

**INDIAN INSTITUTE OF TECHNOLOGY  
DHARWAD**



॥ सा विद्या या विमुक्तये ॥

भारतीय प्रौद्योगिकी संस्थान धारवाड  
Indian Institute of Technology Dharwad

**Department of Mechanical  
Engineering**

Information Brochure

**Ph.D. Admissions**

Spring Semester (2018-19)

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## A. SCHEDULE OF PH.D. ADMISSION

S. No.	Particulars	Dates
1	Availability of online application forms	4 <sup>th</sup> October, 2018
2	Last date for submission of completed application forms	7 <sup>th</sup> November, 2018
3	List of shortlisted candidates for the Selection Process <sup>1</sup>	9 <sup>th</sup> November, 2018
4	Dates for the Selection Process	3 <sup>rd</sup> and 4 <sup>th</sup> of December, 2018
5	Declaration of Result <sup>1</sup>	10 <sup>th</sup> December, 2018
6	Last date for Fee Payment (at IITDh)	28 <sup>th</sup> December, 2018
7	Date of Joining (Reporting & Registration)	31 <sup>st</sup> December, 2018
8	Instruction begins	2 <sup>nd</sup> January 2019
9	Last date of withdrawal	10 <sup>th</sup> January, 2019

## B. ELIGIBILITY FOR ADMISSION

**General Criteria:** M.Tech. / M.E. / MSc (Engg.) or equivalent degree in Mechanical Engineering / Aerospace / Automobile / Chemical / Civil with specialization in either Machine Design or Thermal and Fluid Sciences or related areas.

### 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./MSc-Engineering) is a **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, a relaxation of 5% in the performance at the qualifying degree is applicable.

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<sup>1</sup> Will be announced on the institute webpage

## **C. GUIDELINES FOR SHORTLISTED APPLICANTS**

The following are the important guidelines of the institute to be followed by the shortlisted applicants on the day(s) of the selection process.

1. Shortlisted applicants should report to the institute on 3<sup>rd</sup> of December, 2018 at 8.00 am.
2. No accommodation will be provided for the candidates during the selection process or interview.
3. Applicants should bring:
  - a. Photo ID card (any one from these: PAN/AADHAR/Driving Licence/Voter ID/Passport/Govt. issued ID/Educational Institute ID)
  - b. Printed copy of the application
  - c. Thesis/dissertation/report of M.Tech./M.E./MSc-Engineering or equivalent degree
  - d. Copy of certificates and mark-sheets
  - e. Two recent passport size photographs
  - f. Scientific calculator

### **NOTE:**

- a. Mobiles are not allowed in the examination hall or during the interview(s).
- b. Selection committee decision is final, regarding any disciplinary matters/malpractice.
- c. Candidates are responsible for their own belongings.

## **D. MODALITY OF WRITTEN TEST(S) AND INTERVIEW(S)**

The selection process consists of **two** written tests and an interview. The written tests comprise of an objective and a subjective test, and are referred to as the First Round and the Second Round, respectively. The interview is the Third Round.

Candidates shortlisted based on the selection criteria have to attend the First Round in the area of specialization chosen in the PhD application form based on the syllabus given in Section G. Only candidates selected in the First Round are allowed to write the Second Round. No change in specialization will be allowed. The Second Round comprises of a subjective test appropriate to their chosen specialization in the PhD application form, and the syllabus for the test is detailed in

Section G. Candidates selected in Second round are eligible for the Third round comprising of technical interview. If necessary, an applicant may have to appear before the interview panel more than once. The details of the tests/interview are given in the following sections.

#### **D.1. Details of the First Round**

1. There is a 90-minute objective test to all the applicants.
2. Syllabi for Fluid and Design fields are given in Section G.
3. A user name and a password is given to you to login and start the exam.
4. No changes will be allowed in the choice of field of specialization once specified in the application form.
5. There is negative marking for all answers that are wrongly marked.
6. Submit your answers and logout after your examination.
7. After the examination, the applicants are expected to wait till the short-listing for the second round of selection will be announced.
8. Second round of selection follows immediately after the announcement of the result.
9. It is the responsibility of the applicant to note the results of the first and second round. The results would be displayed at the location/notice board; announced during the test.
10. Results will not be informed to the applicants personally, and no complaints in that regard would be entertained.

#### **D.2. Details of the Second Round**

1. The examination contains 90 minutes of subjective paper.
2. Syllabi for Fluid-Thermal and Design fields are given in Section G.
3. All answers should be written in clear hand writing.
4. Assumptions made should be written down clearly.
5. The results will be announced for the third round of selection process on notice board.

#### **D.3. Details of the Third Round of selection**

1. A personal interview is conducted to each applicant.
2. The applicant is advised to read basics regarding the area of specialization and the topic that he/she has chosen in the application form.

APPLICATION RECEIVED



SHORTLISTED CANDIDATE ATTEND TEST ON DEC. 3<sup>RD</sup>, 2018  
(REFER [SECTION B](#) AND [SECTION C](#) FOR SHORTLISTING AND GUIDELINES, RESPECTIVELY)



APPEAR FOR FIRST ROUND (REFER [SECTION D](#))



SHORTLISTED CANDIDATES (FROM FIRST ROUND) APPEAR FOR SECOND ROUND  
(REFER [SECTION D](#))



SHORTLISTED CANDIDATES (FROM SECOND ROUND) APPEAR FOR THIRD ROUND  
(REFER [SECTION D](#))



SELECTED CANDIDATES (RESULTS DECLARATION, REFER [SECTION A](#))



FEE PAYMENT DEADLINE (REFER [SECTION A](#))

### **Flow Chart for PhD Selection Process**

## **E. APPLICATION CATEGORIES AND FINANCIAL SUPPORT**

The Department of Mechanical Engineering admits Ph.D. candidates under the full time research scholarship, Teaching Assistantship (TA) only.

### **E.1. Teaching Assistantship (TA)**

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 the financial support as per the MHRD norms.

1. For students with M.Tech./M.E./ MSc-Engineering/M.Phil. or equivalent degree as the qualifying degree, the assistantship is payable for a maximum duration of 5 years or up to the thesis submission, whichever is earlier. At present, the monthly rate of assistantship is ₹ 25,000 for the first 2 years and enhanced rate of ₹ 28,000/- for the remaining period.
2. To get the 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.
3. The continuation of the assistantship will be subject to the satisfactory performance of the duties assigned by the Departments as well as satisfactory academic performance.
4. As per MHRD directives, the employees on the rolls (with or without pay) of any organization are not eligible for admission under this 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.
5. Students getting assistantships from the Institute may join projects sponsored by external agencies and obtain corresponding fellowships in lieu of TA ship.

## **F. PROBLEM STATEMENT WITH A BRIEF DESCRIPTION**

There are **six** topics floated in the Department of Mechanical Engineering for the PhD program in this semester. Applicant has to choose one of these topics and fill in the application form.

### **1. Turbulence with an imposed helical initial condition**

- The rotating turbulence is evident as in the natural phenomena such as cyclones, tornadoes or hurricanes. A numerical understanding of physical processes in such flows is proposed. Turbulence may be generated from the special highly symmetric initial conditions in three-dimensional periodic box which then superimposed with a specific type of perturbations so as to generate initial helix.

### **2. Impact of hydrophilic and hydrophobic bodies onto a liquid-air interface**

- It is important to analyze effects when a solid or deformable body (hydrophilic or hydrophobic) impact onto a liquid surface. Analysis of splash, crater or cavity formation, bubble trapped are important in many applications such as industrial coating. A numerical investigations of the impact is proposed using particle based methods.

### **3. Design and development of multi-fingered robotic hand for manipulation**

- Survey of kinematics, statics and control of kinematic linkages that emulate hand, Developing a low cost prototype of multi-fingered hand, Exploring novel mechanisms for robotic hand and novel applications.

### **4. Investigation of swirling flow and flame in the context of gas turbine combustion**

- The employment of swirl flow to stabilize the flame is widespread in modern lean combustors. However, swirl-stabilized flames are susceptible to thermo-acoustic instability or combustion instability. The proposed research herein will aid in understanding underlying fluid mechanics in gas turbine engines in order to gain fundamental insights into unsteady combustion process responsible for these instabilities.

### **5. Frictional instability**

### **6. Computational Solid Mechanics**



## G. SYLLABUS FOR THE WRITTEN TEST

### G.1. Engineering Mathematics: Common for Fluid-Thermal and Design Streams

- **Linear Algebra:** Matrix algebra, systems of linear equations, eigenvalues and eigenvectors.
- **Calculus:** Functions of single variable, limit, continuity and differentiability, mean value theorems, indeterminate forms; evaluation of definite and improper integrals; double and triple integrals; partial derivatives, total derivative, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.
- **Differential equations:** First order equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.
- **Complex variables:** Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.
- **Probability and Statistics:** Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.
- **Numerical Methods:** Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

### G.2. Design Stream

- **Engineering Mechanics:** Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions.
- **Mechanics of Materials:** Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

- **Theory of Machines:** Displacement, velocity and acceleration analysis of plane mechanisms; dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope. Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.
- **Machine Design:** Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.

### G.3. Fluid-Thermal Stream

- **Fluid Mechanics:** Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes and bends, flow in convergent-divergent channels, vorticity and stream-functions, elementary Computational Fluid Dynamics, finite-difference approximation to the first and second order partial derivatives.
- **Heat-Transfer:** Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan- Boltzmann law, Wien's displacement law, black and grey surfaces, view factors radiation network analysis.
- **Thermodynamics:** Thermodynamic systems and processes; properties of pure substances, behaviour of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability and irreversibility; thermodynamic relations.
- **Applications Power Engineering:** Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Air-standard Otto, Diesel and

dual cycles. Refrigeration and air-conditioning: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes.

- **Turbomachinery:** Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines.