Deposits	36,85,807	53,89,348
- On Other Deposits	1,79,018	1,61,281
Sub Total (b)	**5,30,20,594**	**5,73,60,514**
TOTAL (a+b)	**46,29,63,401**	**50,40,14,026**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
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SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2020

(Amount in Rs.)

	2019-20	2018-19
Schedule 8 :: GRANTS / SUBSIDIES		
(irrevocable Grants & Subsidies Recovered)		
1. Central Government	64,25,00,000	70,03,65,000
TOTAL	**64,25,00,000**	**70,03,65,000**
Schedule 9 :: FEES / SUBSCRIPTIONS		
1. Entrance Fees	41,50,250	31,61,000
2. Annual Fees/Subscriptions	3,41,37,655	1,87,99,904
TOTAL	**3,82,87,905**	**2,19,60,904**
Schedule 10 :: INTEREST INCOME OF IIST		
1. On Term Deposit		
a) With Scheduled Banks	78,79,748	78,25,534
b) Others	0	0
2. On Loans / Advances		
a) Employee/Staff	1,16,158	68,567
3. Others		
a) Interest on IT Refund	0	420
TOTAL	**79,95,906**	**78,94,521**
Schedule 11 :: INTEREST EARNED ON GRANT & RETIREMENT FUNDS		
1. On Term Deposit		
a) With Scheduled Banks	1,81,11,227	2,32,22,175
b) Others	2,31,891	2,15,796
TOTAL	**1,83,43,118**	**2,34,37,971**
Schedule 12 :: OTHER INCOME		
1. Rent Receipts	5,75,372	6,96,387
2. Sale of Tender Forms	7,500	11,000
3. Sale of Scrap / Vehicles / Trees	4,45,200	2,79,358
4. Student Activities Income (External)	3,00,000	0
5. Miscellaneous Income	29,54,482	28,98,581
TOTAL	**42,82,554**	**38,85,326**

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SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED 31ST MARCH, 2020

(Amount in Rs.)

	2019-20	2018-19
Schedule 13 :: ESTABLISHMENT EXPENSES - REGULAR		
1. Salaries & Allowances	29,59,99,211	27,50,79,202
2. Contribution to NPS	2,25,07,395	1,45,89,995
3. Contribution to CPF	2,68,920	2,68,920
4. Medical Expense- Staff	27,12,231	48,11,222
5. Expense on Employees Retirement & Terminal Benefits	67,64,522	82,89,803
6. Interest on PF Contribution	6,10,902	1,97,280
7. Staff Training Expense	5,310	13,740
TOTAL	**32,88,68,491**	**30,32,50,162**
Schedule 14 :: ESTABLISHMENT EXPENSES - SUPPORT SERVICES		
1. Consultancy & Manpower Charges	8,56,91,363	8,67,85,947
2. Remuneration to Contract Employees	68,76,348	64,30,833
3. CISF Expenses	7,68,13,092	7,53,68,745
TOTAL	**16,93,80,803**	**16,85,85,525**
Schedule 15 :: ACADEMIC & OTHER STUDENT EXPENSES		
1. Admission Expense	48,45,251	31,93,465
2. Assistanceship to Students	3,34,86,155	3,43,44,724
3. Library Services	2,37,02,374	2,07,55,656
4. Academic Expense	5,21,70,918	5,01,64,054
5. Supplies & Materials	1,54,67,567	1,56,97,321
6. Student Activities Expense	10,28,523	15,09,581
7. Student Activities Expense (External)	3,00,000	0
TOTAL	**13,10,00,787**	**12,56,64,801**
Schedule 16 :: OTHER ADMINISTRATIVE EXPENSES		
1. Maintenance & Upkeep		
Repairs & Maintenance - CMD	3,76,81,686	2,38,35,786
Repairs & Maintenance - Labs & Others	1,64,33,906	1,48,41,991
House Keeping Expense	10,12,314	8,02,827
Sub Total (a)	**5,51,27,906**	**3,94,80,604**
2. Professional Charges		
Audit Fees	1,53,400	2,65,500
Legal Expense	6,00,391	1,94,451
Sub Total (b)	**7,53,791**	**4,59,951**
3. Administrative Expenses - Others		
Vehicle Operating Expense	2,01,48,063	2,12,16,768
Electricity & Water Charges	2,75,22,691	3,27,99,909

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SCHEDULES FORMING PART OF INCOME AND EXPENDITURE ACCOUNT
FOR THE YEAR ENDED 31ST MARCH, 2020

(Amount in Rs.)

	2019-20	2018-19
Travelling Expense	63,68,681	64,41,026
Research & Development Expense	1,29,96,394	92,97,863
Printing & Stationery	40,86,710	33,42,330
Advertisement & Publicity	5,47,357	6,34,690
Hospitality Expense	29,27,565	33,37,775
Telephone & Internet Expense	16,55,035	18,74,002
Office and other Miscellaneous Expense	21,87,809	25,24,112
Recruitment & Review Expense	8,49,717	11,29,263
CEP & IPR Expenses	4,28,017	0
Compensation Paid	18,45,146	0
Bank Charges	1,35,950	90,747
Sub Total (c)	**8,16,99,134**	**8,26,88,486**
TOTAL	**13,75,80,831**	**12,26,29,041**

Schedule 17 :: INTEREST REFUNDABLE BY IIST		
Interest to CPF Fund [Expense]	5,56,001	2,38,040
Interest to DOS [Expense]	1,16,18,146	1,80,94,973
Interest to GPF Fund [Expense]	26,56,820	21,63,614
Interest to Retirement Fund [Expense]	35,12,151	29,41,344
TOTAL	**1,83,43,118**	**2,34,37,971**

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
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Schedule 18 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2020

A. Significant Accounting Policies

1. Basis of Accounting
   The financial statements have been prepared in accordance with the Generally Accepted Accounting Principles in India (Indian GAAP) and are prepared on accrual basis under the historical cost convention. The accounting policies adopted in the preparation of the financial statements are consistent with those followed in the previous year.

2. Use of estimates
   The preparation of the financial statements in conformity with Indian GAAP requires the Management to make estimates and assumptions considered in the reported amounts of assets and liabilities (including contingent liabilities) and the reported income and expenses during the year. The Management believes that the estimates used in preparation of the financial statements are prudent and reasonable. Future results could differ due to these estimates and the differences between the actual results and the estimates are recognized in the periods in which the results are known / materialize.

3. Inventories
   The inventories represents canteen inventories and is valued at lower of cost or net realizable value as certified by the Canteen Manager.

4. Depreciation
   a. Depreciation has been provided on the written down value method as per the rates prescribed in the Income Tax Act, 1961.
   b. Depreciation on assets acquired in a particular year is provided for the whole year irrespective of date of addition.
   c. Depreciation has not been charged on capital work in progress and on those assets under installation as on 31.03.2020.
   d. Software not having perpetual licenses are written off over the license period.

5. Revenue Recognition
   a. Grant in aid received from the Department of Space, is accounted on accrual basis. Out of the total grant received, the amount received towards revenue expenditure is treated as Revenue Grant / income over the period necessary to match them with the costs for which they are intended to compensate, on a systematic basis. The remaining grant forms part of the Corpus Fund along with other grant received.
   b. Tuition fees, fines and other recoveries from underperforming students (as per the policy of the institute) are accounted on cash basis. As per Department of Space instructions, Fees received from B.Tech students (performing and non-performing students) who have joined the Institute prior to 2018 is not recognized as income and is shown as a liability payable to Department to Space after adjusting related costs. With respect to BTech students joining the Institute from 2018 onwards the Fees received is recognized as Income of the Institute.
   c. Interest income is accounted on accrual basis. Interest on deposits created out of grant received is refundable to Department of Space.

6. Fixed Assets
   a. Land – (i)The present activity of the Institute is in the Valiamala campus which has been handed over by LPSC vide letter no. VSSC/CMG/2010 dated 05.08.2010 and has been measured at 53.43 acres. No value has been separately provided in the books for this land. (ii) 20 acres of Land in Survey No. 4003 in Thennoor Village has been assigned and handed over to ISRO authorities on 31.12.2007 as per letter No. B8-85534/07 dated

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Schedule 18 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2020 (contd)

01.01.2008 of District Collector, Trivandrum subject to the condition that facilities stated by ISRO in their letter no. ISST-DIR-2007 dt 06.12.2007 should be set up in the property within 18 months. The said land should be used only for scientific and educational purposes. No value has been mentioned in the Land Assignment Order and hence the value of the property is taken at Re. 1/- for each property.

b. Building –Construction of buildings is still in progress. Buildings, the construction of which are more than 90% complete, certified by the Construction and Maintenance Division and which have been put into use have been transferred from Capital Work-in-Progress to Buildings based on actual payments made.
c. Plant and Machinery – It mainly constitutes Laboratory Equipment, Office Equipment, Electricals & Electronics and other Machinery.
d. Buildings and other Fixed Assets are carried at cost less accumulated depreciation. Cost comprises the purchase price or acquisition cost, installation charges and any attributable cost of bringing the assets to working condition for its intended use. Exchange differences arising on restatement / settlement of foreign currency payables relating to acquisition of depreciable fixed assets are adjusted to the cost of the respective assets and depreciated over the remaining useful life of such assets.
e. Capital Work-in-Progress pertains to construction in progress at Valiamala.
f. Assets that have been delivered to IIST up to 31.03.2020 have been recognized as assets but depreciation has not been charged on Assets under installation.

7. Foreign currency transactions
Foreign currency monetary items outstanding at the Balance Sheet date are restated at the year-end rates. Non-monetary items are carried at historical cost. The exchange differences arising on restatement / settlement of long-term foreign currency monetary items are capitalised as part of the depreciable fixed assets to which the monetary item relates and depreciated over the remaining useful life of such assets.

8. Earmarked / Endowment Funds
Earmarked / Endowment Funds mainly include external agency funding received for research & development purpose and conduct of seminars & workshops. Value of assets procured out of such funds for the purpose specified have gone to reduce the value of Fund in hand and have not been treated as an asset of the Institute as the ownership of the same vests with the funding agency. Earmarked / Endowment Funds are held in a separate Current Account linked to Term Deposits. The interest received in the account has been taken as the Institutes Income. Interest claims in the future, if any, from the disbursing parties of such Earmarked / Endowment Funds will be met at the time of the claim based on the deposit rates prevailing during the period of holding of the particular Fund.

9. Employee Benefits
Employee benefits include General Provident Fund (GPF), Contributory Provident Fund (CPF), New Pension Scheme (NPS), and Group Insurance Scheme (GIS). The Institute's contribution to CPF and NPS are considered as defined contribution plans and are charged as an expense as they fall due based on the amount of contribution required to be made.
GPF and CPF funds are maintained separately by the Institute in Savings Bank Account and linked Flexi deposits. Annual Interest provision on GPF and CPF balance is made from Interest earned during the year from investment of such funds in flexi deposits. Interest earned over and above the provision made is transferred to an Interest Fluctuation Reserve and in the event of a shortfall in interest earned, the difference is met from such Reserve, and any balance shortfall after adjustment with Reserve is met by IIST.
Retirement Benefits consisting of pension fund, gratuity and leave encashment received from previous employers of employees joining from other Government organizations have been maintained separately in a Current Account and linked Term Deposits.

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Schedule 18 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2020 (contd)

10. Taxes on income
    Being a non-profit institution existing solely for education purposes and being wholly financed by the Government of India, the income of the Institute is exempt under section 10[(23C)][iiiab] of the Income Tax Act, 1961.

11. Research and Development Expenses
    Revenue expenditure pertaining to research is charged to the Income and Expenditure Account. Fixed assets utilized for research and development are capitalized and depreciated in accordance with the policies stated for Fixed Assets.

12. Provisions and Contingencies
    A provision is recognised when the Institute has a present obligation as a result of past events and it is probable that an outflow of resources will be required to settle the obligation in respect of which a reliable estimate can be made. Provisions (excluding retirement benefits) are not discounted to their present value and are determined based on the best estimate required to settle the obligation at the Balance Sheet date. These are reviewed at each Balance Sheet date and adjusted to reflect the current best estimates.

B. Notes to the Accounts

1. Depreciation
   Assets are depreciated at written down value method as per rates prescribed in the Income Tax Act, 1961 as recommended by the Office of the Principal Director of Audit, Scientific Departments, Bangalore. Software not having perpetual licenses are written off over the license period

2. Revenue
   a. Out of Grant of Rs. 90,25,00,000/-received during 2019-20, Rs. 64,25,00,000/- received specifically towards revenue expenditure has been transferred to Revenue Grant.
   b. Interest earned (actually received) on funds from grant-in-aid maintained in deposits is refundable to DOS. Interest of Rs. 1,28,11,021/- (excluding the interest received on the Provident Fund Accounts and Earmarked Funds) has been actually received during 2019-20 and the same has been shown as refundable to DOS.
   c. Fees received from B.Tech students (performing and non-performing students) who have joined the Institute prior to 2018 is not recognized as income and is shown as a liability payable to Department to Space after adjusting related costs. Based on the Department of Space Letter No. B. 12011/7/2015-Sec.2 dated 21.10.2015, "Fees paid back by students on receipt of Assistanceship package and receipts from non-performing students" are to be remitted back to Government Account. During 2019-20, an amount of Rs. 1,91,33,840/- has been shown as refundable to DOS after deducting related costs.
   d. With respect to BTech students joining the Institute from 2018 onwards the Fees received is recognized as Income of the Institute based on the decision of the Twelfth Finance Committee, IIST.
   e. Canteen Accounting Committee accounts is maintained separately and the gross deficit / surplus, which is exclusive of administrative cost, is recognised in the Income and Expenditure Account.

3. Fixed Assets
   Land – There is a stay by the Honorable High Court of Kerala on carrying out construction activities on a part of land (approximately 80 acres) purchased at Ponmudi in Trivandrum District for setting up the Institute. Over and above this 80 acres, approximately 20 acres

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
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Schedule 18 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2020 (contd)

of land at Ponmudi and 44.18928 acres at Valiamala has been transferred by the Government of Kerala free of cost in December 2007 and April 2009 respectively. These two properties have been brought into the books of accounts in 2013-14 by assigning a nominal value of Re. 1/- each. The present activity of the Institute is in the Valiamala campus which has been handed over by LPSC vide letter no. VSSC/CMG/2010 dated 05.08.2010 and has been measured at 53.43 acres. No separate lease agreement / transfer of ownership of land was obtained by IIST. No value has been separately provided in the books for this land..

a. Capital Work-in-Progress includes a sum of Rs. 5,26,92,357/- towards project management and consultancy charges and service tax of Rs. 7,73,61,215/-, both pending for appropriation to fixed assets on final completion of all buildings.
b. An amount of Rs. 51,98,256/- pertaining to assets that have been delivered to IIST before 31.03.2020 but under installation as on 31.03.2020 have been accounted as fixed assets & depreciation has not been charged on the same. Office Equipment worth Rs. 6,85,011/- procured from CMS computers has been uninstalled for 6 years.

4. Employee Benefits
   a. Employer and Employee contribution to New Pension Scheme is being transferred to NSDL.
   b. The Institute has entered into a Group Insurance Scheme (GIS) agreement with Life Insurance Corporation of India from 2011-12 onwards.
   c. Provision for interest on PF Contribution, at the rates prescribed, have been made and the corresponding expenditure has been adjusted against Interest earned on GPF and CPF funds parked in Savings Accounts (linked to flexi deposits) and the balance interest earned has been retained as Interest Fluctuation Reserve. Provision for liability in respect of gratuity, pension and leave encashment has not been made. Permission from DOS for creation &maintenance of a separate pension fund has been received during 2013-14. Provision for Retirement Benefits [Pension, Gratuity & Leave Encashment] has been incorporated based on the actuarial valuation provided by Life Insurance Corporation during 2018-19. In addition, the retirement benefits from the previous employers for the members governed under the GPF have not been received in all cases.

5. Prior Period Item
   Details of prior period items are as given below :-

Details	Prior period expenses
GST portion of buy back sale	305.00
CHSS expenses	7,800.00
Warranty charges	8,73,281.00
Interest income to be returned	1,09,957.00
Prior Period Depreciation	15,045.00
Total (A)	**10,06,388.00**

Details	Prior period income
CHSS receipts	28,668.00
Depreciation reversal	2,51,240.00
Ultrafiltration Unit	6,664.00
Total (B)	**2,86,572.00**

Net prior period expense (A-B) = Rs. 7,19,816.00

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
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Schedule 18 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2020 (contd)

6. Academic Expenses
   Academic Expenses mainly include expenses towards Lectures for students, Project & Internship expenses, stipend / fellowship paid to PhD and M.Tech students and expenses incurred on Seminars, Symposia and Conferences.

7. Admission Expenses
   Admission expenses include expenses incurred towards B.Tech, M.Tech and PhD admissions

8. Assistanceship to Students
   As per the approval of The Chairman, Board of Management-IIST / Secretary, DOS vide Letter No. PP & PM : IIST : 09-10 dated July 17th, 2009, the B. Tech students of the Institute are entitled for an assistanceship of Rs. 49,000/- [increased to Rs. 51,400/- from Even semester 2014-15] for each semester towards Statutory Semester Fee, Student Amenity Fee, Hostel & Dining, Establishment charges and Medical cover. For the students who have joined the Institute prior to 2018, the assistanceship amount of Rs. 48,400/- (exclusive of book grant)for a semester is disbursed to eligible students based on the performance of the previous semester. The assistanceship amount disbursed is then remitted back by the students to the Institute and expenditure corresponding to the assistanceship so received (under Hostel, Dining & Medical cover) is set off against the assistanceship amount.

   From 2018 admission onwards fees is collected from all the students at the beginning of the Semester and the eligible Assistanceship is disbursed based on the performance of the student at the end of the semester

   During 2019-20, an amount of Rs. 3,34,86,155/- was disbursed as assistanceship..

9. Supplies and Materials
   Supplies and Materials mostly consist of lab consumables.

10. Salary
    Salary cost for the month of March 2020 has not been taken into the books of accounts for 2019-20 as March salary for a particular year for central government employees is released in April of that year only. Expenditure for March 2019 to February 2020 has been shown in 2019-20.

11. Bank balances
    The negative balance in the SBI and UBI Current Account represents the cheques issued on the closing date of the financial year which are not presented for payment. The Institute has sufficient balance to cover these cheques issued in the flexi deposits maintained with UBI. Hence, the negative balance does not represent any Overdraft.

12. Earmarked / Endowment Funds
    a. An amount of Rs. 126.14 lakhs pertaining to expenditure for Externally Funded projects has been met from IIST bank accounts and is to be transferred from the balance in Earmarked Funds bank accounts to IIST's main bank account.
    b. As on 31.03.2020, assets amounting to Rs. 6.35 crores have been purchased from externally funded projects. The same has not been included in the Balance Sheet of the Institute as the ownership of the same vests with the sponsor.

13. Format of accounts
    The accounts of the Institute are prepared as per proforma suggested by the Office of the Principal Director of Audit, Scientific Departments, Bangalore.

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

Schedule 18 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2020 (contd)

14. Insurance
The Institute being an autonomous body under the Department of Space (DOS), it is governed by the rules and regulations as applicable to DOS. As per the "Book of Financial Powers" prescribed by DOS "No Government property whether movable or immovable shall be insured. No liability shall be incurred in connection with the insurance of such property without the prior approval of the Department of Space in consultation with the Member for Finance." The matter was taken up for consultation with the Department of Space during 2012-13 and it was decided in the Seventh Finance Committee meeting of IIST dated 3rd June, 2014 not to insure the assets of the institute.

15. Inoperative Balances
An amount of Rs. 19.71 lakhs (credit balances) relates to balances that have been outstanding from 01.04.2019.

16. Balances in personal accounts
Balances in personal accounts are subject to confirmation from respective parties.

17. Contingent Liabilities
a. The unexecuted portion of the contracts entered into by the Institute will form part of the current liability of the Institute. However, the same could not be quantified.
b. Interest earned on Earmarked / Endowment Funds held in a separate Current Account linked to Term Deposits has been taken as the Institutes Income. Interest claims in the future, if any, from the disbursing parties of such Earmarked / Endowment Funds will be met at the time of the claim based on the deposit rates prevailing during the period of holding of the particular Fund
c. In the case of buildings / structures completed by SPCL, only 90% has been billed by SPCL and subsequently paid by IIST. The balance 10% (approximately Rs. 18.31 crores) has not been billed and the same will be paid only on completion of the project. In case of all other works completed by SPCL and not billed as on 31.03.2020 provision has not been made in the books of accounts since the same is not quantifiable.

18. Building Construction:
The institute entered into a contract with SPCL, Mumbai on 27.08.2008 for Rs. 278.60 crores with a completion period of 18 months for setting up building and infrastructure at its campus in Valiamala on turnkey basis. As per the note provided by the CMD office the project was delayed due to various unforeseen reasons and the extension of the contract was given up to 31.10.2020 without prejudice to the right of the institute to impose the levy of compensation for the delay. As per clause 2 of the agreement the institute can levy penalty on the works which will have an impact on the accounts. The same could not be quantified due to want of details. As on 31.03.2020, advance amount paid to SPCL towards interim advance amounts to Rs. 12.43 crores. The Institute currently holds the following instruments as security with respect to the contract with SPCL.

Nature of security	Amount (in crores)
Security Deposit – Bank guarantee	12.14
Performance Bank guarantee	12.14
Bank guarantee against Interim Advance	12.43

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
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Schedule 18 :: SIGNIFICANT ACCOUNTING POLICIES AND NOTES TO THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2020 (contd)

19. Figures for the previous year
Figures for the previous year have been regrouped and/or reclassified wherever considered necessary.

As per our report of even date attached

For Samsutheen & Co.
Chartered Accountants
FRN : 013162S

UDIN:20200384AAAABT1011

C.A. M. Samsutheen
(Proprietor, Mem No. 200384)

For and on behalf of
Indian Institute of Space Science and Technology (IIST)

Dr. V. K. Dadhwal
Director

R. Hari Prasad
Finance Officer

Place : Thiruvananthapuram
Date : 6th November, 2020

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST MARCH, 2020

(Amount in Rs.)

Receipts	2019-20	2018-19	Payments	2019-20	2018-19
I. Opening Balance			**I. Expenses**		
a.Cash and DD's in hand	55,351	54,361	**a.Establishment Expenses - Regular**		
b.Bank Balances			Salaries & Allowances (admin & faculty)	29,57,47,968	27,49,84,845
In current accounts	2,22,72,101	7,32,126	Contribution to NPS	2,25,07,395	1,45,89,995
In deposit accounts	27,22,99,687	41,05,78,010	Contribution to CPF	2,68,920	2,68,920
In earmarked/retirement benefits accounts	15,12,58,047	13,01,48,814	Medical Expense- Staff	29,37,813	49,44,333
			Employees Retirement Benefits	27,29,600	43,70,172
II.Grants Received			Interest on PF Contribution	6,10,902	1,97,280
a.From Government of India	90,25,00,000	81,20,85,000	Staff Training Expenses	5,310	13,740
III. Interest Received			**b.Establishment Expenses - Support Services**		
a. On Bank Deposits	84,96,475	1,66,04,800	Consultancy & Manpower Charges	8,73,21,732	8,80,69,059
b. On Other Deposits	0	0	Remuneration to Contract Employees	68,76,348	64,30,833
c. Loans, Advances etc	1,16,158	68,567	CISF Expenses	7,67,64,139	7,43,97,975
d. Others	0	420			
IV. Other Income			**c. Academic & Other Student Expenses**		
a. Entrance Fees	41,59,250	31,61,000	Admission Expense	48,45,251	31,94,785
b. Annual Fees/Subscriptions	3,79,96,270	2,24,35,464	Assistanceship to Students	3,35,24,739	3,43,06,140
c. Other Income	40,51,661	38,39,747	Library Services	2,34,34,853	2,83,55,335
			Academic Expense	5,16,53,114	4,96,72,233
V. Any other receipts			Supplies & Materials	1,49,69,514	1,53,55,609
a. MCF Hassan - ISRO	2,00,000	0	Student Activities Expense	10,83,523	14,66,337
b. Security Deposits received	8,60,097	19,99,573			
c. Earnest Money Deposits received	43,27,493	56,07,698	**d. Other Administrative Expenses**		
d. Performance Guarantee	10,09,681	43,277	Repairs & Maintenance	1,86,87,620	1,50,44,997
e. Advance for Research & Seminars	3,14,53,919	4,27,24,018	Repairs & Maintenance - CMD	3,72,34,316	2,32,47,638
f. BTech Fees refundable to DOS	1,91,33,840	3,11,21,088	House Keeping Expense	8,27,132	8,02,827
g. Caution Deposit from Students	1,98,000	2,81,000	Audit Fees	1,79,950	2,38,950
h. Bond Amount received [Btech]	0	20,00,000	Legal Expense	6,05,247	1,94,821
i. Stale cheques	35,082	96,765	Vehicle Operating Expense	2,15,36,853	2,06,77,550
j. Canteen Accounting Committee	2,25,41,674	2,12,66,125	Electricity & Water Charges	2,76,63,344	3,27,56,451
k. Miscellaneous receipts	0	112	Travelling Expense	66,64,837	61,28,391

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST MARCH, 2020

(Amount in Rs.)

Receipts	2019-20	2018-19	Payments	2019-20	2018-19
l. Interest received and payable to DOS	1,28,11,021	1,61,03,136	Research & Development Expense	1,21,95,754	99,12,300
m. Net addition to Statutory Liabilities(Staff)	1,21,39,768	1,01,12,536	Printing & Stationery	41,20,865	33,64,908
n. Unexplained credits - Banks	38,232	8,16,876	Advertisement & Publicity	5,47,357	6,34,690
o. Tax Collected at Source	0	21,000	Hospitality Expense	29,88,140	34,10,464
p. Recovery of loans to staff	2,88,466	3,43,731	Telephone & Internet Expense	17,05,363	19,02,980
q. Contingency advance	1,26,893	0	Office Expense	24,24,772	25,29,866
r. Increase in TDS, GST & Labour Cess	5,22,391	0	Recruitment & Review Expense	8,56,658	11,29,388
			CEP & IPR Expenses	4,28,017	0
			Compensation Paid	18,45,146	0
			Bank Charges	1,35,950	90,747
			II. Payments made against funds for various projects		
			DOS - Dr. Palash - HSP - Real TIme Gas Sens	10,34,025	0
			DOS - MOM2 - RPA - Dr. Ambili KM	13,56,229	45,79,907
			DOS - Dr. Rajesh V J (Spectral)	4,10,748	3,10,577
			IISU - Dr. Umesh Kadhane - Proj Assistant	1,89,846	1,77,148
			IISU - Perf. of Ball Bearings - Dr. Jinesh KB	36,49,045	7,80,041
			IPRC - Dr. Palash - 2018 - Hydrogen Sensor	8,72,905	10,45,311
			ISRO -Dr. K G Sreejalekshmi -Gaganyaan	50,364	0
			ISRO - MOM - Dr. Rajesh VJ	1,75,645	4,12,909
			LPSC - Dr.Jinesh K B - Laser Ignition System	4,41,971	0
			LPSC - Dr. Jinesh K B - SDS	15,45,345	0
			LPSC - Dr. Umesh K - Monte Carlo Model	1,06,452	5,09,877
			LPSC Dr. Umesh K - Plasma Thruster	1,35,333	94,575
			LPSC - High Thrust EPS - Dr. Umesh K	71,34,201	42,01,318
			SAC - NavIC (IRNSS) Gagan	4,42,237	3,88,935
			DBT - Dr. Palash - 2017- Liquid Biopsy for Can	15,65,812	5,96,318
			DBT - Dr. Shaiju - Ramalingaswami Fellowship	2,37,000	0
			DBT - Dr. Rama Rao N	4,84,807	24,78,163
			DRDO - ARMREB - Dr. K. Prabhakaran	8,55,407	23,69,961
			DST - Dr. Rama Rao N	8,77,623	12,74,976
			Mangrove Cell - Dr. Gnanappazham - 2018	16,01,281	41,56,748

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST MARCH, 2020

(Amount in Rs.)

Receipts	2019-20	2018-19	Payments	2019-20	2018-19
			Max-Planck - Dr. Jagadheep - 2017	7,70,562	4,58,897
			MeitY SAMEER - Dr. Priyadarshnam	28,27,818	9,35,901
			SERB - Dr. Rakesh Kumar Singh	85,215	65,054
			SERB - 2018 - Dr. Anand N. - Baryons	2,74,785	80,071
			SERB - Dr. Resmi L - 2017 - Gamma Rays	2,83,026	6,66,140
			SERB - Dr. Seena V - Nanomechanical Sensor	28,58,318	21,32,924
			SERB - Dr. Jayanthi S	1,47,467	2,82,619
			SERB - 2018 - Dr. Umesh K. - PAH	3,39,097	0
			SERB - Dr. Roymon Joseph	2,52,012	9,53,522
			SERB - 2019 - Dr. Vineeth B S - Wireless ReL	6,01,396	0
			UGC - DAE - Dr. Kuntala B	28,000	3,21,857
			AICTE - INAE - Aswathy RV - 2017	1,45,000	1,80,000
			AICTE - INAE - 2018 Batch	7,18,548	4,41,292
			SERB - PDF - Dr. Krishnaswamy R - 2017	1,74,289	7,85,186
			SERB - PDF - Dr. Linsha Vazhayal - 2017	1,95,849	8,23,395
			SERB - PDF - Dr. Priyanka B - 2017	1,15,323	10,44,489
			KSCSTE - PDF - Dr. Prescilla - 2018	4,31,952	4,74,287
			KSCSTE - PhD - Elizabeth George - 2018	1,29,533	1,77,206
			KSCSTE - PhD - Haritha A - 2018	1,10,000	1,63,119
			AICTE - INAE - 2019 - Nisha	1,10,806	0
			KSCSTE - PDF - Dr. Linsha V - 2019	3,82,433	0
			SERB - TARE - Dr. Santhosh B	0	0
			DST - NRDMS - Dr. Ramarao N.	1,86,781	0
			DAE - NBHM - CSDEA - Dr. Sakthivel	2,00,000	3,00,000
			SERB - DST - National Conference - Dr. Sakth	1,50,000	0
			DAE - ICIAM - Dr. Sakthivel (Travel)	1,92,677	0
			SERB - DST - Dr. Deepak TG (Travel)	1,13,009	0
			SERB - PhD - Aravind G P (Travel)	1,45,560	0
			SERB - PhD - Aryadutt Oamjee (Travel)	1,24,461	0
			SERB - Dr. Chinmoy Saha (Travel)	1,40,546	0
			SERB - PhD - Shashank V (Travel)	65,331	0
			DST Inspire - Dr. Sakthivel	0	4,06,316
			SERB - Dr. Seena V	0	3,75,794
			DST Inspire - Dr. Ambili K M	0	6,94,766

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST MARCH, 2020

(Amount in Rs.)

Receipts	2019-20	2018-19	Payments	2019-20	2018-19
			DOS-SAC- Dr. Rajesh V J	0	78,000
			NBHM-DAE-PDF- Dr. V.Govindraj	0	43,200
			VSSC - Dr. Natarajan E	0	39,290
			DRDO - SASE - Dr. Govindankutty M	7,612	2,16,362
			SERB - PDF - Dr. Ishwar Kumar C - 2017	0	2,52,987
			SERB - INTOPMAA-17	0	20,005
			Hindi Technical Seminar - 2018	0	1,08,000
			ICMST - 2018 - Dr. Prabhakaran K	0	2,00,000
			IPRC- 2018- Jayapal	0	1,00,000
			NCM - 2018 - Dr. Moosath	0	4,48,308
			Sponsorship - Souvenirs	0	1,45,374
			DST - Dr Deepak Mishra - Travel Grant	0	1,32,561
			DST - Sathish Kumar - Travel Grant (Phd)	0	30,000
			SERB - Praveen Krishna - Travel Grant	0	1,41,181
			SERB - Richu Sebastian 2018	0	1,75,924
			SERB - Sudharshan Karthik Travel Grant	0	1,28,417
			LPSC - Dr. Umesh K	0	21,337
			III. Expenditure on Fixed Assets & Capital Work-in-Progress		
			a.Purchase of Fixed Assets	11,40,62,535	11,95,31,662
			b.Expenditure on Capital Work-in-progress	14,87,68,349	3,64,91,547
			IV. Other Payments		
			Security Deposits (Asset) paid	2,21,170	2,32,570
			Security Deposits repaid to Contractors	9,97,824	11,84,923
			Earnest Money Deposits repaid	46,84,370	47,04,758
			Performance Guarantee	8,02,207	98,543
			Contingency Advance to Staff	0	1,59,323
			Loans to staff	37,50,000	19,22,400
			Canteen Accounting Committee	2,03,27,834	1,81,41,764
			Sundry debtors	14,660	11,505
			Stale Cheques - paid	7,67,669	2,05,553

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
THIRUVANANTHAPURAM

RECEIPTS AND PAYMENTS FOR THE YEAR ENDED 31ST MARCH, 2020

(Amount in Rs.)

Receipts	2019-20	2018-19	Payments	2019-20	2018-19
			Decrease in TDS, GST & Labour Cess	0	4,15,329
			Employee recovery - Ex ISRO employees	17,518	29,247
			Tax deducted at source [from IIST]	29,04,671	29,43,593
			Unexplained credits - Banks - transferred	8,35,381	0
			Btech Fees & Interest refunded to DOS	0	14,01,82,237
			MCF Hassan - ISRO	45,330	0
			V. Closing Balances		
			a.Cash in hand	1,30,655	55,351
			b.Bank Balances		
			In current accounts	68,92,166	2,22,72,101
			In deposit accounts	24,24,39,005	27,22,99,687
			In earmarked/retirement benefits accounts	15,98,28,089	15,12,58,047
Total	1,50,88,91,556	1,53,22,45,245	Total	1,50,88,91,556	1,53,22,45,245

Significant Accounting Policies & Notes on Accounts 18

As per our report of even date attached.

For Samsutheen & Co.
Chartered Accountants
FRN : 013162S

C.A. M. Samsutheen
(Proprietor, Mem No. 200384)

For and on behalf of
Indian Institute of Space Science and Technology (IIST)

Dr. V. K. Dadhwal
Director

R. Hari Prasad
Finance Officer

Place : Thiruvananthapuram
Date : 6th November, 2020

Design & Print: IIST Library

Version :13

IIST-129-IP-E-11-2020

Indian Institute of Space Science and Technology

Declared as Deemed to be University under Section 3 of the UGC Act, 1956

An autonomous institute under Department of Space, Govt. of India

Valiamala P O, Thiruvananthapuram - 695 547, Kerala

www.iist.ac.in