INDIAN INSTITUTE OF SPACE SCIENCE AND TECHNOLOGY
(Declared as Deemed to be University under section 3 of the UGC act 1956)
Thiruvananthapuram – 695547

IIST Ph.D. Programme – January 2020 Admissions

Indian Institute of Space Science and Technology envisions basic and applied research for meeting the national R&D requirements of Science and Technology in general and the Indian Space Programme in particular. The institute provides a vibrant research atmosphere and offers doctoral and post doctoral programmes.

Applications are invited from highly motivated applicants for admission to the Ph.D. Programme starting in January 2020, in the departments given below:-

(i) Aerospace Engineering
(ii) Avionics
(iii) Chemistry
(iv) Mathematics
(v) Physics

Eligibility

1. Nationality: Applicant should be an Indian citizen.

2. Age Limit: Applicant should be below 35 years as on November 11, 2019. Age relaxation is applicable as per Government Rules.

3. There is no provision for PhD admission in IIST under Self Financing Category.

Minimum Qualifications:

1. Applicants with Master's Degree in Engineering/Technology as their highest qualifying degree

Applicants with Master's Degree in Engineering/Technology must have secured 65% marks or 7.00CGPA or equivalent in the Qualifying Master's degree (60%marks or 6.50CGPA for OBC, 55%marks or 6.00 CGPA for SC/ST/PD). **They must have pursued their Master's degree on the basis of qualified GATE score.** However there is no GATE cut off score for applicants with M.Tech./M.E as the highest qualifying degree, who are applying for Ph.D. in Engineering Discipline. Applicants with Master of Science in Engineering or equivalent from leading foreign Universities with minimum CGPA 8/10 or 3.6 /4 or equivalent can be considered without GATE score.

Selection Procedure: For candidates with M.E/M.Tech. as their highest qualifying degree, selection to the PhD programme will be based on a **written screening test**

followed by an interview. However, candidates with a valid fellowship such as CSIR/NET-JRF fellowships and CSIR-NET Lectureship post their ME/M Tech, will be directly called for the interview.

2. Applicants with Master's Degree in Science as their highest qualifying degree

Applicants must have Master's Degree in the relevant area with a minimum of 65% marks or 7.00CGPA or equivalent in the Qualifying Master's degree (60%marks or 6.50CGPA for OBC, 55%marks or 6.00 CGPA for SC/ST/PD). They must have cleared a National level eligibility test, such as a valid **UGC-CSIR-NET-JRF/Lectureship/fellowship or NBHM/JEST/GATE** and State Government Science and Technology Scheme**,** in the relevant disciplines.

Selection Procedure: For candidates applying with their Master's degree in Sciences as their qualifying degree and having a valid score card/certificate in any of the National level eligibility tests listed above, **selection to the programme will be based on an interview to be conducted at IIST.**

Applicants applying with their JEST score should have secured a rank within the first 300.

Candidates applying with a valid GATE score in a Science discipline, having a minimum score of 500 for General Category (450 for OBC and 350 for SC/ST/PD categories), are exempted from the Ph.D. written screening test conducted by IIST. Applicants having GATE score in Science disciplines less than indicated cut-off above will not be considered for Ph.D. Admission.

3. Candidates who have been provided research fellowships by State Government Science and Technology Scheme/DST-INSPIRE etc, are eligible to apply If they have already cleared a National level eligibility test, such as a valid **UGC-CSIR-NET Lectureship or JEST/GATE**. A valid GATE score of minimum 500 for General Category (450 for OBC and 350 for SC/ST/PD categories) in a Science discipline or JEST rank within the first 300 is required.

Applicants who are employed in Government/Semi Government/PSUs/Autonomous Bodies should produce a "No Objection Certificate (NOC)" from the current employer at the time of Interview.

Applicants who hold External Fellowships, meeting Table 2 requirements, can also apply for research areas listed in Table 1 provided they meet the eligibility requirements.

Table 1(Funded by IIST)

Research Areas for January 2020 PhD Admission				
Sl. No.	**Department**	**Department code**	**Research Area**	**Eligibility**
1	Aerospace Engineering	PAE01	Laser Spectroscopy for High Temperature Gas Dynamics Applications	M.E./M.Tech/MS or equivalent in Aerospace/Mechanical/Thermal Engineering background in laser diagnostics desirable OR MSc (Physics)/M.Tech Photonics or equivalent with background in laser spectroscopy **<u>Syllabus for Written Screening Test</u>** For M.E./M.Tech/MS or equivalent in Aerospace/Mechanical/Thermal Engineering **Fluid Mechanics**: Fluid Statics, conservation equations of mass, momentum and energy (integral and differential form) potential flow theory, viscous flow of incompressible fluids, boundary layer, elementary turbulent flow. **Compressible Flows**: Basic concepts of compressibility, conservation equations, and one dimensional compressible flow. Fanno flow, Rayleigh flow, isentropic flows, normal and oblique shocks, Prandtl-Meyer Flow, Flow through nozzles and diffusers. For MSc (Physics)/M.Tech Photonics **Basic Statistical Mechanics**: Maxwell Boltzmann & Fermi Dirac statistics, Partition function, Internal energy modes, Thermodynamic properties of equilibrium gas mixtures **Basic Quantum Mechanics & Spectroscopy**: Wave function, Schroedinger equation, Atomic/molecular structure and energy levels, Light matter interaction- Einstein coefficients, Beer Lambert law, Selection rules for transition between energy levels, Line broadening effects, Spectroscopy applications

Research Areas for January 2020 PhD Admission				
Sl. No.	**Department**	**Department code**	**Research Area**	**Eligibility**
		PAE02	Smart Structures, Structural Health Monitoring	Masters (M.Tech/M.S.) in Machine Design/ Machine Dynamics, Structural Engineering or Allied Branches in Mechanical/ Applied Mechanics/ Aerospace/ Aeronautical/ Civil Engineering, with B.Tech in Mechanical/ Applied Mechanics/ Aerospace/ Aeronautical/ Civil Engineering or Allied branches. **<u>Syllabus for Written Screening Test</u>** **Engineering Mechanics:** System of forces, free-body diagrams, equilibrium equations; internal forces in structures; friction and its applications; kinematics of point mass and rigid body; centre for mass; Euler's equations of motion; impulse-momentum; energy methods; Principles of virtual work. **Solid Mechanics:** Bending moment and shear force in statically determinate beams; stress and strain relationships; Theories of failures; Simple bending theory, flexural and shear stresses; shear centre; Uniform torsion, buckling of column, combined and direct bending stresses. Free and forced vibrations of undamped SDOF systems.
		PAE03	Combustion	M.Tech/ ME/MS in Mechanical/ Thermal/ Propulsion/ Chemical/ Applied Mechanics/ Aerospace/ Aeronautical
		PAE04	Computational Fluid Dynamics, Reactive Flow Modelling, Ablative Thermal Protection Systems	B.Tech (Mechanical Engineering, Aerospace Engineering, Aeronautical Engineering, Chemical Engineering) or Equivalent and M.Tech (Thermal Sciences, Thermal Engineering, Propulsion Engineering, Heat Power Engineering, Turbomachines, Energy Engineering, Applied Mechanics, Chemical Engineering) or Equivalent
		PAE05	Computational Fluid Dynamics	M.Tech/ ME/ MS in Mechanical/ Aerospace/ Thermal/ Applied Mechanics
		PAE06	Compressible flow	BTech/BE in Mechanical/Aerospace/Aeronautical and MTech/MS/ME in Mechanical /Aerospace /Aeronautical/Thermal/Propulsion /Aerodynamics and Flight Mechanics /Applied Mechanics

<table>
<tr><th colspan="5">Research Areas for January 2020 PhD Admission</th></tr>
<tr><th>Sl. No.</th><th>Department</th><th>Department code</th><th>Research Area</th><th>Eligibility</th></tr>
<tr><td></td><td></td><td colspan="3"><u>Written Test Pattern and Syllabus for PAE03, PAE04, PAE05 and PAE06</u>
Written test consist of questions from Fluid mechanics (compulsory) and Compressible flow or Heat transfer. Candidates can choose either Compressible flow or Heat transfer.

<u>Syllabus for Written Screening Test</u>

Fluid Mechanics: Fluid Statics, conservation equations of mass, momentum and energy (integral and differential form) potential flow theory, viscous flow of incompressible fluids, boundary layer, basics on turbulent flow.
Compressible Flows: Basic concepts of compressibility, conservation equations, and one dimensional compressible flow. Fanno flow, Rayleigh flow, isentropic flows, normal and oblique shocks, Prandtl-Meyer Flow, Flow through nozzles and diffusers.
Heat Transfer: Modes of heat transfer; heat conduction, thermal resistance concept, thermal boundary layer, free and forced convective heat transfer, radiative heat transfer.</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Avionics</td><td>PAV01</td><td>Power Electronics in distributed generation</td><td rowspan="2">ME/ M. Tech/ MS in Power Electronics or related disciplines/ Electrical Engineering / Control Systems Engineering/ Applied Electronics.

Desirable experience: Final year Masters' dissertation in the broad area of Power Electronics would be preferred. Experience in designing and building hardware setup would be an advantage.

<u>Syllabus for Written Screening Test</u>

Electric Network analysis- Transients in R-L, R-C, R-L-C circuits – Time domain and frequency domain analyses.

Switched mode power conversion – Basic principles, behavior of reactive elements (L and C) in power electronic circuits.

DC to DC converters: Buck, Boost, Buck-Boost, Flyback and Forward converters.

DC to AC converters: Single Phase and Three-Phase voltage source inverters, square wave operation, sinusoidal PWM.</td></tr>
<tr><td>PAV02</td><td>Power Electronics and Drives</td></tr>
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Research Areas for January 2020 PhD Admission				
Sl. No.	**Department**	**Department code**	**Research Area**	**Eligibility**
		PAV03	Wireless Communication and Signal Processing	M.Tech/ ME in Signal processing, communication and its equivalent **<u>Syllabus for Written Screening Test</u>** Signals and Systems: - Continuous-time and discrete-time signals and systems - LTI systems , sampling and reconstruction - Transform domain analysis of LTI system- Fourier, Laplace, and Z-transforms - Discrete Fourier Transform (DFT)- Fast Fourier Transform algorithm -Design of FIR Digital filters, IIR Digital filters. Basics of Multirate processing - Decimation and Interpolation. Probability and Random Processes: Probability axioms, conditional probability, discrete and continuous Rvs-CDF, PMF, PDF, conditional PMF/PDF, expected value, variance, functions of a RV, multiple random variables, joint CDF/PMF/PDF-independent/uncorrelated Rvs, sums of Rvs, moment generating function, random sums of Rvs- The sample mean, laws of large numbers, central limit theorem, convergence of sequence Rvs. Introduction to random processes(RP)- Mean and correlation of RP, stationary, wide sense stationary and ergodic processes. RP as inputs to linear time invariant systems: power spectral density, Gaussian processes as inputs to LTI systems, white Gaussian noise. Linear Algebra :- Vector Spaces ,Properties of Vector Spaces, Subspaces, Span and Linear Independence, Bases, Dimension Inner-Product Spaces - Inner Products, Norms, Orthonormal Bases, Orthogonal Projections -Null Spaces and Ranges- Eigenvalues and Eigen vectors Digital Communication:- Signal space concepts- Gram-Schmidt orthogonalization procedure. Matched filter receiver, ISI, Pulse Shaping, Nyquist criterion for zero ISI, Signaling with duobinary pulses, Eye diagram, Equalizer- Decision Procedure: Maximum aposteriori probability detector- Maximum likelihood detector, Error probability performance of binary signaling. Digital band pass modulation schemes: ASK, FSK, PSK, MSK – Digital M-ary modulation schemes – signal space representation Detection of signals in Gaussian noise

Research Areas for January 2020 PhD Admission				
Sl. No.	**Department**	**Department code**	**Research Area**	**Eligibility**
		PAV04	Semiconductor Optoelectronics / Photonics/ Optical Communication	M.Tech/ME in Optical Engineering/ Applied Optics / Optoelectronics/ Electronics and Communication / VLSI and Microsystems/ Electrical Communication / Solid State Physics/ Electronics and Communication. A good knowledge in semiconductor device physics is desirable. **<u>Syllabus for Written Screening Test</u>** **Optoelectronics:** Carrier concentration, Fermi and Quasi Fermi levels, Drift, Diffusion, carrier generation and recombination. Direct and indirect bandgap materials. Finite and infinite potential wells. Quantum wires, Quantum dots. p-n junction, Heterojunction, Schotkky junction, p-n, pin photodetectors, Solar cell. Light emission and absorption, Semiconductor laser, LED, Light modulation, Electrooptic, Electroabsorption, Thermooptic effects. Kerr and Pockel's effect. Reflection, Refraction, Total internal reflection. **Optical Communication:** Optical fibers fundamentals – single mode and multimode fibers, step index, graded index fibers, attenuation effects, cut-off wavelengths, linear and non-linear scattering losses, fiber bend losses, fiber dispersion, dispersion compensating fibers, polarization maintaining fibers, fiber connectors, alignment losses, fiber splices. Coupled mode theory, directional couplers, Optical amplifiers (fiber and SOA), Optical multiplexing, Fiber bragg Gratings, Fiber optic link design. Single frequency light sources, VCSEL, DFB, DBR laser, Plasmonic lasers.
3	Chemistry	PCH01	Organic Functional Materials	MSc Chemistry / BS-MS with Specialization in Chemistry (specialization in Organic/ Bioinorganic / Bioorganic Chemistry is desirable)

Research Areas for January 2020 PhD Admission				
Sl. No.	**Department**	**Department code**	**Research Area**	**Eligibility**
4	Mathematics	PMA01	Machine Learning	M.Tech/ M.E. or related degree in Computer Science/Machine Learning& Computing/ Electronics & Communication or related areas **<u>Syllabus for Written Screening Test</u>** **Linear Algebra**: Vector spaces, subspaces, linear independence, inner product spaces, orthogonal basis, conditional number, regularization techniques. **Matrices:** Traces and determinants, eigenvalues and eigenvectors, matrix derivatives. **Probability:** Fundamental axioms in probability, conditional probability, independence, random variables, expectation, probability distributions. **Machine Learning:** Classification, regression, clustering, cross validation techniques, performance measures, dimensionality reduction methods, feature selection, association rules, neural networks, kernel methods, deep learning, graphical models, reinforcement learning.

Table 2 : External Fellowship Holders

Candidates having a valid fellowship from Government agencies such as DST, CSIR, NBHM, UGC and State Government Science and Technology Scheme etc. may also apply for Ph.D. admission in various departments in IIST in the areas given below. Such candidates will be selected based on an Interview.

1E	Aerospace Engineering	EAE01	Satellite Thermal Control/Low Temperature Physics	Masters (M Tech/ MS/M.Sc) in Physics/ Thermal Sciences/ Mechanical/ Civil/ Aerospace/ Applied Mechanics or related areas.
		EAE02	Molecular Dynamics Simulations of Nanocomposites/ Physics of Fracture	Master's degree in Physics/ Nanotechnology/ Material Science/ Mechanical/ Civil/ Aerospace/ Applied Mechanics or related areas
2E	Avionics	EAV01	Spacecraft Mission Design	M.E./ M.Tech - Control Systems, Aerospace Engineering and related areas.

Research Areas for January 2020 PhD Admission				
Sl. No.	**Department**	**Department code**	**Research Area**	**Eligibility**
3E	Chemistry	ECH01	Nanomaterials/ Analytical Chemistry	MSc Chemistry (all branches)/ BS-MS with Specialization in Chemistry/ MTech in Nanoscience and Technology/Materials Science and Technology/ Polymer Science and Technology and allied branches
		ECH02	Porous Carbon/ Ceramic Materials for EMI shielding	
		ECH03	Polymer Nanocomposites	
		ECH04	Energy Storage Materials	
4E	Mathematics	EMA01	Suspension Rheology	M.Sc/BS-MS in Mathematics/ M.Sc/BS-MS in Physics with Good Background In Mathematics
5E	Physics	EPH01	Quantum Information and Quantum Computing	MSc in Physics/Master of Science in Solid State Physics/BS-MS in Physics

RESEARCH FELLOWSHIP:

1) All scholars selected to the programme specializations listed in Table 1 shall receive a fellowship of Rs.31000/- per month. (Research Scholars selected with UGC/CSIR/NET-JRF/NBHM and State Government Science and Technology Scheme etc., shall draw fellowship from the concerned organizations). For all research scholars with external fellowship, the concerned rules and regulations apply.
2) The fellowship will be enhanced to Rs.35,000/- per month based on a performance review after two years of Research.
3) The scholars will be required to assist the Departments in tutorials, practical training in labs or similar academic activities normally limited to 6 hours per week.
4) The scholars will have to pay applicable fees as well as charges for the services provided by the Institute like boarding/lodging/medical facilities etc., as per IIST rules.
5) For those who receive fellowship from agencies such as DST, CSIR, NBHM, UGC and candidates who have been provided research fellowship by State Government Science and Technology Scheme through competitive written test etc., the Institute will not bear the fellowship of the student if the same is stopped due to any reasons by the concerned agency.
6) The Institute is completely residential and will provide accommodation to all the regular Ph.D students. However, in the event of shortage of rooms in the hostels,

preference will be given for room allotment to candidates whose fellowships are borne by the Institute.

FEE STRUCTURE:
(To be paid at the beginning of every semester)

Sl No	Description	Full Time
1	Tuition Fee/Statutory Semester Fee	1,500/-*
2	Student Amenities Fee	1,350/-
3	Hostel Charges	4,500/-**
4	Establishment Charges	4,000/-
5	Medical Charges	800/-
	Total	**12,150/-**
6	Registration Fee (One-Time)	1,000/-
7	Thesis Submission Fee (One-Time)	1,000/-
8	Re-Registration Fee (If any)	1,500/-

Note:
***For SC/ST/PD** Tuition Fee/Statutory Semester Fee is exempted.
****Students of Ph.D programmes can purchase food coupons for Canteen Services separately.
***** Based on decisions of Board of Management, fees could be revised during the study period.

GENERAL SELECTION PROCEDURE:

1) **Applications will be received until November 11, 2019 through on-line only.**

2) **Candidates having fellowship from funding agencies such as DST, CSIR, NBHM, UGC, State Government Science and Technology Scheme etc, applying to research areas in Table 2 may also apply for other research areas in Table 1, if eligible.**

3) Candidates are advised to visit the individual department profile for more details on the respective areas of research.

4) Candidates with valid fellowship from Government funding agencies shall upload a scanned copy of the fellowship award letter.

5) A short-list of applicants for written test or interview will be displayed in IIST website by November 19, 2019**.**

6) The Ph.D. written screening test will be for one and half hours, starting at 9:30 AM on **December 01, 2019 (Sunday)** in the cities listed below.

   i) Thiruvananthapuram
   ii) New Delhi

iii) Kolkata

iv) Mumbai

v) Hyderabad

vi) Chennai

7) The written screening test for Ph.D candidates not holding eligibility through a national test for Ph.D admissions will have two parts A & B. Part A (40 marks) will comprise of questions that test both aptitude and mathematics, Part B (60 marks) will have questions related to subject area that are indicated in the syllabus. While Part A (30 minutes duration) will be conducted first for all Ph.D candidates, Part B (60 minutes duration) will be held starting from 10:15 AM and lasting one hour for different subject areas. A student applying to multiple research areas can write the corresponding subject area (Part B) of the various different research areas in the indicated time slot. The results of the written screening test will be published in IIST website on December 06, 2019.

8) Selection Criteria based on Written Screening Test & Interview:

(i) The students who have participated in the Written Screening Test will be shortlisted if they secure a minimum of 30 % in each of Section A and Section B and a combined mark of 50 % and above for Section A and Section B together.

(ii) There will be a relaxation of 5 % for SC/ST/PD and OBC students, i.e., SC/ST/PD and OBC students require a combined mark of 45 % and above for Section A and Section B together, while the minimum is 30% in each of the Section A and B respectively.

(iii) There will be a 70 % weightage for the PhD Written Screening Test and 30 % weightage for the interview.

(iv) A student securing less than 10 marks out of 30 marks in the interview will not be selected irrespective of category and irrespective of the performance in the Written Screening Test.

(v) The combined mark for the PhD Written Screening Test and interview for a UR student should be 60 % and above to be selected

(vi) For the SC/ST/PD and OBC students, the combined mark for the PhD Written Screening Test and interview should be 55 % and above.

9) Candidates screened in through the written test will be called for an interview to be held at IIST, Thiruvananthapuram on **December 16 & 17, 2019**

10) Provisionally selected candidates list, after the interview, will be displayed in the IIST website on **December 23, 2019**.

11) Outstation applicants will be reimbursed to-and-fro sleeper class train fare/bus fare by shortest route from the place mentioned in the application to Thiruvananthapuram, or actual fare paid (whichever is less) for attending the interview. The applicants are advised to make their own arrangements for their stay at Thiruvananthapuram.

12) No travel support will be provided for attending the written screening test.

13) Admissions are governed by Ph.D Rules and Regulations of IIST. (https://www.iist.ac.in/academics/rules-regulations).

14) **The date of the Written Screening Test and the dates of Interview will not be changed under any circumstances.**

15) During interview, candidates will be tested in their main research area and not restricted to the syllabus of the Written Screening Test.

HOW TO APPLY:

1) Applications shall be submitted **online** at the IIST website: http://admission.iist.ac.in. Applications received online only will be considered.

2) The applicants will not be allowed to make any changes in their registration profile once submitted. Hence utmost care should be taken by the applicants while filling their profile

3) Application fee is to the extent of Rs. 700/- per Department (for SC/ST/PD and Women applicants - Rs.350/- per Department). If the applicant is eligible and wishes to apply for more than one Research Area in the same Department, he/she need not pay any additional application fee. The application fee is non-refundable. Applicants, who wish to apply to multiple departments, will have to pay the appropriate application fee (sum of the application fee for each department).

4) The application fee shall be paid, through 'Bill Desk' after the course registration only.

5) **Applicants who are employed in Government/Semi Government/PSUs/ Autonomous Bodies need to produce a "No Objection Certificate (NOC)" from the current employer at the time of Interview.**

6) SC/ST/OBC/Persons with Disabilities (PD) applicants shall upload the relevant certificate in the website before the prescribed date.

IMPORTANT DATES		
Sl. No.	**Event**	**Date**
1	Opening of IIST website for online submission of applications	**October 29, 2019 - 1600 hrs (Tuesday)**
2	Closing of IIST website for online submission of applications	**November 11, 2019 - 2345 hrs (Monday)**
3	Display of shortlisted candidates for Test	**November 19, 2019 - 1700 hrs(Tuesday)**
4	Date of written screening test	**December 01, 2019 (Sunday) at 0930 hrs**
5	Publishing of screening test results	**December 06, 2019 – 1700 hrs (Friday)**
6	Interview Dates	**December 16 &17, 2019 (Monday & Tuesday)**
7	Display of Provisionally selected candidates	**December 23, 2019-1700 hrs (Monday)**
8	Last Date of remittance of semester fee	**December 31, 2019 (Tuesday)**
9	Reporting date at the Institution	**January 01, 2020 (Wednesday)**
10	Classes begin for Ph.D Programme	**January 02, 2020 (Thursday)**