INFORMATION BROCHURE

Masters in Technology (M.Tech)

DEPT. OF AVIONICS

INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY

THIRUVANANTHAPURAM
KERALA, INDIA

ADMISSION LINK

http://bit.ly/iist_adm

www.iist.ac.in

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ABOUT THE INSTITUTE

Indian Institute of Space Science and Technology (IIST) established in 2007, and situated at Thiruvananthapuram, Kerala, is a Deemed to be University under Section 3 of the UGC Act, 1956. IIST, functions as an autonomous institution under the Department of Space (DoS), Government of India. IIST was conceived with a vision to nurture exceptional manpower for the Indian Space Research Organization (ISRO), one of the world's leading scientific organizations engaged in space research and space applications. 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 in areas with special focus towards space sciences, space technology and space applications. Equipped with excellent infrastructure and about 100 highly qualified faculty members, IIST has, within a decade of its inception, risen to great heights. It was ranked among the top 30 Engineering institutes of the country according to 2020 NIRF rankings of MHRD with a high score of more than 75% in Teaching, Learning and Resources; a score much better than many premier institutes in the country. The institute currently offers three undergraduate and fifteen postgraduate programmes that are listed below.

ABOUT THE DEPARTMENT

a. Vision Statement

To be globally recognized for being at the forefront of innovation in higher education and research for empowering students in Avionics and allied areas to contribute significantly to the benefit of the society at large and Indian space science and technology.

a. 1 Mission Statement

- Inspire and educate our undergraduate, postgraduate and doctoral students and impart deep understanding of Electrical, Electronics and Communication, Computing and related areas.
- Nurture the spirit of innovation and creativity among students and contribute to cutting-edge the growth of the nation through excellence in teaching, research and development following ethical practices.
- Develop skills in design and building of systems that impact society and space technology.
- Continue to collaborate and establish a peer-to-peer network with

institutions and industries of national and international repute.

b. Brief Description of the Avionics Department

The department of Avionics at the institute was established in the year 2007. The department offers graduate courses in Electronics and Communication Engineering (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/Computer Science Engineering. The curriculum of various academic programmes in the department of Avionics 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 houses excellent faculty members with proven research backgrounds. The department has established various laboratories where research and experiments were undertaken.

The department is undertaking futuristic research in areas related to various areas of Electrical and Electronics Engineering, Computer Science, Space Science and Technology etc. All graduate/post graduate students from the department will have excellent opportunities to build their career in various leading public and private organizations including ISRO/DoS through institute/department placement assistance. The department houses a well-organized academic and research programme supported with lab facilities comparable with the world class institutions and is provided to achieve excellence in the field of electronics, in particular to the Space Science and Technology and to meet the National requirements in the field of Science and Technology.

UG/PG/PhD Students in the department of Avionics get an inspiring opportunity to be a part of various IIST-ISRO collaborative/other funded projects and other institute level space activities. Several of our students are contributing significantly to various small satellite and payload development activities undertaken at Institute level.

M.TECH. PROGRAMS OFFERED BY THE DEPARTMENT

Postgraduate Programmes

1. M.Tech. in RF and Microwave Engineering
2. M.Tech. in Digital Signal Processing
3. M.Tech. in Control System
4. M.Tech. in VLSI and Microsystems
5. M.Tech. in Power Electronics

MESSAGE FROM THE HEAD OF THE DEPARTMENT

Welcome to the Avionics Department at IIST Trivandrum. We started our journey in the year 2007. Over the last 14 years, we have grown our expertise and competence in the core of Avionics (which is a perfect blend of Electronics Communications, Electrical and computer science engineering) curriculum and research.

We have a strong undergraduate program in Electronics Communications engineering (Avionics). At the postgraduate level, we offer M. Tech., and PhD degrees. The department offers post graduate courses (M.Tech.) in RF and Microwave Communication, Digital Signal Processing (DSP), Control Systems, Power Electronics, and VLSI & Microsystems. The sanctioned students' strengths of B. Tech., and M. Tech., are respectively 66 and 50 per year. At present, the department has 50+ Ph.D scholars. Several sponsored candidates from ISRO and DoS carry out their post-graduate studies in our department. Besides this, our department is always eager to host postdoctoral fellows.

Our department offers a science-based engineering curriculum. The primary focus of our curriculum is to impart technical know-how to students, promote their problem-solving skills and innovation of new technologies. The department offers a large number of cutting-edge elective courses for providing a wide spectrum of options to the students to pursue their interests. The course contents are periodically updated for introducing new scientific and technological developments. Undergraduate students are encouraged to undertake various research projects.

Our department maintains active research groups for carrying out collaborative and interdisciplinary research. Furthermore, the majority of our research is in collaboration with the Indian Space Research Organization and the Department of Space. Within our department, we have developed important state-of-the-art research facilities to support our academic programs and research. We use all the available funding for research to help us to maintain and modernize our research infrastructure. Our department has a distinguished record in both teaching and research. Faculty members have excellent academic credentials and are highly regarded. They have been conferred with many prestigious awards at national and international levels. Several faculty members serve on the editorial boards of national and international journals, regularly review technical articles for journals, and organize international symposia and conferences.

This Institute's/Avionics department's website provides an overview of the academic programs, research activities of our department, research facilities, profiles of faculty members, and details of student activities. We hope that whether you are a prospective undergraduate or graduate student, or work in industry, or another university, or a visitor, you will find this website to be informative.

Finally, I would like to reiterate that the avionics department possesses a forward-looking academic environment. A very strong linkage is always encouraged amongst various PG programs in the department. Furthermore, a strong Interdisciplinary research environment and Research collaborations involving faculty/scientists/students from different fields have emerged as innovative steps in the growth of the department. The existing research and post-graduate programs are supported by lab facilities comparable with the world-class institutions. If you join our department you will have an ample opportunity to contribute towards various societal needs and in particular to Space Science and Technology.

If you have further questions after browsing IIST/Avionics Department's website, please do not hesitate to contact us. You may also correspond with individual faculty members, or contact them by email, using the addresses shown on the faculty pages. Our department strives to address the challenges of society through the judicious application of technology. Thank you for your interest in joining IIST.

Best wishes,

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LIST OF CLUBS AND TECHNICAL SOCIETIES

1. Robotics club
2. AI-ML Club
3. SSPACE
4. IEEE Students branch
    a. Antenna Propagation
    b. Industry Applications Society
    c. MTT Society
    d. GRSS

M.TECH. IN RF AND MICROWAVE ENGINEERING

6.1 Overview

The M.Tech. in RF and Microwave Engineering programme under the department of Avionics is a unique two-year course designed with a specific focus of the state of the art industry requirements, Government R & D Laboratories, and higher education. The course curriculum under the programme is designed in a well-balanced manner to equip the students with fundamental courses along with advanced ones in the niche area of Advanced Electromagnetics, Antenna technology, Microwave and MM-wave circuits and THz Technology.

There are ample opportunities for the students to pursue advanced research through integrated components of the curriculum like, course-based mini-projects, Engineering Design, Seminar Presentation on the latest trends as well as extensive projects work running for two full semesters. Thanks to the availability of the well-equipped antenna fabrication facilities and high frequency measuring instruments in the laboratory, students get ample exposure to 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.

Due to strong association and collaboration with various centres and laboratories of Indian Space Research Organization (ISRO), students get opportunities to work in various live projects catering to the space antennas, mm-wave and THz antennas, Internet of Things testbeds, and circuits, etc. in various ISRO centers and industries. Above Figure shows the glimpses of some of the research equipment/facilities along with a few selected prototypes developed by the M.Tech RF and Microwave Engineering students under the

supervision of the faculty members of the group.

Figure: Glimpses of the selective major equipment and devices/antennas/system realized by the M.Tech. in RF and Microwave students at IIST

6.2 Faculty Profile

	**Dr. Basudeb Ghosh** Computational Electromagnetics, Fractal Electromagnetics, Waveguide Passive Components, Aperture Antennas, Frequency Selective Surfaces (FSS), Electromagnetic Band Gap (EBG) structures, Substrate Integrated Waveguide (SIW).
	**Dr. Chinmoy Saha** Planar Microwave circuits and systems, Wireless Power Transfer, Energy Harvesting, Feed Antennas for SatelliteTracking Applications, Split Ring Resonators and their applications, Engineered Left Handed Materials, Metamaterial, Printed Antennas, Ultra Wide band (UWB) antennas, Multifunctional Antennas, THz Technology, Bioelectromagnetics and Biomedical Engineering
	**Dr. Basudev Majumder** Planar Antenna and passive system design, Application of Metamaterials and Metasurfaces in Antenna DesignReconfigurable Antenna Design, Broadband Negligibly Loss Metamaterials and design of Frequency Selective Surfaces.
	**Dr. Immanuel Raja** Analog, mixed-signal and RF IC Design, millimeter-wave CMOS IC design, analog/mixed-signal subsystems for space applications.

6.3 Program Objectives

- Impart quality education in the area of RF and Microwave

Engineering with equal emphasis in understanding of the fundamental and advanced concept and its application in the applied electromagnetics.

- Equip the students with ample practical knowledge and exposure on various technologies associated with the field of RF and Microwave Engineering through course based seminars, advanced laboratories, course projects, design projects, industry internships as well as final year projects.
- Enable the student to have a successful academic/research or industrial career in the area of RF and Microwave Engineering.
- Produce quality human resources and successful professionals

6.4 Important Laboratories

RF and Microwave Research group of the department has established following laboratories to cater to the teaching, learning and research requirement of the students and faculty members:

- Advanced Microwave Lab

This laboratory deals with the design, development and characterization of microwave circuits. The laboratory is equipped with microwave circuit simulators, computational facilities and advanced measuring instruments upto 40 GHz.

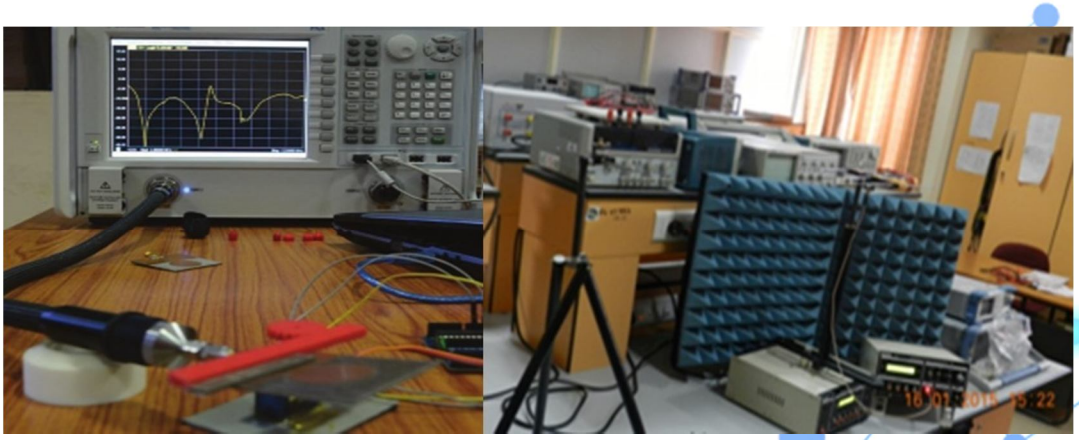

Figure: Characterization facility at advanced microwave laboratory, Avionics, IIST

- Advanced Antenna Fabrication and Characterization Lab

This laboratory deals with the design, development and characterization of various types of antennas for microwave and mm-wave applications. The laboratory is equipped with various EM solvers, circuit simulators, antenna fabrication facility,computational facilities and advanced measuring instruments upto 40 GHz. The lab is currently getting equipped with an anechoic chamber upto 40 GHz.

Following are major equipments in these laboratories:

- Computational Facility
- EM/Circuit Simulators: Ansoft's HFSS, CST, ADS
- Antenna Fabrication Facility: Mechanical (Drilling and Milling) based PCB facility
- Characterization Facility (S-parameters): Upto 40 GHz
- VNA (Agilent PNA-X N5224A)
- Spectrum Analyzer (upto 40 GHz)
- Signal Generator (upto 40 GHz)

6.5 Student Project and Research Opportunities

Students of M.Tech. RF and Microwave Engineering undergo compulsory projects distributed over the 3rd and 4th semesters of their curriculum. Based on the interest of the students, various projects in the area of microwave, mm-wave and THz technology and diversified applications are offered to the students. Along with projects offered by the faculty members, students get opportunity to pursue their project in R&D projects funded by external agencies, industry and various centres of ISRO, such as, URSC, Bangalore, SAC, Ahmedabad, SCL, Chandigarh, NRSC, Hyderabad etc.

6.6 Career Opportunities

Well planned courses and knowledge/skill-sets developed through integrated components of the curriculum like, course-based mini-projects, Engineering Design, Seminar Presentation on the latest trends as well as extensive projects work running for two full semesters help the graduates in the discipline in becoming successful professional in the area of RF and Microwave Engineering. Students can take a successful career in research & developments in Government Labs, industry etc. or pursue higher studies in an Institute of international repute.

6.7 Selection Procedure

Students in the discipline are selected based on, i) GATE score or ii) GATE score followed by an interview before an expert panel. In 2021 selection of the students will be based on GATE score only.

Follow the institute website for more information.

6.8 Placement and Higher Education

More than 65% of the alumni of M.Tech. in RF and Microwave have been placed and currently working in different reputed organizations (selective):

- Ansys , Bangalore, India
- Mercedes-Benz, Bangalore, India
- Mathworks
- COMSOL Multiphysics, Bangalore, India
- Astra Microwaves , Hyderabad, India
- Asarva Chips and Technologies Pvt. Ltd., Bangalore, India
- TeamIndus, Bangalore, India
- Honeywell, India and Canada
- NEST Technology, Trivandrum, India
- BPL Medical Technologies, Bangalore, India
- Space Application Centre, ISRO, Ahmedabad, India
- UR Rao Satellite Centre,ISRO, Bangalore, India
- SatishDhawan Space Centre (SDSC), ISRO, Sriharikota, AP, India
- Raman Research Institute, Bangalore, India
- NIT Surathkal, India
- Shivaji University, Kolhapur, Maharashtra

Till date 27% of the graduates from the RF and Microwave Engineering Students have opted for higher education at premier Institutes across India and abroad. A selective list is as follows:

- Indian Institute of Space science and Technology, Trivandrum, India
- University of Waterloo, Ontario, Canada
- IMEC Leuven, Belgium
- Curtin University, Perth, Australia
- IISC Bangalore, India
- Indian Institute of Technology Madras, India
- Indian Institute of Technology, Hyderabad, India

6.9 Recent Student Awards

Graduates of M.Tech. in RF and Microwave Engineering students have received several best paper awards in prestigious International conferences and International Travel support awards from DST, Government of India. Following are list of the awards received over last few years:

- A research paper titled "Dual-Band Flat-Top Pattern Synthesis Using Phase Gradient Metasurface" authored by **Mr. Vinod Kumar P** has been awarded the Best student paper award sponsored by International Symposium on Antennas & Propagation (APSYM 2020), Organized by The Department of Electronics,Cusat,December 14 - 16 , 2020.

- **Ms. S. Keerthipriya,** M.Tech , RF and Microwave Engineering, Avionics under the supervision of Dr. Chinmoy Saha has been awarded prestigious 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 titled "Reconfigurable Multifunctional Vivaldi MIMO Antenna for Cognitive Radio Applications'' authored by S. Keerthipriya and Dr. Chinmoy Saha. The award constitutes a certificate, plaque and a cash prize of Rs.5000.

- **Ms. S.Keerthipriya,** M.Tech (RF and Microwave Engineering) was awarded the International travel support Award by AICTE-INAE for presenting her paper titled “Dual Tunable Multifunctional Reconfigurable Vivaldi Antenna for Cognitive/Multi-Standard Radio Applications” co-authored by Dr. Chinmoy Saha, Dr.Jawad Siddiqui and Dr.Y.M.M.Antar, in the IEEE International Symposium on Antennas and Propagation and USNC-URSI Radio Science Meeting, held at Atlanta, USA during July 7-12, 2019. A total amount of Rs.1 Lakh constituting the Registration fees, Visa fees and partial air-fare was awarded for her participation.

- **Ms. S.Keerthipriya** M.Tech , RF and Microwave Engineering, Avionics under the supervision of Dr.Chinmoy Saha has been awarded best paper award in Technical Session T-6 of IMICPW-2019 (International Conference on Microwave Integrated Circuits, Photonics, and Wireless Networks) held at NIT-Trichy during May 22-24,2019 for the paper titled "Tunable Multifunctional Reconfigurable Step Profiled Dielectric resonator Antenna for Cognitive Radio Applications"

authored by S.Keerthipriya and Dr. Chinmoy Saha.

- Research paper titled “Dual Band (S/Ka) Composite Dual Polarized Monopulse Feed for LEO Satellite Tracking” authored by SS Roy, **Chinmoy Saha**, S.Mane, T. Nagasekhar, G. Umadevi and CS Padmavathy have been awarded the Best Paper Award in IEEE INCAP 2019 (in Antenna Application Category) , held during Dec 17-20, 2018 at Hyderabad, India.

- **Mrs. Elizabeth George,** Senior Project Fellow under the supervision of Dr. Chinmoy Saha, RF and Microwave Research Group, Department of Avionics, IIST has been awarded Best Paper Award in the technical section-T8 of iAIM 2017(International Conference on Antenna Innovations & Modern Technologies for Ground, Aircraft and Satellite Applications) held at Hotel Sterling Mac, Bangalore, India on 24-26 November 2017 for the paper on "Boresight Gain Enhancement of Dielectric Resonator Antenna using Metasurface Lens" authored by Kaushik Kannan, Elizabeth George, Dr. Chinmoy Saha and Dr. K.P.Surendran.

- Faculty awards can be seen from the faculty profile pages at https://www.iist.ac.in/departments/people/46

6.10 Research Projects

Microwave and mm-Wave Circuits/Systems

- Realization of Various Passive Building Blocks and Antennas for THz communication using Silicon Micromachining.
- Design of Millimeter Wave Passive and Active Non-linear Circuits for Front End RF Receiver Module at 183.31 GHz for Humidity Sounding Application.
- Design and Development of a Monolithic C-Band IQ Modulator using UMS Foundry for Synthetic Aperture Radar (SAR) Applications
- Design of Cascadable S-band Amplifier using Tunable Equalizer
- Design and Development of Terahertz Photoconductive Antenna
- Millimeter Wave SIW Based LTCC System-In-Package for Space Applications
- Wideband Highly Linear Variable Gain Amplifier With Telecommandable Gain Control For Ku Band Reconfigurable Communication Payload
- Design and Analysis of Various Su-8 Micro Structures for On/Off Mems Switch in RF Applications

Antennas and Space Application

- Design of Multifunctional Reconfigurable Antennas for Cognitive Radio Applications
- Antennas for mm-wave 5G Applications (Base station and Cell phone)
- Design of Bowtie Phased Array MIMO Antenna for 5G Applications
- Design of Integrated Tri-band (S-X-Ka) Monopulse Auto Tracking feed for Satellite Data Reception
- Film Bulk Acoustic Resonator: Design and Analysis for 2.4 Ghz Applications
- Design and Implementation of S-Band Microstrip and Dielectric Resonator Antennas for Space Applications
- SIW Based DR Antennas for mm Wave Applications

Metasurface and Applications

- Metamaterial Inspired Antennas and Circuits
- Metamaterial Inspired Printed Antennas with Improved Radiation Performance
- Analysis and Design of Phase Gradient Metasurface Reflectarray Antennas
- Three Port Antenna Design Using Theory of Characteristic Modes
- Microwave Imaging Applications in Dielectric Characterization and Real Time Imaging
- Wireless Power Transfer and Energy Harvesting

6.11 Selected Recent Publications

Faculty members and students of the RF and Microwave research group regularly publish various high quality articles in reputed journals like IEEE Transaction on Antennas and Propagation, Microwave and Optical Technology Letters, IEEE Access, IET Microwave Antennas and Propagation etc. and conference proceedings.

Following are list selected list of publications by the group over last few years:

a. Book Published:

- **Dr. Chinmoy Saha**, Dr. Jawad Y. Siddiqui and Dr. Yahia M.M. Antar, "Multifunctional Ultrawideband Antennas: Trends, Techniques and Applications", Taylor and Francis, 6000 Broken Sound Parkway , NW, Suite 300, Boca Raton, Florida 33487,USA (April 2019, ISBN: 9781138553545).

- **Basudeb Ghosh**, Sachendra N. Sinha, M.V. Kartikeyan, "Fractal Apertures in Conducting Screens, Waveguides, and Antennas: Analysis and Design," Springer Series in Optical Sciences, Vol. 187, Springer–Verlag, Berlin–Heidelberg, Germany, 2014 (ISBN 978–3–319–06534–2)

b. Journal Papers published

- Sandip Sankar Roy, **C. Saha**, M Naresh Kumar and D.Sarkar "Circular Split Ring Resonator (C-SRR) Array Integrated Frequency-Notched Horn-Filtenna with Wide and Strong Rejection Band" IEEE Access vol. 9, pp. 52664-52671, 2021.
- **P. Vinod Kumar and Basudeb Ghosh**, " Characteristic mode analysis of linear to circular polarization conversion metasurface", Journal of Electromagnetics, vol 20, No. 8, pp. 605-612, 2020.
- Aneesh K.R, **C. Saha**, J. Pollock and A. K. Iyer "Analytical and Numerical Investigation of Radiation Enhancement by Anisotropic Metamaterial Shells" IEEE Access, vol. 8, pp. 2983-2994, 2020.
- Sandip Sankar 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.
- **C. Saha, L.Ahmed**,.R. Muntha, Y. M.M. Antar and J.Y. Siddiqui, "A dual Reconfigurable Printed Antenna: Design Concepts and Experimental Realization" IEEE Antennas and Propagation Magazine ,Vol. 60, issue 3, pp- 66-74, June 2018.
- **L.Ahmed, C. Saha**,Y.M.M. Antar and J.Y. Siddiqui, " An antenna advance for Cognitive Radio: Introducing Multilayered Split Ring Resonator Loaded Printed Ultra-Wideband Antenna with Multi-Functional Characteristics" IEEE Antennas and Propagation Magazine , Vol. 60, issue. 2, pp 20-33, March 2018.
  Full publication list can be accessed here: https://www.iist.ac.in/departments/people/46

6.12 Contact Us

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M.TECH. IN DIGITAL SIGNAL PROCESSING

7.1 Overview

The M.Tech in Digital Signal Processing (DSP) programme is a two-year graduate course offered to students who are passionate about the field of signal processing and allied fields such as communication systems, image processing, machine learning for signal processing, and computer vision. Students in this course are instructed by experienced faculty in fundamental subjects such as probability and random processes, estimation and detection, linear algebra, advanced signal analysis, pattern recognition, and machine learning. These fundamental subjects enable students to proceed seamlessly to advanced courses in signal processing, communication systems, deep learning, computer vision and Internet of Things which are offered in the programme.

The DSP programme also offers elective courses in cutting edge subjects such as Reinforcement Learning and Control and Internet of Things. This course experience enables the students to carry out research and development activities in digital signal processing, communication systems, machine learning as well as allied fields. It also prepares them for industrial jobs in such fields.

7.2 Faculty Profile

	**Dr. Deepak Mishra** Computer vision, Image processing, Deep/Machine learning, Signal processing, Information Security and Biometrics, Mathematical Modeling (related to Computational Neuroscience).
	**Dr. Manoj B.S** Computer Networks, Internet, Internet Security, Next Generation Internet, Wireless Networks, Ad hoc wireless networks, Wireless Mesh Networks, Cognitive Networks, Sensor Networks, Giant Scale Computing, and Future Networked Systems.
	**Dr. Sheeba Rani J** Computer Vision and pattern recognition, Image analysis and Understanding. Design and performance evaluation of hardware solutions for signal and image processing techniques Digital VLSI Design
	**Dr. Vanidevi M** Hybrid beamforming for millimeter-wave communication,Massive MIMO Channel Estimation,MIMO OFDM signal processing and Communication Aspects,Underwater Acoustic Communication-OFDM,Multiuser detection in Sparse Code Multiple Access, LDPC Channel coding, Anti Spoofing algorithm for IRNSS receiver

	**Dr. Lakshmi Narayanan R** Statistical signal processing-estimation theory
	**Dr. Chris Prema S** Digital Signal Processing, Multirate Signal Processing, Digital Communication, Image processing, Cognitive Radio, 5G Communications
	**Dr. Vineeth B.S** Applied probability, stochastic processes with applications in sequential decision making.

7.3 Program Objectives

- Impart a fundamental understanding of the field of digital signal processing through theoretical courses in this area
- Impart a practical understanding of the various technologies associated with the field of digital signal processing through laboratories, course projects, design projects, industry internships as well as final year projects.
- Enable the student to have a fruitful academic or industrial career in digital signal processing or allied fields

7.4 Important Laboratories

The M.Tech in DSP programme also offers the students hands-on experience in various subjects through laboratories in digital signal processing, communication systems, machine learning, artificial intelligence, computer networks and systems, and computer vision. Our labs are well equipped with software-defined radios, MIMO evaluation kits, spectrum analyzers, RF signal generators, digital signal processing boards, sensor network modes, and network development kits, to name a few.

For machine learning related projects, high performance workstations with state of the art GPU facilities are available in the multidisciplinary computing center. Our real-time digital signal processing laboratory is equipped with software such as Visual DSP, Code Composer studio, Xilinx system generator tools and multiple processor kits such as TMS320C6713, TMS320C6455, TMS320C2812, TMS320DM355 and ADSP-21369. Image processing as well as virtual reality based research is carried out in the Virtual Reality lab which is equipped with 3D monitors as well as 3D vision pro glasses.

A few representative pictures of the labs are given below.

Figure: (clockwise from top left), Digital Signal Processing Laboratory, Communication Systems Laboratory, Virtual Reality Laboratory, Systems and Networks Lab

7.5 Student Project and Research Opportunities

The students have ample opportunities for developing and honing their research skills. With an innovative design project in their second semester a student in the M.Tech DSP programme can start working on a project of their choosing or as part of a faculty's research programme. This is followed by a summer design project as well as a final year project. The students have opportunities to work along with faculty members of the DSP programme or any other faculty member in IIST in a project which is meant to push the state-of-art in DSP or related fields.

7.6 Career Opportunities

The rigorous study enables the M.Tech in DSP students to participate competitively in current research activities, development projects, and pursue higher studies. The students work on various research projects in association with several centers of ISRO such as URSC, IISU, NRSC, and VSSC. They also get opportunities to work in collaborative projects with other institutes such as IIT. The two-year programme also offers ample opportunities for developing industry-specific skills through an innovative design project, summer internship, and final year project.

7.7 Selection Procedure

Applicants are first shortlisted based on their GATE score. Shortlisted candidates are then selected by an interview before an expert panel.

7.8 Placement and Higher Education

To date, 25% of our students have been ISRO employees who have joined the DSP programme for further training or have been placed in ISRO after their graduation. Of the rest of the students, 58% have been placed or have had internship opportunities in PSUs, industries, and research organizations such as:

- NPOL (DRDO),
- IES (Railways),
- Analog Devices,
- Mathworks,
- Team Indus,
- Mercedes Benz,
- Tata Consultancy Services (Research and Development),

- Subex,
- Flytxt Mobile Ltd. KPIT.

After graduation, 24% of students (non ISRO employees) have or are pursuing higher studies in universities and institutes such as:

- Indian Institute of Science,
- Indian Institute of Technology (Bhubaneswar),
- Indian Institute of Technology (Madras),
- Indian Institute of Technology (Kharagpur),
- Georgia Institute of Technology, Atlanta.

7.9 Recent Student Awards

Students from M.Tech in DSP have received the prestigious INAE best project award, and best paper awards for their work. Some representative awards are:

- The project on “Computationally Efficient Deep Tracker: Guided MDNET” done by Ms Pallavi Venugopal M has been conferred an Innovative Student Projects Award 2017 from The Indian National Academy of Engineering (INAE).

- The paper "Graph Fourier Transform Based on Directed Laplacian" authored by Rahul Singh, Abhishek Chakraborty, and B. S. Manoj has been awarded the Best Student Paper Award sponsored by Springer at the 11th International Conference on Signal Processing and Communications 2016 (SPCOM 2016)

- Faculty awards can be seen from the faculty profile pages at https://www.iist.ac.in/departments/people/46

7.10 Research Projects

a. Machine learning/Deep Learning/Reinforcement Learning/Robotics

- Object based high resolution (optical) image analysis for landslide and land use land cover classification
- Design, Modelling and Implementation of deep neural networks for automatic landslide detection and susceptibility mapping
- Development and Analysis of Image Fusion Techniques for Satellite Images
- Object Based High Resolution Image Analysis for the LandSlide

and Land Use Land Cover Classification
- Developing of Virtual reality model for disaster simulation
- Deep learning application for Multi object and single object tracking

b. Communication, Radar Systems, and Networks

- Development of a low complexity modulated wideband converter for sub-Nyquist wideband spectrum sensing
- IIST Mesh Net: A Programmable Hybrid Wireless Mesh Network Testbed
- Real time algorithms for track estimation for Multi Object Tracking Radar
- Optimal Scheduling and Routing of Packets over Delay Tolerant Hierarchical Interplanetary networks
- Indo-US collaborative Research on Pervasive Computing for Disaster Response
- MICRONet – Mobile Infrastructure for Coastal Region Offshore Communications & Networks
- Research and Development of an Integrated Enterprise Network Security System
- Decoder for CCSDS Recommended Turbo Codes
- Design and Development of NavIC receiver
- RapidMAC: Development of a rapid prototyping software for multiple access protocols
- Wireless ReLoD - Wireless Reliable, Low Latency Networks for IIoT and FieldBus replacement

c. Robotics

- Mechatronic Design of Adult sized Humanoid robot
- Visual Servoing
- Visual control of robotic arm

7.11 Selected Recent Publications

Some representative recent journal publications with M.Tech students as lead authors:

- Minimol, Pallavi Venugopal, **Deepak Mishra**, and RK Sai Subrahmanyam Gorthi. "Guided MDNet tracker with guided samples." *The Visual Computer* (2021)

- Deevi, S. A., Kaniraja, C. P., Mani, V. D., Mishra, D., Ummar, S., & Satheesh, C. (2021). HeartNetEC: a deep representation learning approach for ECG beat classification. *Biomedical Engineering Letters*, *11*(1), 69-84
- **John, Soumya Sara**, **Deepak Mishra, and Sheeba Rani Johnson.** "Retraining a Pruned Network: A Unified Theory of Time Complexity." *SN Computer Science* 1.4 (2020): 1-8
- Kandi, H., Jain, A., Chathoth, S. V., Mishra, D., & Subrahmanyam, G. R. S. (2019). Incorporating rotational invariance in convolutional neural network architecture. *Pattern Analysis and Applications*, *22*(3), 935-948.
- Mounika K.J, **Sheeba Rani J**, Govindan Kutty, G.R.K.Sai Subrahmanyam,"Consistent Robust and Recursive Estimation of Atmospheric Motion Vectors From Satellite Images," IEEE Transactions on Geoscience and Remote Sensing Volume: 57,Issue 3, March 2019.

7.12 Contact Details

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M.TECH. IN CONTROL SYSTEMS

8.1 Overview

M.Tech in control Systems is a unique two-year interdisciplinary master's program designed to provide due weightage for both R&D as well as Industrial sectors. This well-structured and focused M.Tech programme gives a comprehensive exposure to students in a wide area of control systems theory and practice. Senior scientists of ISRO who had been involved in the development of control systems for ISRO launch vehicles and satellites are also serving as adjunct/ guest faculties in the control group.

Courses in this program range from fundamental topics like classical control design techniques to advanced topics like nonlinear control theory, optimal control design, etc. These courses are backed with design projects in embedded systems and control. Further, students are exposed to the application of control theory in the field of launch vehicles, spacecraft, and robotics as part of their elective courses. As part of their final year project, students get an opportunity to work with cutting edge technologies in the field of robotics, spacecraft attitude control, biomedical engineering, UAVs, etc

8.2 Faculty Profile

	**Dr. Sam K. Zachariah** -Locomotion Control of biped and quadruped robots -Modelling, Control and Simulation of robotic manipulators -Configuration design, modelling and control of electromechanical and electro hydraulic actuation systems -Digital Autopilot Design for Aerospace vehicles

	**Dr. N.Selvaganesan** System Identification and Adaptive Control,Fractional Order Control,Fault Detection and Diagnosis
	**Dr. Rajesh J. Abraham** Control Systems and its Applications, Robust Control and Applications
	**Dr. Priyadarshnam** Control system, Spacecraft Control, Small satellite space mission design, On-board computers, and payload design for small spacecraft.
	**Dr. Harsha Simha M.S** Nonlinear Dynamical Systems and Control with applications to Spacecrafts and Unmanned Aerial Vehicles
	**Dr. Anoop C.S.** Measurements and Instrumentation, Interface Electronics, Direct-Digitizers, Analog Signal Processing

8.3 Program Objectives

- To develop mathematical and analytical skills required for modelling and analysis of linear and nonlinear dynamical systems through systematic course works.

- To build up competence in controller design and hardware implementation for benchmark control problems through course projects, seminars, and laboratory experiments,
- To build up expertise in mathematical modelling and performance analysis of multidisciplinary engineering systems through elective courses, industry internships, and final year projects.
- To bring up professionally qualified and research oriented control engineers to develop state-of-the-art control methodologies to solve real world control problems.

8.4 Important Laboratories

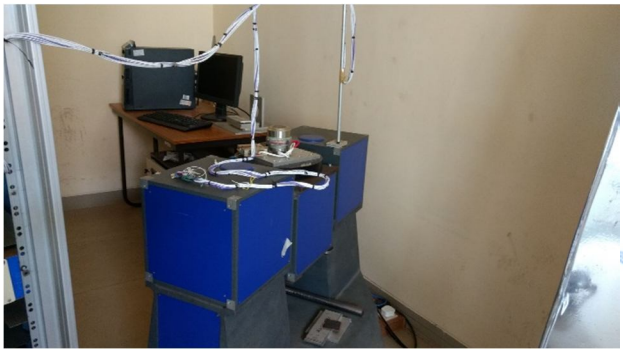
Control System Laboratory

Navigation System and Instrumentation and Measurement Laboratories

This lab was set up to provide hands-on training in the field of navigation Systems and sensors. Various experiments like calibration of inertial sensors such as servo accelerometers, MEMS accelerometers, Dynamically Tuned Gyroscopes, MEMS gyroscopes are performed in the lab. Navigation system level tests such as rate test, multi-position test, all attitude test, Hardware in loop tests are planned to be carried out in this lab. In addition, provisions for carrying out the simulation of

an inertial navigation system are provided to impart training on different navigation algorithms in different navigation frames.

Major equipment such as servo accelerometer check-out system, DTG check-out system, 2-axis Angular Motion Simulation set up, 3-axis dividing head setup are available in the lab. Further, Navigation System packages which are used in the PSLV, GSLV Mk-3 are available for demonstration in the lab. Significantly, the lab has one of the first few deployed IRNSS receivers across the country, and two portable IRNSS receivers and ISRO-SAC in-house developed IRNSS simulator. This gives focus on satellite navigation receiver design for GPS, IRNSS (NAVIC) etc.



Satellite attitude control test setup

Small-spacecraft Systems and PAyload CEntre (SSPACE)

Small-spacecraft Systems and PAyload CEntre (SSPACE) is an interdisciplinary centre involved in the development of satellite systems and mainly driven by students and faculty of IIST. The SSPACE center is involved in realisation of payloads, related electronics, small satellites, assembly,integration, testing and ground station to carryout mission operations. SSPACE at the moment is involved in the following missions

- **ARIS-2** (Advanced Retarding potential analyser for Ionosphere Studies): This is a 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.
- **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.

- **PILOT** (**P**slv **I**n-orbita**L** **O**bc and **T**tc): This is an offshoot of AHAN where the subsystems developed for AHAN mission will be tested in the PS4 stage prior to the flight. The subsystem designs were completed during this period and are awaiting integration and testing.

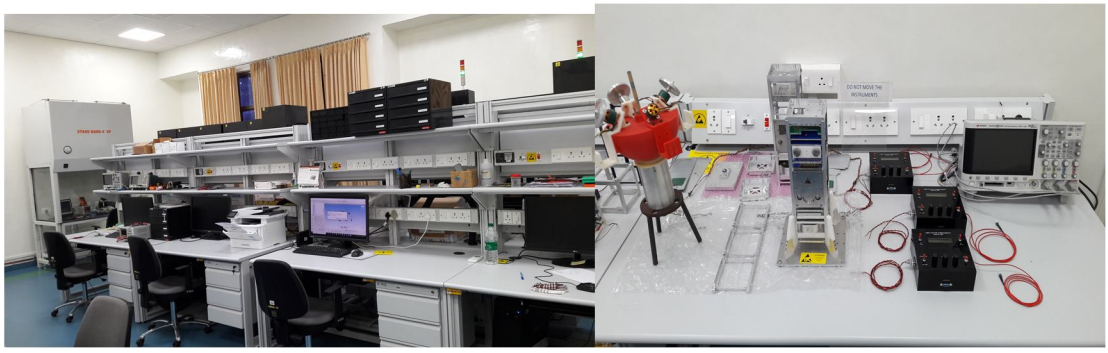
- **InspireSat1:** This is a student satellite developed as part of international collaboration with **L**aboratory of **A**tmosphere and **S**pace **P**hysics (**LASP**), **University of Colorado, Boulder**. During this period, the satellite was integrated and is awaiting testing at LASP.

- **AAReST** (Autonomous Assembly of Reconfigurable Space Telescope): 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 University of Surrey, UK.

- **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.

- **RPA for Venus:** The ionosphere of Venus will be studied by an RPA being developed for the Venus mission.

SSPACE Ground Station and Operational Antennas



SSPACE Electronics Fabrication Laboratory

8.5 Student Project and Research Opportunities

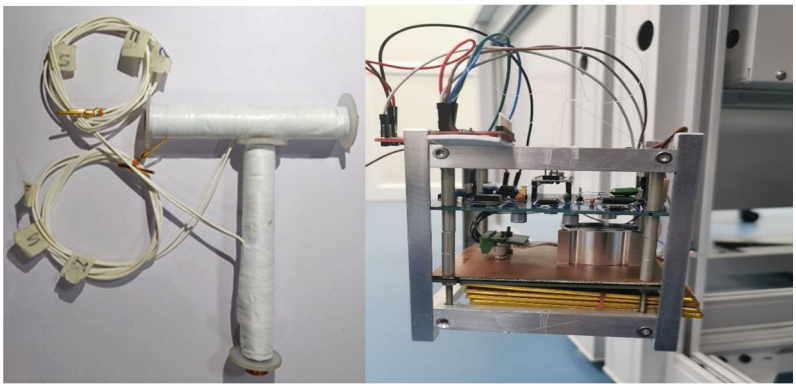
The M. Tech students have ample opportunities to do internships and projects related to the advanced research projects undertaken by the faculties of the control group. The list of a few such projects is given below:

- Control system development for the half humanoid Vyommitra to be launched by ISRO to function on-board the Gaganyaan, a crewed orbital spacecraft.
- Configuration design and Control system development for a human mimetic general-purpose humanoid, an advanced R&D project initiated by ISRO as a part of Vision-2030.
- Mathematical modeling, Control, and simulation of quadruped robots.
- Attitude Determination and Control Systems test setup using Quadcopters.
- Attitude Determination and Control Systems for small satellites (Ahan) developed at SSPACE IIST and to be launched by ISROs launch vehicle.
- Three axis reaction wheel development for attitude control of cubesats.
- Attitude control system using cold gas thrusters for small satellites to be launched by ISRO
- Health care assessment in the space arena using deep learning-based monitoring, diagnosis and prognostics for human health care in space.

- Deep space navigation using pulsars
- Development of payload and navigation algorithms for deep space mission using pulsars
- Development of navigation algorithms for IRNSS receivers.
- Parameterisation of control inputs and states for state space systems and its application in optimal control and other areas

Photographs of some recent student projects are given below:

a) Quadcopters developed at IIST by M.Tech Control systems students



b) Magnetotorquer and Single axis Momentum wheel based ADCS system developed at IIST by M.Tech Control Systems students.

c) Leftmost Image is the mass dummy developed for Ahan satellite and the rest of 3-images are the structure, and mass dummies developed for AAReST mission

8.7 Selection Procedure

Students in the discipline are selected based on their GATE score followed by an interview before an expert panel.

8.8 Placement and Higher Education

Our alumni are currently placed in reputed companies/organization such as:

- Mercedes Benz Research and Development India Pvt.Ltd.
- Agnikul Cosmos
- Skylark Drones
- Continental Automotive Components (India) Pvt. Ltd.

- GE Transportation
- Axiom Research Lab Private Labs
- Delta Electronics
- HCL Technologies
- Team Indus Aerospace

After graduation, many of our students are pursuing higher studies in Universities and Institutes such as:

- Indian Institute of Science, Bangalore
- Indian Institute of Technology, Bombay
- Indian Institute of Technology, Madras
- Indian Institute of Technology, Delhi

8.9 Recent Student Awards

- **Ms. Neethu** (MTech Control System Student, 2017-2019) received Indian National Academy of Engineering (INAE) Innovative Student Project Awards for her M.Tech Project titled "Actuator interface board design for momentum biased CubeSat ADCS" under the guidance of Dr. Harsha Simha and Dr. Priyadarshanam
- Honorable Mention Award at the Frank J. Redd Student Paper Competition at the 33rd Annual AIAA/USU Conference on Small Satellites in Aug. 2019 **Logan, Utah,** USA for the paper titled: INSPIRESat-4/ARCADE: A VLEO Mission for Atmospheric Temperature Measurements and Ionospheric Plasma Characterization.

8.10 Research Projects

- Control design strategy for systems with structured uncertainty
- Development of control design strategy for coupled MIMO systems
- Design and development of small-spacecrafts for LEO, interplanetary missions, deep space navigation systems
- Design and development of attitude determination and control systems for small spacecraft
- State estimation and locomotion control of quadruped robot over rough terrain

8.11 Selected Recent Publications

- Ranjakonda Shri Rama Akshay, Rajesh Joseph Abraham, “Improving dynamic frequency regulation of a multisource power system

considering GRC and deadband with TCSC and SMES", Int. J of Power and Energy Conversion, vol 10, no 1, pp. 51-75, 2019

- Nandapurkar Kishor Bhaskarrao, Anoop C. S., Pranab K. Dutta, "Performance Investigation of a Simplified TMR-Based Rotary Position Sensing System," IEEE Transactions on Instrumentation and Measurement, vol. 70, 2021, DOI: 10.1109/TIM.2021.3049234.
- Tapabrata Sen, Anoop C. S. and Siddhartha Sen, "Linearized Sigma–Delta-Based Direct Digital Converter for GMR Sensors," IEEE Transactions on Instrumentation and Measurement, vol. 70, 2021, DOI: 10.1109/TIM.2020.3032187.
- British Ashok Sontakke, Rahul Kumar, Jishnu V. R. and Anoop C. S., "Design, Modeling and Experimental Verification of a Hall-Effect-Based Linear Instrumentation System for Through-Shaft Angle Sensing," IEEE Transactions on Instrumentation and Measurement, vol. 69, no. 5, May 2020, pp. 2419 - 2428.
- Nikhilraj, A., Simha, H., & Priyadarshan, H. (2019). Optimal Energy Trajectory Generation for a Quadrotor UAV Using Geometrically Exact Computations on SE (3). IEEE control systems letters, 3(1), 216-221.
- Sam K. Zachariah and Thomas Kurian, `Hybrid-state driven autonomous control for planar bipedal locomotion over randomly sloped non-uniform stairs', Robotics and Autonomous systems, vol.97, pp.18-39, 2017

8.12 Contact Details

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M.TECH. IN VLSI AND MICROSYSTEMS

9.1 Overview

M.Tech in VLSI and Microsystems is a 2-year Full-Time post-graduate program offering specialization in Very Large Scale Integration (VLSI) design and Microelectronics systems.

The course covers the basics and advanced topics of Semiconductor devices and technology, analog, digital and mixed-mode VLSI design, RF Integrated Circuit Design, microelectronic devices and materials, Microelectromechanical Systems (MEMS) and its applications and Optoelectronics system design. Mastering the above courses, entails the students to acquire significant theoretical, practical experience and knowledge with the techniques and state of the art development tools of Integrated circuits design and Micro electro Mechanical System to cater the need of integrated microsystem and VLSI industries.

The uniqueness of this course is depending on the student interest, they will get the opportunity to work specifically on VLSI designs on developing analog/digital/mixed-signal/RF design or integrated microsystem which includes sensors, actuators and its sophisticated electronic system for control and communication which will enable them to get expertise in the respective area. o Faculty members associated with this M-Tech program have active collaborative R&D projects with ISRO centres for development of MEMS and VLSI based ASICs. The programme also has close collaboration with SCL Chandigarh (ISRO) for realizing the devices.

9.2 Faculty Profile

	**Dr. Seena V** Micro/Nanoelectronics, MEMS and Sensors,Polymer MEMS
	**Dr. J. Sheeba Rani** Computer Vision and pattern recognition, Image analysis and Understanding. Design and performance evaluation of hardware solutions for signal and image processing techniques Digital VLSI Design
	**Dr. Palash Kumar Basu** Gas Sensor, Bio Sensor and Flexible Electronics.

	**Dr.Sooraj R.** Semiconductor Optoelectronics and Photonics, Optical sensors, Semiconductor nano-structures, Optical interconnects and integrated circuits, Photovoltaics, Plasmonics.
	**Dr.Immanuel Raja** Analog, mixed-signal and RF IC Design. Particular focus on millimeter-wave CMOS IC design. Analog/mixed-signal subsystems for space applications.

9.3 Program Objectives

- M-Tech VLSI and Microsystems students are introduced to the Fundamentals of Modern VLSI and Compound Semiconductor Devices, Microsystems (MEMS) Analog, Digital and Mixed signal VLSI Design with hands-on laboratory exposure in the Design, Micro/Nanofabrication and characterization laboratories.
- The M-Tech program would educate the students to take up and solve any industry and research oriented problems starting from VLSI design (ASIC, Low power VLSI, etc.), analog, and mixed-signal IC design to microsystem (MEMS, Micro and Nanofabrication, Nanoelectronics etc.)
- Faculty members associated with this M-Tech program have active collaborative R&D projects with ISRO centres for development of MEMS and VLSI based ASICs. The programme also has close collaboration with SCL Chandigarh (ISRO) for realizing the devices.
- The graduates of this M-Tech program in VLSI and Microsystems shall become potential candidates for leading VLSI and semiconductor industries such as Intel, Analog Devices, STMicroelectronics, and Micron Technologies etc.

9.4 Important Laboratories

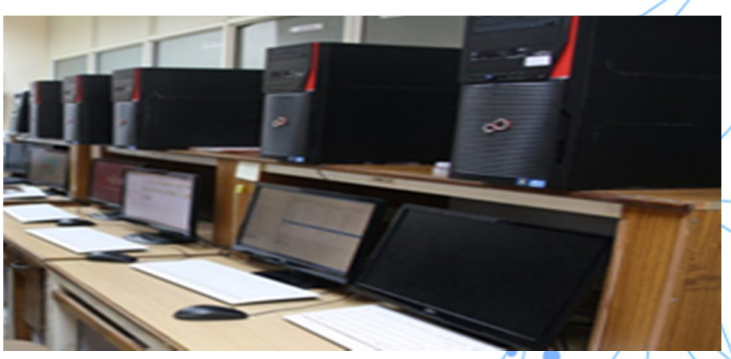
The following laboratories are being established to support the Post Graduate programme VLSI and Microsystems introduced in the year 2013 and research activities in the areas of VLSI, Micro/Nanoelectronics, MEMS/NEMS devices and technologies. These laboratories would support the R&D activities in these areas at ISRO. The development of the R & D ecosystem in the area of NEMS and Nanoelectronics at IIST for academia, ISRO and other research organizations is also in progress.

VLSI Design Lab

The VLSI Design Lab is equipped with high end computing facility, FPGA design kits (zynq , Virtex 7) with latest IDE softwares and state of art IC design design simulation tools

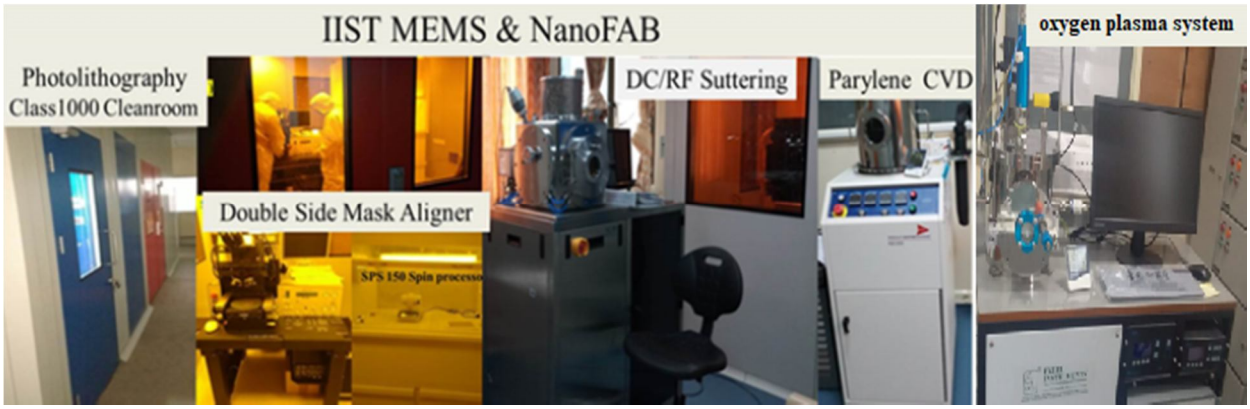
MEMS & Microelectronics Design Lab

MEMS and Microelectronics lab is equipped with modelling, design and simulation tools for MEMS devices, Micro/Nanoelectronics devices and systems. (High end workstations, Coventorware and MEMS+ from Coventor,, Silvaco ATLAS and ATHENA TCAD, Sentaures TCAD 3D Process and Device TCAD from Synopsis, COMSOL Multiphysics etc.)



MEMS & NanoFAB (Micro/Nanofabrication Laboratory)

MEMS/Micro/nanofabrication facility is planned to be established in a clean room spanning 140 square meters. The facility is planned for 4″ silicon wafer substrates with upgradability for 6″ wafers. Phase-1 of MEMS & NanoFAB has been established.



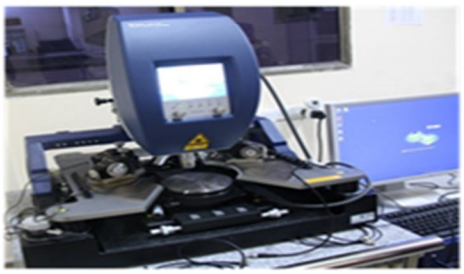
Micro/Nanosystems Characterization lab

Micro/Nanosystems characterization lab has characterization equipment for electrical and mechanical characterization of micro/nano-scale devices and VLSI.

Wafer Probe Station
Cascade EPX 150 Triax

Semiconductor Parametric Analyzer
Agilent B1500

Optical high Resolution
Semiconductor Microscope



MSA-500 Microsystem Analyzer
(Laser Doppler Vibrometer)

Hysitron Nanoindenter

Gas Sensor and Biosensor Lab

The lab has a facility to characterize the gas sensor for four gases together. Now, the lab is upgrading to handle eleven gases including explosive and toxic volatile compounds. It is also having a facility to develop electrochemical sensors for various applications.


9.5 Student Project and Research Opportunities

Students of M.Tech. VLSI and Microsystem undergo a one-year project during the final semester. Students have the opportunity to work at IIST based on the topics/projects offered by the respective faculties. Apart from this the students can opt various internship programs mainly with industry or external agencies mainly with different centres of ISRO.

- Design of a Transmitter with Integrated Power Amplifier (PA) for Millimeter-wave 5G Bands in 65nm CMOS
- Design of On-Chip Passives for Millimeter-wave (Ka-band) Circuits
- Development of MEMS Accelerometer with Ultra-Sensitive Transductions for Space Applications
- Design and Analysis of passive and active optical waveguides for optical interconnects
- Design and Development of NavIC receiver
- ASIC Design-SAR ADC
- Flash ADC Design
- Development of Real-Time Gas Sensor Array to Monitor Critical Gases in Crew Modules for Human Space Mission.
- Investigating the Nanomaterial Based Exosome Sensor for Cancer Prognostic: An Approach towards Liquid Biopsy for Cancer
- Development of Low-cost, Low Power, High-Performance Sensor Array on Flexible Substrate with Integrated Optical Source to Measure the Emission of GreenHouse Gases: Applications towards Agriculture and Aquaculture including Harsh Environment

9.6 Career Opportunities

There are a lot of opportunities in India and abroad for well-trained VLSI engineers. Companies such as Intel, Global Foundries, TI, Analog Devices, Qualcomm, etc., have their presence in India and recruit engineers for hard-core VLSI roles in the domains of digital, analog, mixed-signal, RF IC design, verification and characterization. Students in this program are trained with an industry perspective, so that they are industry-ready when they graduate. On the other hand, the courses also have a strong focus on the latest state-of-the-art research in the domains of VLSI, micro and nano systems, MEMS, sensors, opto-electronic devices, etc. The program includes a seminar, engineering design project and a final year project, in addition to regular classroom courses which trains the students strongly in conducting research and exposes them to the latest technologies. For those aiming to make a career as a researcher, the program puts you on a very good trajectory to achieve their goals.

9.7 Selection Procedure

Based on Gate score. Please check the website.

9.8 Placement and Higher Education

Students who have completed this course are working in many top-notch VLSI industries like

- Intel
- Samsung
- Analog Devices
- Global Foundries
- Synopsys
- ISRO centers - IISU, LPSC
- Ignitarium

Besides, quite a few students are pursuing their doctoral work in the best research institutes of India, like Indian Institute of Science, Bangalore, IIT - Bombay, etc.

Students have the option of doing a 1 year industry internship as

their final year project. This is an excellent gateway to be absorbed into top-tier industries. From the current batch (2020-22), 4 students have received internship offers from Intel in April/May 2021.

9.9 Recent Student Awards

1. L. Karthikayan, INAE award for M.Tech thesis, 2017

9.10 Selected Recent Publications

- B. S. Tina, C. Anjana, N. Kumar and V. Seena, "Polymer/Ceramic MEMS: A Nanomechanical Sensor Platform with Low Temperature High Gauge Factor ITO for Electromechanical Transduction," in IEEE/ASME Journal of Microelectromechanical Systems (JMEMS), 2020 doi: 10.1109/JMEMS.2020.3035399.
- Thomas James Thomas, J. Sheeba Rani,"Sparsity Independent Regularized Pursuit for Compressed Sensing reconstruction",accepted in Signal Processing Elseveir Jan 2020
- I. Raja and G. Banerjee, "A 0.75–2.5-GHz All-Digital RF Transmitter With Integrated Class-E Power Amplifier for Spectrum Sharing Applications in 5G Radios," in IEEE Transactions on Very Large Scale Integration (VLSI) Systems, vol. 28, no. 10, pp. 2109-2121, Oct. 2020, doi: 10.1109/TVLSI.2020.3005438.
- Fayza K. A., Sooraj. R, K. Park, K. Alameh, A. Bengi, Hajara A. V., and Y. T. Lee, “Advanced Realization and Characterization of Directed Optical Logic Gates using Electroabsorptive Quantum-Well-based Micro Ring Resonator", in Optik vol 221, 164426, 2020
- L. Karthikeyan, Akshaya. M. V, Palash Kumar Basu, Reliable and Flow Independent Hydrogen Sensor based on Microwave-assisted ZnO Nanospheres: Improved Sensing Performance under UV light at Room Temperature, IEEE Sensor, 18(2018)1810-1819

9.11 Contact Us

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M. TECH IN POWER ELECTRONICS

10.1 Overview

M. Tech in Power Electronics (PE) programme offers courses that cover the latest trends in Power Converters, Electric Drives, Grid Connected Systems, Internet of Things, Electronic Systems Design, Emerging and Advanced Topics in Power Electronics, and Control Systems with hands-on laboratory experience.

The Power Electronics Laboratory is equipped with several equipments such as converter modules including rectifiers, inverters, multi-phase and multi-level converters, high-end digital signal oscilloscopes, LCR meters, thermal-cameras, power quality analysers, programmable power supplies, and electronic loads, which are made available for research and extensive experimentation to PG students. Control platforms such as Digital Signal Controllers, Programmable System on Chip, and FPGA are available. Electric machines including induction machines (3-phase, 5-phase, 6-phase), synchronous machines (3-phase, 6-phase), DC machines are available. In addition to these, special electrical machines such as BLDC motors, multi-phase motors are also available.

PG students are encouraged to design and build converter prototypes and controller platforms, design electrical machines, explore research problems in emerging areas such as solid-state transformers, electric-vehicle technology, multi-level converters, and multi-phase drives.

B. Tech and M. Tech students who work in power electronics labs regularly publish in high-quality journals and present their work in international conferences.

10.2 Faculty Profile

	**Dr. Rajeevan P.P** Power Electronics – Power Converters, PWM techniques, Multiphase Drives, Power Quality, and Renewable Energy.
	**Dr. Anindya Dasgupta** Modelling and control of Power Electronic (PE) converters, PE topologies, applications in distributed generation.
	**Dr. R. Sudharshan Kaarthik** Power Electronics, Multilevel Converters, Electric Drives, Modulation and Switching Techniques, Power Hardware in-the-loop Emulation, Grid Connected Systems, Analog and Digital Circuit Design
	**Dr. Anoop C.S** Measurements and Instrumentation, Interface Electronics, Direct-Digitizers, Analog Signal Processing

10.3 Program Objectives

- To train students in the field of Power Electronics, with strong fundamentals, and exposure to practical and real life systems.
- To nurture the spirit of engineering through innovation, creativity and building of power electronic systems.
- To provide opportunities and to develop skills for carrying out

research and development in the power electronics field.

10.4 Important Laboratories

The M.Tech in Power Electronics Programme has three instruction laboratory courses covering topics such as DC-DC converters, Switched Mode Power Converters, Digital Control and Embedded Systems, Motor Drives, and Grid Connected Systems. The uniqueness of these lab courses is students build converters on their own and test them. This hands-on experience would enhance learning and would train students in design methods, and practical skills.

In addition to three laboratory courses, students take up Electronics Design Project (a 3 credit practical oriented course) and summer internship where they have an opportunity to explore a topic deeply.

Power Electronics in Distributed Systems Lab Power Electronics Research lab

10.5 Student Project and Research Opportunities

Students have a final year project which involves development of theory and building hardware and experimental setups which results in their dissertation. The work done in one year is expected to be quite exhaustive and has the scope to result in hardware prototype development, or a publication. Students are encouraged to participate in international and national level technical competitions and develop hardware and experiments targeted for those. Several students from M. Tech Power Electronics have been successful and have received awards in competitions.

10.6 Career Opportunities

Power electronics is a growing field and job opportunities are plenty. Students will be trained in core power electronics with industry relevant topics. Emphasis is given on hardware design and

systems engineering which are skills that are required in research setting, as well as in industry setting.

10.7 Selection Procedure

Selection will be based on Gate Score followed by an interview.

10.8 Placement and Higher Education

M.Tech in PE started in 2016 and has graduated three batches of students so far in 2018, 2019 and 2020 respectively. All students have been placed or have opted for higher studies.

The placement details for selected students are listed here.

- 2018:
  3 students got placement offers from four companies namely Delta Electronics, Schneider Electric India, Centum Electronics, and ROHM Semiconductors in the final year of their PG program. One student went on to pursue PhD at IIT Kharagpur.

- 2019:
  4 students got placement offers from Delta Electronics in the final year of their PG program.
  One student is pursuing her PhD at Indian Institute of Science, Bangalore.

- 2020
  3 students got placement offers from Delta Electronics, Bangalore, and Kone Elevator India, Chennai
  1 student joined as a junior research research fellow at IIT Dharwad
  1 student is pursuing PhD at IIT Roorkee.
- 2021
  2 students have offers from Agnikul Cosmos Pvt. Ltd
  1 student is offered a position in New Space Research and Technologies
  1 student is offered a position in Mercedes Benz India.

Students who have graduated from this programme have received offers from the following companies.

- Mercedes Benz Research and Development India Pvt.Ltd.
- Agnikul Cosmos
- Delta Electronics
- New Space Research and Technologies
- Schneider Electric
- ROHM Semiconductors
- Kone Elevators
- Centum Electronics

A few students who have decided to pursue higher studies have been admitted in the following institutes

- Indian Institute of Science, Bangalore
- Indian Institute of Technology, Kharagpur
- Indian Institute of Technology, Dharwad
- Indian Institute of Technology, Roorkee

10.9 Recent Student Awards

- GS Athira (M.Tech 2018) Shortlisted for final presentation for INAE Innovative Student Project Award.
- Ranjith S (M.Tech 2019) Shortlisted for final presentation for INAE Innovative Student Project Award.
- Pragya Yadav (M. Tech 2020) Semi-finalist in India Innovation Design Challenge Competition 2020 (IICDC 2020).
- GDDV Sai Pavan and Harshith are winners in IEEE Future Energy Challenge Design Competition, 2020.

10.10 Research Projects

Power Electronic Converters

- High performance DC-DC converters (Sponsored Project)
- High frequency AC - link power converters
- Integrated chargers for electric vehicles
- Power hardware in the loop emulation system for electric machine (Permanent magnet machines, Induction machines and Special Machines)

Electric Drives

- Decoupled control of series connected multi-phase machines and fault tolerant operation (Sponsored Project)
- Decoupled control of parallel connected multi-phase machines
- Current source inverter fed induction motor drives for high power

applications
- Speed range extension schemes for open-end winding drives for electric vehicle applications

Renewable Energy
- Power generation scheme for auxiliary loads with induction generators
- Solid State Transformers
- Applications of Power Electronics in Power Systems

Electronic Systems for Space Applications
- Avionic Systems for space borne payloads and sensors (Sponsored Project)
- Multi-phase drive systems for space applications - thrust vector control (Sponsored Project)
- Electronics for Electric Propulsion Satellite Systems (Sponsored Project)
- Electronics for Advanced Retarding Potential Analyser for Ionospheric Studies (a scientific payload for MOM-2 and Venus Missions) (Sponsored Project)
- Electrical Power Systems for Small Satellites - Ahan and InspireSAT series (Sponsored Project)

10.11 Selected Recent Publications

- Athira Suresh, Archana C M, R. Sudharshan Kaarthik and Rajeevan P P, "An Induction Generator Scheme with Series-Compensation for Frequency Insensitive Loads," in IEEE Transactions on Industrial Electronics, doi: 10.1109/TIE.2020.3013520.
- Ranjith S, Vidya V and R. Sudharshan Kaarthik, "An Integrated EV Battery Charger with Retrofit Capability," in IEEE Transactions on Transportation Electrification, doi: 10.1109/TTE.2020.2980147
- S. K. Dash and R. SudharshanKaarthik, "Independent Speed Control of Two Parallel Connected Split-Phase IM With a Common DC Link and Inverter," in IEEE Transactions on Power Electronics, vol. 34, no. 10, pp. 9957-9965, Oct. 2019.
- U. Hari Krishna and P. P. Rajeevan, "A Direct Torque Control Scheme for Five-phase Induction Motor Drive with Reduced Current Distortion," 2018 8th IEEE India International Conference on Power Electronics (IICPE), 2018, pp. 1-6, doi: 10.1109/IICPE.2018.8709603.
- G. S. Athira, R. Sudharshan Kaarthik and P. P. Rajeevan, "An Open End Winding Induction Generator System for Simultaneous Supply of Power to DC-link Loads and Frequency Insensitive AC Loads with Voltage Regulation," 2018 IEEE International Conference on Power Electronics,

Drives and Energy Systems (PEDES), 2018, pp. 1-6, doi: 10.1109/PEDES.2018.8707679.

Refer https://www.iist.ac.in/departments/people/46 for Full publication list.

10.12 Contact Details

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FUNDED PROJECT DETAILS

The department of Avionics has a large number of ongoing and completed funded research projects in various fields of Engineering and technologies. Some of the recent ongoing projects are listed below:

SI No:	Project Title	Funding Agency	Duration	Status
1	Development of Real-Time Gas Sensor Array to Monitor Critical Gases in Crew Module for Human Space Mission.	Human Space Flight Centre, ISRO HQ (Waiting for Funding)	3 Years, April 2021 to October 2023	Ongoing

2	Investigation, Design, and Implementation of Multifunctional 5G Antenna Systems for Cognitive Radio and mm-Wave Applications	DST-SERB	3 Years, March 2020 to March 2023	Ongoing
3	Investigating the Nanomaterial Based Exosome Sensor for Cancer Prognostic: An Approach towards Liquid Biopsy for Cancer	Department of Biotechnology	3 .5 year, December, 2017 to June 2021	Ongoing
4	Investigation of TMDC based Thin Film Transistors for Ultra-Sensitive Nanomechanical Bio/Chemical Sensor	SERB Extra Mural Research Funding	3.5 year, November 2017 to May 2021	Ongoing
5	LOC approaches for Separation and analysis of Exosome Derived Biomarkers for Cancer Prognostics	DST-CNRS (CEFIPRA)	3 Years, January 2020 to January 2023	Ongoing
6	Development of Low-cost, Low Power, High-Performance Sensor Array on Flexible Substrate with Integrated Optical Source to Measure the Emission of Green House Gases: Applications towards Agriculture and Aquaculture including Harsh Environment.	Accelerated Translational Grant for Commercialization (ATGC), Department of Biotechnology (DBT)	2 Years, October 2020 to October 2022	Ongoing

7	Development of a low complexity modulated wideband converter for sub-Nyquist wideband spectrum sensing	IIST-Fast-Track	2 years, April 2020 to March 2022	Ongoing
8	Design of a Transmitter with Integrated Power Amplifier (PA) for Millimeter-wave 5G Bands in 65nm CMOS	SERB-Startup Research Grant	2 years, Dec 2020 to Dec 2022	Ongoing
9	Design of On-Chip Passives for Millimeter-wave (Ka-band) Circuits	IIST-Fast Track	2 years, March 2020 to March 2022	Ongoing
10	Mechatronic Design of Adult sized Humanoid robot	IIST	3 years, April 2020, March 2023	Ongoing
11	Mars Orbiter Mission-2 payload proposal titled “Advanced Retarding Potential Analyzer for Martian Ionospheric Studies (ARIS)	DOS	Linked to MOM-2 and Venus missions	Ongoing
12	Design and Development of NavIC receiver	MiETY Funded	July 2017 extended to January 2022	Ongoing
13	Triband (S/X/Ka) Monopulse Auto Tracking Feed for LEO satellites	IIST/ISRO	July 2017	Ongoing
14	IIST Small Satellite (Ahan)	IIST	April 2016	Ongoing
15	Subsystems for InspireSat1	IIST	April 2018	Ongoing

16	Venus Mission-2 payload proposal titled “Advanced Retarding Potential Analyzer for Venusian Ionospheric Studies (ARIS)	DOS	Linked to MOM-2 and Venus missions	Ongoing
17	High Performance SAR ADC with autocalibration and correction for sensor closed loop applications	IIST ASRG	3 years	Approved
18	Wireless ReLoD - Wireless Reliable, Low Latency Networks for IIoT and FieldBus replacement	DST-SERB	3 years, March 2019 to March 2022	Ongoing
19	Development of Control Design strategy for Coupled MIMO systems for ORV	IIST ASRG	April 2021 to May 2022	Ongoing
20	Control Design Strategy for Systems with structured uncertainty	IIST ASRG	April 2021 to May 2022	Ongoing

TECHNICAL STAFF DETAILS

 Preethi Yadav, AG, Technical Officer-C	 Ananthalakshmi S, Senior Technical Assistant -A	 Abhilash S, Senior Technical Assistant -A

ALUMNI DETAILS

Some of our alumni currently working across Government research labs, industry and academia are following:

M.Tech in RF and Microwave

 Dr. Latheef A Shaik 2012 - 2014 (Mtech) 2014-2018 (PhD) Sci./Engr. - SD, SAC - ISRO	 Yamuna Jayan 2013 – 2015 Batch RF System Engineer, Syntronics, Ottawa Canada	 Malika Somnath 2018- 2020 Batch Ph.D student, IISC Bangalore	 Keerthipriya S 2017- 2019 Batch Raman Research Institute.

M.Tech DSP

 Mahesh Kumar Pal M.Tech DSP (2018-2020) Current affiliation: PhD, IIT-Roorkee	 Minha Mubarak M.Tech DSP (2017-2019) Current affiliation: PhD, IIST	 Soumya Sara John M.Tech DSP (2017-2019) Current affiliation: Deputy R&D Manager, Flytxt Ltd.

M.Tech in Control Systems

 Abhisek Mishra (2018 Batch) Research Scholar (PhD) at IISc, Bangalore	 Dweepjyoti Malakar (2015 Batch) Numaligarh Refinery Limited, Golaghat	 Neethu (2019 Batch) Research Scholar (PhD) at IISc, Bangalore

M. Tech Power Electronics

 Mr. Vishnu Sreekumar M.Tech PE (2016-2018) Sr. Design Engineer, Schneider Electric, Bangalore	 Ms. Dharani Moka M. Tech PE (2017-2019) PhD candidate at IISc Bangalore	 Ms. Pragya Yadav M.Tech PE (2018-2020) Sr. Engineer R&D, Delta Electronics, Bangalore

Mtech in VLSI and Microsystem

 Shahan IgnitariumTechnology Solution, Cochin, (2017 Batch)	 Anju Sebastian PhD IISc Bangalore (2017-2019)	 Noble Sebastian Analog Design Engineer Samsung, Bangalore (2018 Batch)	 Pragathi Agarwal Intel Bangalore (2018-2020)

For more details on our alumni please visit https://alumni.iist.org.in

GENERAL INFORMATION

a. **Admission/Academics related Information at**
https://www.iist.ac.in/academics/curricula

b. **Fees**
https://www.iist.ac.in//sites/default/files/admissions/PGBrochure-2021.pdf

c. **Seat Matrix**
https://www.iist.ac.in//sites/default/files/admissions/PGBrochure-2021.pdf

d. **Placement link**
https://www.iist.ac.in/placementcell

Current affiliation of alumni of MTech programs in Avionics department can be seen here: https://iist.ac.in/sites/default/files/placementcell/mtech_av.pdf

e. **Hostel** https://www.iist.ac.in/search/node/hostel

f. **How to reach (about Trivandrum)**
https://www.iist.ac.in/aboutus/how-to-reach

g. **Places to visit**
https://www.keralatourism.org/ktdc-tourist-reception-centres

h. **Contact Us** https://www.iist.ac.in/contact/response-form

SOME PHOTOS