

Indian Institute of Technology Dharwad

Department of Electrical Engineering

Ph.D. Admission for Autumn Semester, 2018

A. SCHEDULE OF PH.D. ADMISSION

S. No.	Particulars	Dates
1	Last date for submission of completed application forms	15th May, 2018 30 th May, 2018
2	List of shortlisted candidates for the Selection Process ¹	31 st May, 2018
3	Dates for the Selection Process	2 nd and 3 rd of July, 2018
4	Declaration of Result ¹	9 th July, 2018
5	Last date for Fee Payment (at IITDh)	20 th July, 2018
6	Date of Joining	23 rd July, 2018
7	Last date of withdrawal	25 th July, 2018

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, and Instrumentation and Control Engineering.

¹ Will be announced on the institute webpage

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.) AND the Bachelor's Degree (B. E./B. Tech./M. Sc) 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.

C. APPLICATION CATEGORIES AND FINANCIAL SUPPORT

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

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.

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 SHORTLISTED APPLICANTS

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

- 1. Reporting Time: 2nd July, 2018 at 9:10 AM.**
- 2. Screening test will begin on 2nd July, 2018 at 10:30AM.**
3. Based on the performance in the screening test, some of the candidates will be shortlisted for the interview.
4. Interviews will be held immediately after the short-list is declared. **Please note that the interviews may extend to the next day i.e. 3rd July, 2018.**
5. **No accommodation can be provided** in the campus during the written/interview.
6. 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. Mobiles are not allowed in the examination hall or in the interview room
- b. Department's decision is the final 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 and an interview. The screening test (either online or written) will consist of multiple choice questions.

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 is a 60-minute objective test (multiple choice questions) for all the shortlisted applicants.
2. Based on the preferred area of the research (first choice), candidates will write test in any **one** of the following streams.
 - a) Communication and Signal Processing
 - b) Control and Robotics
 - c) Electronic Devices

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. If the test is online, a user name and a password will be given to the candidates on the day of test. Candidates will login and attempt the test using these credentials.
5. There is negative marking for wrong answers.
6. After the screening test, candidates are instructed to wait till the short-list for the interview round is displayed on the notice board
7. 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. A personal interview of each candidate, short-listed from the screening test, will be conducted.
2. Faculty from all fields and from other departments will present in the interview panel
3. The final list of selected applicants will be announced on the specified date.

F. RESEARCH TOPICS

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

1. **Communication and Signal Processing:** Including but not limited to, Emotional analytics, Speech Processing, Handwriting and Document Processing, Speech Interfaces for Robotics, Signal Processing for Communication, Next Generation Wireless Systems etc.

2. **Control and Robotics:** Including but not limited to Control of Robots through Speech Signals, Autonomous Vehicles, Control for Differential Games, Control of Structures etc.
3. **Electronic Devices:** Including but not limited to Gas sensors, Nano-electronics etc. *Mixed signal ASIC Design:* This research is about the design of integrated circuits involving analog or mixed signal circuits. Work will include design of integrated circuits, from a new concept to verification of ideas in hardware. Topic could be one of high speed interconnects, circuits and systems for instrumentation, design for testability of mixed signal circuits etc.

G. SYLLABUS FOR THE WRITTEN TEST

Engineering Mathematics: Common for all the three streams

1. **Linear Algebra:** Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.
2. **Calculus:** Mean value theorems, Theorems of integral calculus, Evaluation of definite and improper integrals, Partial Derivatives, Maxima and minima, Multiple integrals, Fourier series, Vector identities, Directional derivatives, Line integral, Surface integral, Volume integral, Stokes's theorem, Gauss's theorem, Green's theorem.
3. **Differential equations:** First order equations (linear and nonlinear), Higher order linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's equation, Euler's equation, Initial and boundary value problems, Partial Differential Equations, Method of separation of variables.
4. **Complex variables:** Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.
5. **Probability and Statistics:** Sampling theorems, Conditional probability, Mean, Median, Mode, Standard Deviation, Random variables, Discrete and Continuous distributions, Poisson distribution, Normal distribution, Binomial distribution, Correlation analysis, Regression analysis.
6. **Numerical Methods:** Solutions of nonlinear algebraic equations, Single and Multi-step methods for differential equations.
7. **Transform Theory:** Fourier Transform, Laplace Transform, z-Transform.

Communication and Signal Processing

1. **Networks, Signals and Systems:**
 - a) **Network solution methods:** nodal and mesh analysis;
 - b) **Network theorems:** superposition, Thevenin and Norton's maximum power transfer;
 - c) Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits;
 - d) **Linear 2-port network parameters:** driving point and transfer functions; State equations for networks.
 - e) **Continuous-time signals:** Fourier series and Fourier transform representations, sampling theorem and applications;
 - f) **Discrete-time signals:** discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals;

g) **LTI systems:** definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

2. **Communication:**

a) **Random processes:** autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications;

b) **Information theory:** entropy, mutual information and channel capacity theorem;

c) **Digital communications:** PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA

Control and Robotics: Mathematical modeling and representation of systems, Basic control system components, Feedback principle, Transfer function, Block diagram representation, Signal flow graph, Transient and steady-state analysis of LTI systems, Frequency response, Stability analysis, Routh-Hurwitz and Nyquist stability criteria, Bode plots, Nyquist plots and root-loci, P, PI and PID controllers, Lag, lead and lag-lead compensation, State-space representation, State-transition matrix, and solution of state equation of LTI systems, Controllability and Observability, Design of state-feedback controllers, Luenberger Observer, Time-delay systems, mechanical, hydraulic and pneumatic system components, servo and stepper motors, on-off control, principle of optimality, dynamic programming, Pontryagin's Maximum Principle.

Electronic Devices:

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:** Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response, multistage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

3. **Digital Systems:** Number systems; Combinatorial circuits; Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs.