

**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 (2020-2021)

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A. SCHEDULE OF Ph.D. ADMISSION

Detailed schedule of the admission process will be announced later on the institute website.

Deadline for submission of online application: ~~5th May~~ 21st May 2020, 11:59 pm.

First shortlist of eligible applicants: 28th May 2020 (tentative)

All potential candidates are requested to visit the institute website regularly for updated information about the schedule, especially in context of ongoing Coronavirus (COVID-19) related developments. Future updates regarding the admission process will be made available on the institute website under section Academics >> Admissions >> PhD.

B. ELIGIBILITY FOR ADMISSION

B.1 Qualifying Degree

M.Tech., MS, ME or equivalent degree in Electrical Engineering, Electronics and Communication Engineering, Electrical and Electronics Engineering, Instrumentation Engineering, Computer Science and Engineering or any related stream. Candidates having M. Sc. in Mathematics and Statistics with valid GATE or NET scores may also apply under appropriate research topics mentioned in Section G.

B.2 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.):

- 1) a minimum of 60% marks (without round off) in aggregate, OR,
- 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.

B.3 Eligibility of applicants who are in the final phase of getting the qualifying degree

Students who are in the final phase of receiving above mentioned qualifying degree and who are likely to graduate before commencement of Autumn 2020 semester of IIT Dharwad are also eligible to apply. However, if offered, the admission to those candidates would be provisional. To join an academic program at IIT Dharwad, such candidates need to furnish necessary documents regarding completion of the degree on the date of joining mentioned in the Section A above. They need to meet the criteria specified in section B.2 above considering an updated score in the qualifying degree. In the meanwhile, the aggregate academic performance announced by the respective university till the last date for submission mentioned in section A should be used to determine eligibility for application and same to be reported in the online application.

C. APPLICATION CATEGORIES & FINANCIAL SUPPORT

The Department of Electrical Engineering admits Ph.D. candidates under the full time research scholarship or Teaching Assistantship (TA) and part-time externally sponsored research scholars.

C.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 financial support as per the MHRD norms.

1. For students with M.Tech./M.E./M.Sc.(Engg.)/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 ₹ 31,000 for the first 2 years and enhanced rate of ₹ 35,000/- for the remaining 3 years and HRA as per rules.
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.

C.2 Externally sponsored part-time Ph.D. (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. 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. 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:

1. The competence of these candidates will be assessed along with the regular candidates.
2. On the day of selection process, the candidate should submit a Sponsorship Certificate (Appendix A) from the organization in which he / she is employed giving an undertaking that the candidate would be released from the normal duties to fulfill 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.

3. 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.
4. 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.
5. 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 progress in courses / seminars / approved research programme by a Research Progress Committee (RPC) nominated by the concerned Department Postgraduate Committee (DPGC).
6. At the time of joining the programme, the student 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. GENERAL GUIDELINES for APPLYING ONLINE

1. Please read all the instructions given in the brochure carefully before filling up the application form.
2. Application fee has to be paid prior filling online application. The transaction details such as Reference No, Transaction Date and Name of the Account Holder have to be mentioned accurately in the application form. **The contact number mentioned in the remarks/comments field of the online payment mechanism has to match with the one which will be entered while filling the application form.** It is also recommended to upload a proof of payment of application fee in pdf format just before submission of the online form.
3. This information brochure and future updates regarding the admission process will be made available on the institute website under section Academics >> Admissions >> PhD.
- 4.
5. You are required to submit the application form online. There are no downloadable forms available. After filling the form, you are advised to take a print and keep the same for future reference.

6. The application fee is as follows,

Women candidates	₹ 100/-
SC/ST/PwD category candidates	₹ 100/-
All other candidates	₹ 200/-

7. The fee is to be paid by NEFT/RTGS Online Payment System. The details of the institute bank details are:

BANK: State Bank of India
Account Name: REGISTRAR IIT DHARWAD
Account No.: 35636327083
Branch: Main Branch, Dharwad
IFSC: SBIN0000833

8. The transaction details like: UTR/ITR/Transaction Number with date are to be necessarily provided in filling up the Online Application Form. **The Application Form without valid online payment details will not be considered. Application FEE is Non-Refundable.**

9. Applicants may find it convenient to keep following information handy while filling the application form online (whichever relevant): i) Skype Id, ii) passport size photo whose size is less than 300 kB, iii) application fee transaction details of application fee payment e.g. reference no, date of transaction, Name of account holder, phone no used for online payment, iv) Educational details from secondary school onwards, v) GATE qualification details, vi) proof of application fee payment (pdf file), vii) list of fellowship/ awards, viii) publications, ix) any other achievements/information.

10. Economically Weaker Sections (EWS) candidates may note that the limit of annual income is ₹ 8 lakhs for determining the eligibility for benefit under Economically Weaker Sections (EWS) reservation. The EWS certificate issued by the Competent Authority in the prescribed format must be submitted at the time of admission.

11. Candidates belonging to OBC – NC (Non Creamy layer) as per Government of India norms should produce certificate from competent authority at the time of selection.

12. Check your emails regularly for any updates from the institute regarding the selection process

13. Keep checking the institute website regularly for updates regarding the selection process. Shortlisted candidates list will be uploaded on the institute website as per the schedule given above.

Candidates called for written test / interview should bring with them Photo ID Card, Admit Card, Printed Copy of Online Application Form, Photocopies of Academic Transcripts & Experience Certificates, Caste Certificate (if applicable), PwD Certificate (if applicable), EWS Certificate (if applicable), Thesis/Dissertation/Report/Publications and all other relevant documents.

E. GUIDELINES for SHORTLISTED APPLICANTS

E.1 General information

1. The candidates who fulfil the minimum eligibility criteria, given in Section B, are recommended to have an interaction via video conferencing (VC) with faculty members from the Department of Electrical Engineering, IIT Dharwad. The VC interaction will serve two purposes: (i) it will provide an opportunity to the candidates for clearing any doubt regarding research facilities, research interests of faculty members, campus life in IIT Dharwad etc., and (ii) it will have a mock interview component to help the candidates in preparing for in-person interview(s) which will be held at IIT Dharwad. **The candidates will not be assessed in the VC interaction and it will not carry any weightage in the final selection.**

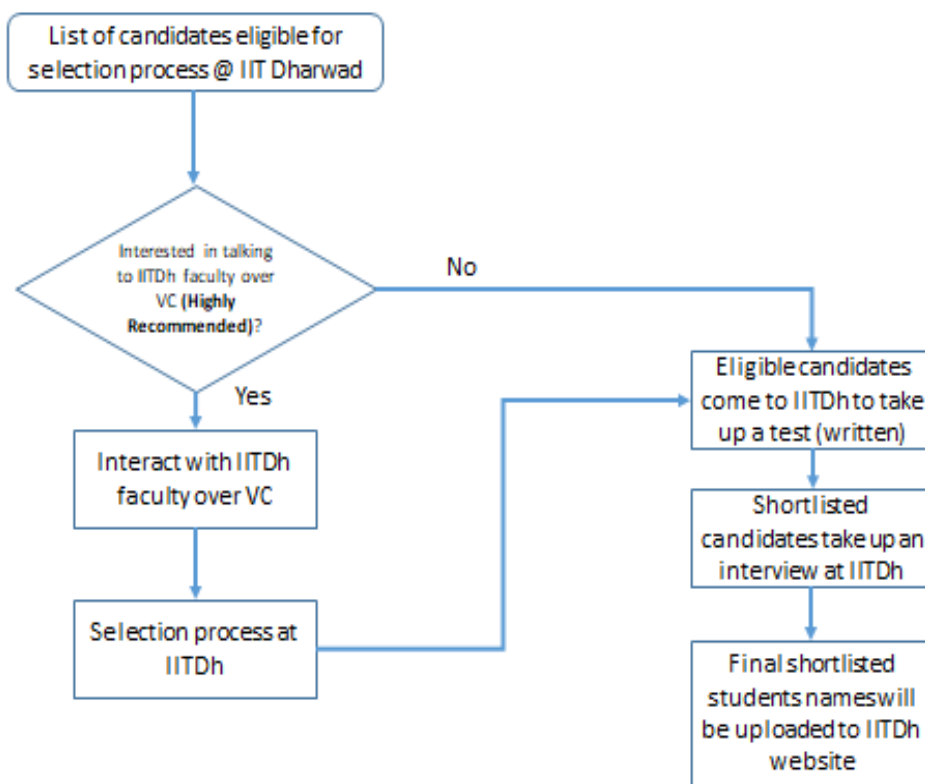


Fig 1: Selection process at the Department of Electrical Engineering, IIT Dharwad. VC refers to video conferencing using Skype, Zoom etc.

2. The candidates who fulfil the minimum eligibility criteria, given in Section B, will be asked to come in-person to IIT Dharwad for a screening test and personal interview. We will release a list of eligible candidates on our website.
3. Reporting Time at IIT Dharwad: **To be announced online.**
The candidates are advised to do a self-check to find out whether they qualify the minimum eligibility criteria given in Section B. If they qualify, as soon as the reporting day/time is announced, the candidates are advised to book train/flight/bus tickets to IIT Dharwad to avoid last minute hassle in travelling to Dharwad.
4. Online screening test will begin on: **To be announced online.**

5. Based on the performance in the online screening test, some of the candidates will be shortlisted for the personal interview scheduled on the same day.
6. Screening test and interview in IIT Dharwad will most likely be completed in one day only, however, it might be extended by another day depending on the number of candidates. Fig. 1 gives a summary flowchart of the selection process.
7. Very limited **accommodation/transportation *may be facilitated*** during the written test/interview. Details will be decided later and the institute reserves the right to cancel the same at short notice depending upon the future circumstances.
8. 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. Scientific calculator
 - g. Copy of publications (if any)

E.2 Examination policy

1. Mobiles are not allowed in the examination hall or during the interview.
2. Candidates are responsible for their own belongings during the selection process, especially, the items that you leave outside before entering the examination hall.
3. Candidates are required to bring all documents mentioned in section E.
4. Delayed candidates may not be allowed to take the exam after 20 minutes of exam start time and no one will be allowed to leave the exam hall before 30 minutes once examination is started.

F. MODALITY OF THE SELECTION PROCESS

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

The selection process consists of one screening test and one personal interview.

Candidates shortlisted based on the selection criteria are eligible to attend the screening test. There will be objective-type questions, based on the syllabus given in Section H.

Candidates selected in screening tests are eligible for the personal interview. The details of the tests/interview are given in the following sections.

F.1 Details of the first Round- Online Screening Test

1. This is a 60-minute objective-type test to be taken by all the eligible applicants.
2. Syllabus is given in Section H.
3. A user name and a password will be given to login and start the exam.
4. There will be negative marking for wrong answers.
5. Submit your answers and logout after your examination.

6. Second round of selection follows immediately after the announcement of the result.
7. 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.

F.2 Details of the Second Round- Personal Interview

A personal interview is conducted for each applicant who is successful in the screening test.

The applicants are advised to study basics of the area of specialization and the topic that he/she has chosen in the application form.

G. RESEARCH TOPICS

The research areas are broadly classified in eight streams as described below. **The applicant MUST indicate the choice of the research topics in an 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, federated learning, deep learning etc.
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, millimeter wave (mmWave) communications, energy harvesting based communications and low-latency communications, federated learning in communication constrained scenarios, Machine Learning for communication problems etc.
3. **Performance modelling:** Modelling and analysis of stochastic systems to meet desired performance objectives. Research topics include the study of queueing systems for computer and communication networks, stochastic networks, epidemic models and load balancing systems for grid or cloud computing platforms.
4. **Control and Robotics:** Including but not limited to Control of Robots through Speech Signals, Autonomous Vehicles, Control for Differential Games, Control of Structures etc.
5. **Electronic Devices:** Including but not limited to Gas sensors, Nano-electronics etc.
6. **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.
7. **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.
8. **Power & Energy Systems:** Power system stability and control; Synchrophasor applications to power systems protection, monitoring and control; Microgrid; Impact of renewables, battery energy storage and Electric Vehicles on Grid; Smart Grid; Power Electronics and converters for Electric Vehicle; Power Electronics and converters for

Renewable Energy; Medium voltage hybrid DC circuit breakers; Grid connected multilevel inverters; high voltage power electronics and control; Electric drives for Electric Vehicles and chargers wide bandgap device (SiC and GaN) based converters, soft-switched and resonant converters.

Note: Candidates having M. Sc. in Mathematics and Statistics with valid GATE or NET scores are encouraged to apply under Signal Processing and/or Communication Technologies specializations.

H. SYLLABUS

Common for all the streams

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

Stream 1: Communication and Signal Processing

1. **Basic Electrical Networks:** KCL, KVL, Node and Mesh analysis, Network theorems etc.
2. **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.
3. **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

1. Basic Electrical Networks: KCL, KVL, Node and Mesh analysis, Network theorems etc.
2. Mathematical modelling 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. **Basic Electrical Networks:** KCL, KVL, Node and Mesh analysis, Network theorems etc.
2. **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.
3. **Analog Circuits:** Basics of Analog circuits.
4. **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:** 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; isolated 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 and 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; control schemes for motors and generators.

I. INFORMATION PERTAINING TO HOSTELS

About IIT Dharwad	Kindly visit the website https://www.iitdh.ac.in/ for available facilities
Hostel Room Allocation	You will be given your room key at the time of registration. Each room accommodates three/four students and has an attached bath & toilet.
Are hostel rooms furnished	Each student is given a cot, chair, table and wardrobe. Students can purchase mattress/bedding, bucket etc. locally.
Possession of motorized vehicle	NOT ALLOWED, however bicycles are permitted.
Climatic conditions	IIT Dharwad is located on the outskirts of Hubballi-Dharwad twin city, in lush green and serene surroundings with pleasant climate throughout the year. The average yearly temperature is about 24.3 ⁰ C. The Western Ghats (Sahyadri) is one hour drive from IIT Dharwad.

J. FEES, DEPOSITS & HOSTEL RENT

S. No	Amount (INR)	Amount (in INR) for General/OBC/EWS	Amount (in INR) for For SC/ST/PwD
A. One-time payment at the time of admission			
1	Admission fee	2,200.00	2,200.00
2	Graduation transcript fee	500.00	500.00
3	Medical examination	400.00	400.00
4	Provisional certificate	500.00	500.00
5	Student welfare fund	1,000.00	1,000.00
6	Modernisation & upgradation	2500.00	2500.00
7	Identity card	500.00	500.00
	Sub-total (A)	7,600.00	7600.00
B. Per semester fee			
1	*Tuition Fee-Statutory fee	5,000.00	00.00
2	Examination fee	1,000.00	1,000.00
3	Registration fee	750.00	750.00
4	Gymkhana fee	1,750.00	1,750.00
5	Student benevolent fund	500.00	500.00
6	Medical fee	1,500.00	1,500.00
7	Hostel rent	2,000.00	2,000.00
8	Electricity & water charges	3,000.00	3,000.00
9	Hostel establishment charges	3,000.00	3,000.00
10	Mess establishment charges	1,550.00	1,550.00
11	Student association insurance fund	200.00	200.00
	Sub-total (B)	20,250.00	15,250.00
C. Deposits (refundable) to be paid at the time of admission			
1	Institute security deposit	1,000.00	1,000.00
2	Library security deposit	1,000.00	1,000.00
3	Mess security deposit	1,000.00	1,000.00
	Sub-total (C)	3,000.00	3000.00
GRAND TOTAL FEE (A+B+C)		30,850.00	25,850.00

NOTE:

1. All the students are required to submit the **Mess Advance of ₹ 26,000.00/-** per semester by online payment method along with the course fee. Students will get breakfast, lunch, afternoon snacks and dinner in mess.
2. * Students admitted under External category (EX) will pay tuition-statutory fee of ₹ 25,000/- per semester (**Grand total fee of ₹ 50,850/-**). It shall be noted institute will

incur semester continuation fee of ₹ **5000/-** when a candidate joins parent organization after finishing the required course work at IIT Dharwad.

3. * IIT Dharwad reserves the right to revise the tuition fee-statutory fee.

Appendix A: Sponsorship Certificate for Ph.D. External Registration (EX)

(To be typed on letterhead of the Sponsoring Organization)

Name of the applicant:

Name of the sponsoring organization:

Address:

Present Designation of the applicant:

Present status of the applicant: (Permanent/Semi-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.

Date:

Signature of proposed Co-supervisor (external)

=====*****=====

Statement of sponsoring authority

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, 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 Shri. /Kum. / Smt./ Dr. _____

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.

Date:

Signature and Seal of the Sponsoring Authority

=====*****=====