

**INDIAN INSTITUTE OF TECHNOLOGY
DHARWAD**



॥ सा विद्या या विमुक्तये ॥

भारतीय प्रौद्योगिकी संस्थान धारवाड
Indian Institute of Technology Dharwad

Department of Electrical Engineering

Information Brochure

Ph.D. Admissions

Autumn Semester (2019-20)

A. SCHEDULE OF Ph.D. ADMISSION

S. No.	Particulars	Dates
1	Availability of online application forms	
2	Last date for submission of completed application forms	Friday, 17/05/2019
3	Listing of shortlisted candidates for the Selection Process ¹	Friday, 31/05/2019
4	Date for the Selection / Examination Process	Tuesday, 02/07/2019
5	Declaration of the Result of the Written Test	Tuesday, 02/07/2019
6	Date for the Interview Process	Tuesday, 02/07/2019 & Wednesday, 03/07/2019
7	Display of the final result ²	Monday, 08/07/2019
8	Last date for the Fee Payment	Friday, 19/07/2019
9	Date of Joining	Monday, 29/07/2019

B. ELIGIBILITY FOR ADMISSION

Qualifying Degree: M.Tech./M.E. or equivalent degree, with good academic records, in the relevant specializations (to the candidate's preferred area of research) of either, Electrical Engineering, Electronics and (Tele)Communication Engineering, Computer Science Engineering, and Instrumentation and Control Engineering or equivalent specializations.

B.1. Minimum score in the qualifying degree

For General/OBC category candidates and/or for candidates where no concession in academic performance is called for, the eligibility criteria in the qualifying degree (M.Tech./M.E. or equivalent) AND the Bachelor's Degree (B. E./B. Tech./M. Sc. or equivalent) is First Class as specified by the University. If the University doesn't specify the division/class, then either:

1. a minimum of 60% marks (without round off) in aggregate.
2. a minimum Cumulative Grade Point Average (CGPA) or Cumulative Performance Index (CPI) of 6.0 on the scale of 0-10; with corresponding proportional requirements when the scales are other than on 0-10, (for example, 4.8 on a scale of 0-8).

For SC/ST category candidates and differently abled candidates (PwD), a relaxation of 5% (or CPI/CGPA of 0.5 on the scale of 0-10) in the qualifying degree is applicable.

¹ & ² Will be announced on the institute webpage

C. APPLICATION CATEGORIES AND FINANCIAL SUPPORT

The Department of Electrical Engineering admits candidates for full time Ph. D. Programme, under Teaching Assistantship (TA), Financial Assistantship (JRF from UGC/CSIR NET, INSPIRE Fellowship etc.) and External (EX) schemes only.

C.1. Teaching Assistantship (TA)

The students admitted as TAs are Funded by MHRD. The TAs are expected to assist in the academic/administrative work for smooth functioning of the Institute. Students under this category are entitled to financial support as per MHRD norms in force.

At present, the assistantship is payable for a maximum duration of 5 years or up to the defence of the thesis, whichever is earlier, at the monthly rate of ₹ 25,000 for the first 2 years and enhanced rate of ₹ 28,000/- for the remaining period, subject to satisfactory performance in academics and assigned TA duties.

To get Teaching Assistantship, the concerned students must assist in teaching, research and/or administrative work as assigned by the respective Academic Unit to the extent of 8 hours of work per week. The continuation of the assistantship will be subject to satisfactory performance of the duties assigned by the Departments as well as satisfactory academic performance.

As per MHRD directives, the employees of any organizations with or without pay are not eligible for admission under TA category. Candidates selected in this category have to resign from the current job and submit a relieving letter from their employer before joining the programme. Students getting assistantships from the Institute may join projects sponsored by external agencies and obtain corresponding fellowships in lieu of TA ship.

Teaching Assistantship Through Project (TAP) The students under this category receive financial support from sponsored projects. Only some disciplines have TAP seats. The candidates do not have to indicate their preference for TAP separately. The rate of stipend may be same or higher than the TAship. The admission procedure and other requirements are same as applicable to TA.

C.2. Financial Assistantship (FA)

The students admitted under FA category are financially supported under various Govt. / Semi Govt. schemes like JRF of CSIR/UGC, DST INSPIRE etc. For admission under this category, the applicant must have qualified for funding through one of such schemes. The admission procedure and other requirements are same as applicable to TA.

C.3. External (EX)

The candidates employed in recognized R&D organizations and desirous of pursuing Ph.D. programme while in employment may apply for admission as external candidates. After fulfilling the coursework requirement at the Institute, these candidates will be allowed to

register for Ph.D. with a Supervisor (internal) from the Institute and a Co-supervisor (external) from their parent organization where they will be doing the research work. The admissions are based on the following norms:

- i. The competence of these candidates will be assessed along with the regular candidates.
- ii. The candidate should submit at the time of application, a Sponsorship Certificate (Appendix A.1) from the organization in which he/she is employed giving an undertaking that the candidate would be released from the normal duties to fulfil the coursework requirement (and qualifier examination, if applicable). The certificate should also provide details of facilities relevant to the research programme and available to the candidate.
- iii. The candidate is required to be at the Institute as a full-time student for the coursework (and qualifier examination, if applicable) of his/her Ph.D. Programme. The coursework requirement is likely to be a period of 1-2 semesters. Depending on the student's background and the programme requirements, an additional semester may be needed to complete the coursework/qualifier examination.
- iv. To promote interaction between the internal supervisor and external co-supervisor, meeting between them should be arranged at least once in a year in the Institute or in the sponsoring organization.
- v. The Ph.D. registration of an external candidate would be reviewed at the end of each year from the date of registration in terms of his progress in courses / seminars / approved research programme by a Research Progress Committee (RPC) nominated by the concerned Department Postgraduate Committee (DPGC).
- vi. The option of external registration is for applicants who are working in well-equipped scientific institutions, laboratories, R&D establishments and industrial organizations engaged in research based activities. Persons working in colleges/universities are **NOT** eligible under this category.
- vii. At the time of joining the programme, the students will have to produce a "Relieving certificate" from his / her employer that he / she has been fully relieved from normal duties during the semester(s) to complete the course work and other academic work at IIT Dharwad

Based on the information provided by the applicants a short-list of candidates called for the selection process will be declared on the Institute website on the date specified in the schedule. Only the short-listed candidates are permitted to participate in the selection process.

D. GUIDELINES FOR THE SHORTLISTED APPLICANTS

The following are the important guidelines of the institute pertaining to the selection process

1. Reporting Time: 02nd July, 2019 at 8:30 AM.
2. Screening test will begin on 02nd July, 2019

3. Based on the performance in the screening test, some of the candidates will be shortlisted for the first interview.
4. Based on the performance in the first interview, some of the candidates will be shortlisted for the second interview.
5. Interviews will be held immediately after the short-list is declared. Please note that the interviews may extend to the next day i.e. 03rd July, 2019.
6. No accommodation can be provided in the campus during the written/interview.
7. Applicants should bring:
 - a. Photo ID card
 - b. Printed copy of the application
 - c. Thesis/dissertation/report of M.Tech. or equivalent degree
 - d. Copy of certificates and mark-sheets
 - e. Two passport size photographs
 - f. Non-programmable scientific calculator

D.1. DO NOT's

- a. Mobile phones are not allowed in the examination hall or in the interview room
- b. Department's decision is the final decision regarding any matter pertaining to this selection process.
- c. Institute doesn't take any responsibility of your luggage/items that you leave before entering the examination hall.

E. MODALITY OF THE SELECTION PROCESS

Only the short-listed applicants are permitted to participate in the selection process.

The selection process consists of a screening test followed by interview(s). The screening test will either be online or written.

Based on the performance in the screening test, some of the candidates will be short-listed for the interviews. The details of the screening test and interview are given in the following sections.

E.1. Details about the screening test

1. Screening test for all the short-listed applicants.
2. Based on the choice indicated in the application form, candidates will answer screening test, candidates will write test in any one of the following streams.
 - a) Communication and Signal Processing
 - b) Control and Robotics
 - c) Electronic Devices and Mixed signal ASIC design

- d) Computer Architecture
- e) Power and Energy Systems

Changes in the subject or preferences for areas of research are NOT permitted after submission of the application form.

3. The syllabus for the screening test is given in Section G of this document. Apart from the prescribed syllabus, the test may contain questions based on general aptitude and reasoning.

4. After the screening test, candidates are instructed to wait till the short-list for the interview round is displayed on the notice board.

5. Interviews will begin immediately after the display of the short-list. It is the responsibility of the candidate to be present at the venue, when (s)he is called for the interview.

No personal intimation will be given after the screening test.

E.2. Details about the interviews

- 1. Faculty from all fields and from other departments may be present in the interview panel.
- 2. The final list of selected applicants will be announced on the specified date.

F. RESEARCH TOPICS

The research areas are broadly classified in seven streams as described below. **The applicant MUST indicate the choice of the research topics in the order of preference.**

- 1. **Signal Processing:** Including but not limited to, Emotional analytics, Speech Processing, Handwriting and Document Processing, Speech Interfaces for Robotics, Signal Processing/Machine Learning methods for Communications
- 2. **Communication Technologies:** Including but not limited to, physical and medium access control (MAC) layer technologies in Next Generation Wireless Systems (5G and beyond), Internet of Things (IoT), novel multiple access methods like non-orthogonal multiple access (NOMA), massive multi-input multi-output (MIMO) systems, millimetre wave (mmWave) communications, etc.
- 3. **Control and Robotics:** Including but not limited to Control of Robots through Speech Signals, Autonomous Vehicles, Control for Differential Games, Control of Structures etc.
- 4. **Electronic Devices:** Including but not limited to Gas sensors, Nano-electronics etc.
- 5. **Mixed signal ASIC Design:** This area is related to practical mixed signal integrated circuits. Topic could be one of high speed interconnects, circuits and systems for instrumentation, design for testability of mixed signal circuits etc. Work will include the design of integrated circuits, from concept formulation to verification of ideas in hardware with a prototype chip.
- 6. **Embedded Systems and Architecture:** This area is an intersection of Embedded Systems, Computer architecture and Systems-on-chip design. Research problems will include modeling and characterization of heterogeneous processors, Power and thermal management of processors, Convolutional Neural Networks (CNN) on edge devices, Reliability and Security of Hardware and Architectures using Non-Volatile Memories.

7. **Power and Energy Systems:** Power system stability and control, synchrophasor applications to power systems protection, monitoring and control, renewable energy, battery energy storage and microgrid. Power Electronics and converters for Electric Vehicle, Medium voltage hybrid DC circuit breakers, Grid connected multilevel inverters, high voltage power electronics and control.

G. SYLLABUS FOR SCREENING TEST AND INTERVIEWS

Common for all the streams

1. **General aptitude, reasoning and comprehension**
2. **Engineering Mathematics:** Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors, Concepts from sequences, limits, series, functions, integration and differentiation, Fourier Transform, Laplace Transform and z-Transform.

Stream 1: Communication and Signal Processing

1. **Signals and Systems:**
 - a. **Continuous-time signals:** Fourier series and Fourier transform representations, sampling theorem and applications;
 - b. **Discrete-time signals:** discrete-time Fourier transform (DTFT), DFT, FFT, z-transform and sampling theorem
 - c. **LTI systems:** definition and properties, causality, stability, impulse response, convolution, poles and zeros and frequency response.
 - d. **Random processes:** basics of probability, random variables, CDF, PDF, random processes, mathematical expectation, conditional probability and conditional expectation.
2. **Communication:**
 - a. **Random processes:** basics of probability, random variables, CDF, PDF, random processes, mathematical expectation, conditional probability and conditional expectation.
 - b. **Digital communications:** Digital modulation schemes, MAP and ML decoding, notions of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction codes (e.g.: Linear Block Codes like Hamming code).

Stream 2: Control and Robotics

Mathematical modeling and representation of systems, Basic control system components, Feedback principle, Transfer function, Block diagram representation, Transient and steady -state analysis of LTI systems, Frequency response, Stability analysis, Routh-Hurwitz, Bode plots, and root-loci, P, PI and PID controllers. State-space representation, State-transition matrix, and solution of state equation of LTI systems, Controllability and Observability, Design of state-feedback controllers, principle of optimality, dynamic programming, Pontryagin's Maximum Principle.

Stream 3: Electronic Devices and Mixed signal ASIC Design

1. **Electronic Devices:** Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.
2. **Analog Circuits:** Basics of Analog circuits.
3. **Digital Systems:** Number systems; Combinatorial circuits; Sequential circuits.

Stream 4: Computer Architecture

1. **Digital Systems:** Number systems; Combinatorial circuits; Sequential circuits.
2. **Computer Organization and Architecture:** Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).
3. **Operating Systems:** Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Stream 5: Power and Energy Systems

1. **Electric Circuits:** Network graph, KCL, KVL, Node and Mesh analysis, Transient response of dc and ac networks, Sinusoidal steady-state analysis, Resonance, Ideal current and voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem, Three phase circuits, Power and power factor in ac circuits.
2. **Power Electronics:** characteristics of MOSFET, IGBT and diode, DC to DC conversion: Buck, Boost and Buck-Boost converters; Single and three phase configuration of uncontrolled rectifiers, Line commutated thyristor based converters.
3. **Power Systems:** Per-unit quantities, Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, System stability concepts, Equal area criterion.
4. **Electrical Machines:** Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase transformers: connections, parallel operation; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Synchronous machines: cylindrical and salient pole machines, performance, regulation, starting of synchronous motor, characteristics.

Appendix A.1

Sponsorship Certificate for Ph.D. External Registration (EX)

(To be typed on letterhead of the Sponsoring Organization)

Name of the sponsoring organization:

Address

Present Designation of the applicant:

Present status of the applicant:

(Permanent/Quasi Permanent/Temporary)

Division where research work is proposed to be done:

Name of supervisor from the sponsoring organization:

(Bio-data of supervisor to be enclosed giving details of designation, qualification, research experience etc.)

Details of facilities relevant to the research problem which will be made available to the candidate by the organization.

Statement of proposed Co-supervisor (external)

If Shri / Kum. / Smt. _____ is registered for the doctorate degree, I agree to act as his/ her research Co-supervisor along with the research Supervisor from IIT Dharwad.

Signature of proposed Co-supervisor
(external)

If Shri. / Kum./ Smt. _____ is admitted to the Ph.D. programme, we shall allow him/ her to undergo the programme of studies at IIT Dharwad.

Further, if Shri. / Kum./ Smt. _____ is admitted to the Ph.D. programme, we shall fully relieve him/her from normal duties to complete the course work requirement (and qualifier examination, if applicable) at IIT Dharwad.

During the period of Doctoral programme, the candidate will be permitted to carry out his / her research work at our laboratories / organization and will be given the required facilities.

We also give our consent to _____ of our organization to be the Co-supervisor (external) of the Ph.D. thesis, along with a faculty member of IIT Dharwad as the Supervisor.

Signature and Seal of the Sponsoring
Authority

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