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 –2021 Admissions
(Any time mode)

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 in the departments given below:-

(i) Avionics (4 vacancies)
(ii) Physics (1 vacancy)

Eligibility

1. Nationality: Applicant should be an Indian citizen.

2. Age Limit: Applicant should be below 35 years as on 17.08.2021. Age relaxation is applicable as per Government Rules.

Candidates applying for vacancies in the Department of Avionics will be provided fellowship under the IIT Palakkad IHub Foundation (IPTIF) Doctoral Fellowship Scheme.

Candidates applying for vacancy in Department of Physics should have valid fellowship from Government agencies such as DST, CSIR, NBHM, UGC and State Government Science and Technology Scheme etc. only are eligible to apply. Candidates will be selected based on an Interview.

Minimum Qualifications:

1. Applicants to the vacancies in Department of Avionics

Applicants must have master's Degree in Engineering/Technology in the relevant area. They must have secured 65% marks or 7.00 CGPA on a scale of 10 or equivalent in the Qualifying Master's degree (60% marks or 6.50 CGPA on a scale of 10 for OBC / EWS, 55% marks or 6.00 CGPA on a scale of 10 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: Selection to the PhD programme will be based on **online screening test** followed by an interview. **Interview will be conducted through Video Conference mode.** However, candidates with a valid CSIR/NET-JRF or Lectureship post their ME/M.Tech, will be directly called for the interview **through Video Conference mode.**

2. Applicants to the vacancy in Department of Physics

Applicants must have Master's Degree in the relevant area with a minimum of 65% marks or 7.00 CGPA on a scale of 10 or equivalent in the Qualifying Master's degree (60% marks or 6.50 CGPA on a scale of 10 for OBC / EWS, 55% marks or 6.00 CGPA on a scale of 10 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: Selection to the programme will be based on an interview through Video Conference mode.

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

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 / EWS and 350 for SC/ST/PD categories) in a Science discipline or valid 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.

Table 1(Funded by IIT Palakkad IHub Foundation (IPTIF) Doctoral Fellowship Scheme)

Research Areas			
Department of Avionics			
Sl. No.	**Department code**	**Research Area**	**Eligibility**
1	EPAV01	Computer Vision and Deep learning (Optimal transport theory and its application in Person Re-Identification)	M.Tech./M.E/M.S. or equivalent qualification in Computer Science / Computer Science and Engineering / Computer Science and Automation / Information Technology/ Electrical/ Electronics/ Signal Processing/

2	EPAV02	Reinforcement Learning - Safe Multiple Agent Reinforcement Learning	Communications/ Computer Science/ Machine Learning/ Artificial Intelligence/ System Science/ Data Science/ Computational Data Science or equivalent degree The candidate should be motivated and have keen interest in computer vision/Machine learning/ Deep Learning etc.

Syllabus for screening test for EPAV01 and EPV02

Mathematical background (20 marks)

Logic and discrete mathematics: Propositional and First-order Logic. Sets, Relations, Functions, Partial Orders, and Lattices, Groups, Graphs: Connectivity, Matching, Coloring Combinatorics: Counting, Recurrence Relations, Generating Functions.

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigenvalues and eigenvectors, rank, solution of linear equations – existence and uniqueness. Calculus: Differentiability, Continuity, Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima. Probability: Axioms of probability, probability space, properties of probability, Random variables and distributions, Uniform, Normal, Exponential, Poisson, and Binomial Distributions. Mean, Median, Mode, and Standard Deviation. Conditional Probability and Bayes Theorem. Random processes and their properties, filtering of random processes via linear time invariant systems.

Computer programming (15 marks)

Basic knowledge in programming principles, data structures, and algorithms (questions will be based on pseudo-code and not a specific programming language).

Choice based part (25 marks): Signals & Systems for ECE background, Data Structures and Algorithms for CS background.

ECE background:

Signals, systems, and control systems: Continuous-time signals: Fourier series and Fourier transform, sampling theorem and applications. Discrete-time signals: DTFT, DFT, z-transform, discrete-time processing of continuous-time signals. LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay. Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems

CS background:

Data Structures and Algorithms: Stacks, Queues, Linked Lists, Trees, Binary Search Trees, Binary Heaps, Graphs. Searching, Sorting, Hashing. Asymptotic Worst-case Time and Space Complexity, Algorithm Design Techniques: Greedy, Dynamic Programming, and Divide-and-Conquer. Graph Search, Minimum Spanning Trees, Shortest Paths.

3	EPAV03	Locomotion Control of Quadruped robots	M.Tech./M.E. in Control Systems or equivalent qualification

Syllabus for screening test for EPAV03

I. Linear Algebra:

Solution of Linear Equations: Vectors and Linear Equations, The Idea of Elimination, Elimination Using Matrices, Rules for Matrix Operations, Inverse Matrices, Factorization, Transposes and Permutations.

Vector Spaces and Subspaces: Spaces of Vectors, The Null space of A: Solving Ax = 0, The Rank and the Row Reduced Form, The Complete Solution to Ax = b, Independence, Basis and Dimension, Dimensions of the Subspaces.

Orthogonality: Orthogonality of the Subspaces, Projections, Least Squares Approximations, Orthogonal Bases and Gram-Schmidt.

Eigenvalues and Eigenvectors, Diagonalizing a Matrix, Applications to Differential Equations, Symmetric Matrices, Positive Definite Matrices, Similar Matrices, Singular Value Decomposition (SVD).

II. Linear Control System Theory:

Transfer function Approach: Open loop-and closed loop control systems- Transfer function - Control system components-Steady stare error- static error coefficient-dynamic error coefficient-Stability Analysis- Root locus- Frequency domain analysis-Bode plot - polar plot - Nyquist stability criterion- Non-minimum phase system - transportation lag, Different types of compensators like PD, PI, PID, Lag, Lead etc.

State space Approach: State variable description of LTI systems, Continuous time systems and Discrete time systems, Different canonical forms, Similarity transformation, Solution of state equations, Controllability and Observability, Relation between state variable and input-output descriptions, Stability of State space models, Pole placement through full state feedback, Full order state observers

III. Kinematics, Dynamics and Control of robotic manipulators:

Representation of rigid body rotation: Rotation matrix, Composition of rotations, Similarity transformation, Parameterization of rotations, Euler Angle, Axis/Angle representation.

Representation of rigid body general motion: Homogeneous transformation matrix, Forward and Inverse kinematics, Velocity kinematics, Geometric and Analytic Jacobians, Manipulator redundancy, Singularity issues, Kineto-Static Duality.

Dynamics and Control of serial chain manipulator: Euler-Lagrange formulation and Newton-Euler formulation for joint space dynamics, Task space dynamics based on task Jacobians, Inverse dynamics control for Joint space and task space. Task prioritization for redundant manipulators.

Reference Texts:

1. Gilbert Strang, Introduction to Linear Algebra, Fifth Edition, Wellesley- Cambridge Press

2. M. Gopal, Control Systems – Principles and Design, Fourth Edition, Tata McGraw-Hill

3. C. T. Chen, Linear System Theory and Design, Third Edition, Oxford University Press, 1999

4. Mark W. Spong, Seth Hutchinson and M. Vidyasagar, Robot modelling and Control, Wiley Student Edition

5. Bruno Siciliano, LorenoSciavicco, Luigi Villani and Giuseppe Oriolo, Robotics-Modelling, Planning and Control, Springer

4	EPAV04	Development of Fractional Chaotic Observer for Secure Communication	M.E/M.Tech in Control Systems / Signal Processing / Communication or Equivalent.
	Syllabus for screening test for EPAV04 **State space Approach:** Continuous and Discrete time systems, Canonical forms, Similarity transformation, Solution of state equations, Controllability and Observability, Stability of State space models, Pole placement through full state feedback, State observer design **Signal Processing -** continuous and discrete Fourier series and Fourier transforms, DFT, LTI system, z-transform, Laplace transform, FIR, IIR Filter design		

Table 2 : External Fellowship Holders

Department of Physics			
1	EPH01	Nano-materials for Device applications	MSc in Physics / Material Science / Nanoscience / Nanotechnology/Electronics/ Or MS in Solid State Physics / Material Science/ Nanoscience / Nanotechnology/Photonics

RESEARCH FELLOWSHIP:

1) All scholars selected to the programme for specializations listed in Table 1 shall receive fellowship under **IIT Palakkad IHub Foundation (IPTIF) Doctoral** Fellowship Scheme. The maximum duration of the fellowship is 4 years. The fellowship shall be extended by an additional year on case-by-case basis. They shall receive Rs.31000/- per month plus 16 % HRA per month for the first two years. The fellowship will be enhanced to Rs.35,000/- per month based on a performance review thereafter. HRA will be available for those students not availing the accommodation facility provided by the institute.
2) 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.
3) The Institute will not bear the fellowship of the student if the same is stopped due to any reasons by the concerned agency.
4) 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.
5) 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.
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, they will be allowed to

make their own arrangements for stay outside the campus. They will draw HRA as per the rules of the funding agency

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

Description of Fees	Amount (Rs.)
Tuition Fees(*)/ Semester	Rs.2500(*)
Other Fees/Semester	Rs.4950
Total Fee(A)	**Rs.7450**
Hostel Fee/ Semester	Rs.10250
Admission Fee (Non-Refundable) One-time	Rs.1500
Caution Deposit (Refundable)(One-time)	Rs.5000
Mess Bill/(Nominal) in advance	Rs.18000 (#)
Total Fee(B)	**Rs.34750(**)**
Grand Total 1st Semester (A+B)	**Rs.42200**
2nd Semester onwards (A+B-one time)	**Rs.35700**

Note:

- **A candidate who confirms the seat has to remit the fees of Rs. 7450/-.**
- (*) SC/ST/PD students are exempted from payment of Tuition Fees.
- **(**) Will be collected at the time of physical reporting at the Institution.**
- **(#)** 3000 p.m. X 6 months as advance
- Additional fees: Supplementary Examination fees - Rs.100/- per paper and Thesis Submission - Rs.1000/- and Convocation fees - Rs.2000/- & Alumni Registration fees - Rs.500/-, which will be collected with the final semester fee.

GENERAL SELECTION PROCEDURE:

1) **Applications will be received through on-line only.**
2) Candidates are advised to visit the individual department profile for more details on the respective areas of research.
3) Candidates with valid fellowship from Government funding agencies shall upload a scanned copy of the fellowship award letter and indicate the period of fellowship validity.
4) A short-list of applicants for Online screening test or interview will be displayed in IIST website by 20.08.2021**(Tentative).**
5) **Online screening test will be on 25.08.2021(Tentative).**
6) **Selection Criteria based on Online screening test & Interview:**

   (i) The candidates who have participated in the Online screening test will be shortlisted if they secure a minimum of 30 % in each of Section A (Section A comprises questions

based on Aptitude and class 12 Mathematics) and Section B (the research area) 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 / EWS students, i.e., SC/ST/PD and OBC / EWS 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 Online 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 Online screening test.

(v) The combined mark for the PhD Online screening test and interview for a UR student should be 60 % and above to be selected

(vi) For the SC/ST/PD and OBC / EWS students, the combined mark for the PhD Online screening test and interview should be 55 % and above.

Candidates screened in through the online screening test will be called for an interview **through Video Conference mode.**

7) Provisionally selected candidates list, after the interview, will be displayed in the IIST website.

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

9) **The date of the Online screening test will not be changed under any circumstances. The date of interview spans over a period of several days. In case the date and time of the interview clashes with the applicant's End semester examination in his/her qualifying examination, the Institute will consider shifting the date and time of interview within the overall window available.**

10) During interview, candidates will be tested in their main research area and not restricted to the syllabus of the Online screening test.

HOW TO APPLY:

1) Applications shall be submitted **online** at the IIST website: https://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 for General/EWS/OBC candidates who are male is 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 online after completing the process of registration.

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/EWS/Persons with Disabilities (PD) applicants shall upload the relevant certificate in the website before the prescribed date. **OBC-NCL/EWS certificates issued after 01/04/2021 only will be accepted.**

IMPORTANT DATES		
Sl. No.	**Event**	**Date**
1.	Opening of IIST website for online submission of applications	29.07.2021-1600 hrs (Thursday)
2.	Closing of IIST website for online submission of applications	17.08.2021-2359 hrs (Tuesday)
3.	Display of shortlisted candidates for Test	20.08.2021- 1700 hrs (Friday)*
4.	Date of online screening test	25.08.2021- 1700 hrs (Wednesday)*
5.	Publishing of screening test results	27.08.2021-1700 hrs (Friday)*
6.	Interview Dates	31.08.2021 onwards*
7.	Display of Provisionally selected candidates	03.09.2021(Friday)*
8.	Last Date of remittance of semester fee	07.09.2021(Tuesday)*
9.	Reporting date at the Institution	08.09.2021(Wednesday)*

*** These dates are tentative and could change depending on the situation of the pandemic Covid-19 in the country.**