

**INDIAN INSTITUTE OF TECHNOLOGY
DHARWAD**

**Information Brochure
Ph.D. Admissions
2017-18**

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IMPORTANT INFORMATION

Important Guidelines for Ph.D. Application

1. Please read the instructions given in the brochure carefully before filling up the application form
2. **Online Application Form** and the Information Brochure are available on the Institute website at the following link: <http://www.iidth.ac.in/academics/phd.php>.
3. You are required to submit the application **ONLINE**. No downloadable forms will be available. After filling the form, you are advised to take a print of your application and keep the same for the record.
4. The application fee is as follows:
 - a. Women candidates: ₹ 100/-
 - b. SC/ST/PwD category candidates: ₹ 100/-
 - c. All other candidates: ₹ 200/-

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: IIT Bombay (IIT Dharwad)

Account No.: 35636327083

Branch: I.I.T. (Powai)

IFSC: SBIN0001109

MICR: 400002034

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.**

5. **Application FEE is Non-Refundable**
6. Only one application is accepted from one candidate. Each candidate can apply for only one department.
7. Statement of Purpose:

- a. Along with your application, you have to submit a Statement of Purpose for all academic units.
 - b. If you are applying in the Department of Humanities & Social Sciences, you need to submit Statement of Purpose as well as a research proposal along with the application form.
8. You should complete the application form in all respects. Incomplete application will not be considered.
9. The limit of annual income for OBC-NC is ₹ 6 lakhs. The OBC-NC certificate issued for the financial year for 2016-17 by the Competent Authority in the prescribed format must be uploaded in the ONLINE application and submitted at the time of admission.
10. Seats are reserved for Other Backward Class-Non-Creamy layer (OBC-NC)/ Scheduled Caste (SC)/ Scheduled Tribe (ST) /Person with benchmark disability (PwD) category, as per Government of India rules.
11. You should check the Institute website for results / important announcements.
12. You should check emails sent to the email address provided in your application for all important communications and announcements.
13. Shortlisted candidates called for selection process (written test/interview) should bring the following with them:
 - a. photo ID Card,
 - b. printed copy of the application submitted online,
 - c. thesis / dissertation / report / publications,
 - d. copy of certificates and mark-sheets along with originals and
 - e. two passport size photographs.
14. Candidates having degree from foreign universities should submit equivalence certificate from Association of Indian Universities (AIU), New Delhi for qualifying Exam and proof of having First class or 60% (55% for SC/ST) marks or equivalent in qualifying examination.
15. Admitted students must submit self-attested copies of his/her qualifying degree certificate / final transcripts within one month of joining the Institute, failing which, admission will stand cancelled.

SCHEDULE OF PH.D. ADMISSION

The dates given below are tentative. Any changes in the dates will be indicated on the website.

S. No.	Particulars	Dates
1	Advertisement (in all leading Newspapers and on website)	18 th November, 2017
2	Availability of online application forms	18 th November, 2017
3	Last date for submission of completed application forms	3rd December, 2017 8 th December, 2017
4	List of shortlisted candidates for the Selection Process ¹	To be declared
5	Dates for the Selection Process	To be declared
6	Declaration of Result ²	To be declared
7	Registration and Orientation Programme (tentative)	To be declared
8	Instructions begin (tentative)	To be declared

¹ List of shortlisted candidates for the selection process will be announced on the institute webpage

² Results will be declared on the institute webpage

A. GENERAL

A.1. The Institute

Indian Institute of Technology Dharwad (IIT Dharwad) is a premier Science and Technology Institute established in 2016 under the mentorship of IIT Bombay. The institute is set up with the objectives of making available facilities for higher education, research and training in various fields of Science and Technology. Academic activities started from July 2016 session with B.Tech. courses in three core branches namely Computers Science, Electrical and Mechanical Engineering. At present, the intake is 40 students in each specialization. The current campus is situated in WALMI, near the Dharwad bench of High Court. All the major facilities in Dharwad are within 10 km radius from the campus. About 470 acres of land has been provided by the Karnataka Government for the permanent campus of IIT Dharwad about 2-3 km away from existing campus. Campus development and establishment of infrastructure are being taken up. The Doctoral Programme (Ph.D.) is being introduced by the Departments of BioSciences and BioEngineering, Chemistry, Computer Science and Engineering, Electrical Engineering, Humanities and Social Sciences, Mathematics, Mechanical Engineering and Physics from the Spring Semester of Academic Year 2017-18.

A.2. Student Amenities

All the students are provided with on-campus hostel accommodation. A well-equipped dining hall is functioning and the second student mess will be ready soon at the upcoming gymkhana. Students are drawn from nearly 20 states across the country thus providing a holistic environment for their growth. IIT Dharwad has a 10% girl student population. Sports facilities are being setup on campus (volley ball, football, cricket etc.). In addition, students are permitted to use neighbouring University of Agricultural Sciences grounds. Astronomy Club, Electronics Club, Music Club etc. are active. More facilities and activity centers will be ready shortly. Limited medical facilities have been arranged.

A.3. Ph.D. Programme

A.4. Eligibility Criterion for Ph.D. Admission

General eligibility criterion for admission across all the departments:

Discipline	Engineering	Basic Sciences	Humanities and Social Sciences
Qualifying Degree	M. Tech. or equivalent degree	M. Phil./M.Tech. or equivalent B. Tech./B. E./ M. Sc. or equivalent	M. Phil or equivalent M. A. or equivalent
Minimum marks/CPI in Qualifying Degree	Marks: 60% (55% for SC/ST candidates) OR CPI/CGPA: 6.0 (5.5 for SC/ST candidates) on the scale of 10	Marks: 60% (55% for SC/ST candidates) OR CPI/CGPA: 6.0 (5.5 for SC/ST candidates) on the scale of 10	Marks: 55% (50% for SC/ST candidates) OR CPI/CGPA: 5.5 (5.0 for SC/ST candidates) on the scale of 10
Additional Requirements	Qualifying score (not necessarily valid) in one of the national level examinations (GATE, NET etc.) is desirable	If a candidate does not have M. Phil./M.Tech. or equivalent degree, the candidate MUST fulfil any one of the following: Valid GATE score Junior Research Fellowship (JRF) of CSIR/UGC/NBHM/DBT/ICAR/ICMR/ICPR/PMRF or DST INSPIRE Fellowship	If a candidate does not have M. Phil. or equivalent degree, the candidate MUST fulfil any one of the following: Junior Research Fellowship (JRF) of UGC/PMRF or other equivalent fellowship UGC-NET Lectureship (LS)

- In addition to the general eligibility criterion, the applicant must satisfy the eligibility criteria specified, if any, in the respective departments. Further, the eligibility criteria for financial support for specific category has to be satisfied.
- Candidates in the final year of their qualifying degree programme may also apply. However, these candidates may be admitted provided they graduate before the beginning of the Ph.D. programme.
- Mere satisfaction of the eligibility criteria does not entitle a candidate to be called for the selection process. Based on number of applications, each department may specify higher cut-offs for shortlisting.

A.5. Requirement of First Class/60%/CPI of 6.0 on the scale of 10 for PG admissions at IIT Dharwad

For general/OBC category candidates and/or for candidates where no concession in academic performance is called for, the First Class/60%/CPI of 6.0 on the scale of 10 in the qualifying degree examination as the eligibility requires meeting ANY ONE of the following criteria:

1. a minimum of 60% marks in aggregate or as specified by the university (any one of them).
2. a First Class as specified by the university (higher of 60% or the percentage specified by the university for First Class will be considered).
3. a minimum Cumulative Grade Point Average (CGPA) or Cumulative Performance Index (CPI) of 6.0 on the scale of 10; with corresponding proportional requirements when the scales are other than on 10, (for example, 4.8 on a scale of 8).

For SC/ST category candidates, the corresponding criteria are:

1. a minimum of 55% marks in aggregate or as specified by the university (any one of them).
2. a First Class as specified by the university (higher of 55% or the percentage specified by the university for First Class will be considered).
3. a minimum Cumulative Grade Point Average (CGPA) or Cumulative Performance Index (CPI) of 5.0 on the scale of 10; with corresponding proportional requirements when the scales are other than on 10, (for example, 4.4 on a scale of 8).

For admission in the Department of Humanities and Social Sciences, the cut-offs are relaxed to 55% or CPI of 5.5 on the scale of 10 (50% or CPI of 5.0 on the scale of 10 for SC/ST candidates).

A.6. Application Categories and Financial Support

The Institute admits Ph.D. candidates under the following categories:

Full Time Research Scholar

A full time research scholar can belong to one of the following types:

1. **Teaching Assistantship (TA):** Funded by MHRD. The TAs are expected to assist in the academic/administrative work for smooth functioning of the Institute
2. **Project Staff-Teaching/Research Assistantship through Project (PS-TAP/RAP):** The students admitted in this type are funded from the specific sponsored projects. They are expected to assist in the academic/administrative work of the Institute.
3. **Govt./Semi Govt. Fellowship Award (FA) (CSIR, UGC, DAE, DST Inspire, DBT, NBHM, PMRF etc.):** Candidates who have been awarded any government/semi- government fellowship, specifically, for doing Ph.D. are considered for admission under FA category. Students admitted under this type receive their funding from the agency that has awarded the fellowship. They are expected to assist in the academic/administrative work for the smooth functioning of the Institute.
4. **Sponsored Candidates (SW):** The sponsored candidates receive their funding from their parent organizations.

Part Time Research Scholar

The part time research scholars can belong to any of the following types:

1. **External candidates, sponsored by recognized R & D organizations (EX):** The funding source is the parent organization.
2. **College Teacher (CT):** Teachers from the AICTE/UGC approved colleges in the vicinity of IIT Dharwad can apply in this category. Their funding source is the parent institute.

A.6.1. Teaching Assistantship (TA)

Students under this category are entitled to financial support as per MHRD norms.

1. For students with M.Tech./M.E./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. For students with M.A./M.Com. or equivalent as the qualifying degree and having NET lectureship may be considered for admission under TA category in the Department of Humanities and Social Sciences. 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 two years and enhanced rate of ₹ 28,000 for the remaining period.
3. 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.
4. The continuation of the assistantship will be subject to satisfactory performance of the duties assigned by the Departments as well as satisfactory academic performance.
5. Employees on the rolls (with or without pay) of any organization are not eligible for admission under this category.

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. The candidates who are employees of any organization and do not plan to resign, may be considered under SW category, if found suitable. Students getting assistantships from the Institute may join projects sponsored by external agencies and obtain corresponding fellowships in lieu of TA ship.

A.6.2. Project Staff-Teaching/Research Assistantship Through Project (PS-TAP/RAP)

The students under this category receive financial support from sponsored projects. The candidates do not have to indicate their preference for TAP separately. The rate of stipend, the admission procedure and other requirements are same as applicable to TA, except that these

students may be assigned research related to the specific projects in place of other duties assigned to TAs.

A.6.3. Fellowship Award (FA)

These students are financially supported under various Govt. / Semi Govt. schemes like CSIR, UGC, DAE, DST, DBT, NBHM, PMRF or DST INSPIRE etc. and some other organizations. The admission procedure and other requirements are same as applicable to TA.

A.6.4. Sponsored Candidate (SW)

These students are sponsored by their employers for doing research work in the Institute. They are expected to be released for full-time course-work and research at the Institute for a minimum period of three years. They will not receive any financial support from the Institute. Sponsorship letter (Appendix I) should be submitted at the time of written test and/or interview.

A.6.5. 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:

1. The competence of these candidates will be assessed along with the regular candidates.
2. The candidate should submit at the time of application, a Sponsorship Certificate (Appendix I) 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. 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 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.

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 his progress in courses / seminars / approved research programme by a Research Progress Committee (RPC) nominated by Academic Progress Evaluation Committee (APEC).
6. 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 (they may apply under CT).
7. **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.**

A.6.6. College Teacher (CT)

The candidates employed as faculty members in Colleges and Universities in the vicinity of IIT Dharwad and desirous of pursuing Ph.D. Programme while in employment and without availing study leave may apply for admission under this Category. The admissions are based on the following norms:

1. The competence of these candidates will be assessed along with the regular candidates.
2. The candidate should submit at the time of application, a “NO OBJECTION CERTIFICATE (NOC)” (Appendix III) from the College/University in which he / she is employed giving an undertaking that the candidate would be relieved from the normal duties to fulfil the coursework requirements.
3. The candidate is required to fulfil the coursework requirement (and qualifier examination, if applicable) of his/her Ph.D. Programme which 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.
4. After fulfilling the coursework requirements, 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. Appointment of external co-supervisor is optional based on recommendations of the supervisor and APEC.

5. Candidates admitted under this category will be treated on par with SW category as far as payment of fees and deposits are concerned.
6. Place for research will be treated as IIT Dharwad even though candidate may be carrying out part of the work at their Institute. These candidates are required to be available with the Supervisor (internal) for interaction during weekends, holidays and vacations.

A.7. Admission Procedure

Admission is offered on the basis of an interview. The interview may be supplemented by a written and/or online test, if necessary. Merely satisfying the general eligibility criterion as well as criterion set for each admission category is no guarantee for being called for test/interview. Depending on the number of applications received and considering the constraints of time and other resources for conducting Written/online Test and Interview, the Academic Units may put additional academic performance based shortlisting criterion.

Candidates called for the selection process under the Teaching Assistantship (TA) category, only candidates belonging to SC/ST and PwD categories will be paid single second class return railway fare by the shortest route (as per rules) from their place of residence to the Institute. They have to produce evidence (Original/Photocopy of Railway Ticket) in support of their claim. A candidate called for more than one discipline, can submit only one claim.

A.8. Registration for the Ph.D. Degree

After a candidate has been admitted to the Institute, he/she has to make an application on a prescribed form for registration for the Ph.D. degree. This application will be considered by the Academic Progress Evaluation Committee (APEC) which will make appropriate recommendations to the Senate regarding (a) the course work prescribed for the candidate and (b) the date of registration.

The period of validity of Ph.D. registration for all candidates is FIVE/SIX years from the date of confirmation of registration (Registration is confirmed as per rules, after successfully completion of course credit requirements).

A.9. Confirmation of Registration

All Ph.D. admissions are provisional until the “Confirmation of Registration” is completed. This confirmation takes place after six months to a year after admission, and only if academic performance criterion set by the department is met. Failure to meet the satisfactory performance criterion may lead to termination of studentship.

A.10. Submission of Thesis and the Award of Degree

Subject to fulfilling the course credit requirements and other conditions as may be laid down from time to time, the candidate may submit the Ph.D. thesis after two years from the date of registration (3 years for external candidates). The thesis is examined by two/three referees from outside the Institute. The Senate examines the reports of the referees and on acceptance of the thesis, appoints a Board of Examiners to conduct a viva-voce examination at which a candidate is required to defend the thesis. On the basis of the report of the Board of Examiners, the Senate decides the student's eligibility for award of the degree of Doctor of Philosophy.

B. INFORMATION ON DEPARTMENTS

In addition to the eligibility requirements as given in Section A.4, the candidate should also fulfil the requirements for the admission in the disciplines and specializations of their choice.

B.1. Department of BioSciences and BioEngineering (BB)

B.1.1. Eligibility for admission

B. Tech./B. E./ M. Sc. or equivalent in Bioinformatics /Biotechnology /Computer science /Organic chemistry or other allied biology subjects.

B.1.2. Problem statements with brief description

1. Identification of novel mutation, copy number aberration and other genetic in various cancer types

- Selected candidate will be using high throughput data available from different databases and analyze it to identify genetic and epigenetic aberrations.
- **Essential Skills:** Candidates should have basic knowledge of Bioinformatics and Biostatistics
- **Desirable Skill:** Candidates ought to have a quantitative or computational track record and an inclination to work in interdisciplinary areas across biology, medicine, computational sciences and engineering

2. Structure based design and synthesis of potent organic small molecular inhibitors for cancer

- Selected candidate will be extensively participated in the synthesis of organic small molecules and study their drug like nature and potency towards cancer.
- **Essential Skills:** Candidates should have sound knowledge of organic synthesis

B.1.3. Syllabus for the Written Test

- **Bioinformatics:** Major bioinformatics resources (NCBI, EBI, ExPASy); Sequence and structure databases and analysis, Sequence analysis, Phylogeny, Comparative genomics; Molecular modeling and simulations. Overview and functions of a computer system; Basics of database management system- Conceptual Schema, ER diagrams, normalization and SQL. Basics of programming; Statistics: Descriptive statistics, Correlation and regression, Hypothesis Testing, Probability theory.

- **Biochemistry, Molecular & Cell Biology, Genomics:** Biomolecules, Metabolism, Membrane transport, Structure and regulation of prokaryotes and eukaryotes genes, Transcription, Translation, Post-transcriptional and Translational modifications, Molecular interaction, Phylogenetics, Molecular markers, Genetic and physical mapping, Gene interaction; Population genetics, Genetic engineering; Cloning and expression vectors, rDNA technology, Gene cloning approaches, Whole genome sequencing & annotation, High throughput gene expression and Function elucidation technologies, PCR, Blotting techniques, Gene transfer technologies, Protein-protein interactions, Mass spectrophotometry, Signal transduction pathways and their elucidation, Primary and secondary metabolic pathways, Systems biology frameworks for metabolic engineering, Nanobiotechnology, Genomics and proteomics.
- **Synthetic organic chemistry:** Organic name reactions, Organic reagents, Molecular spectroscopy, Photochemistry.

B.2. Department of Chemistry (CH)

B.2.1. Eligibility for Admission

First Class or 60% marks (55% marks for SC/ST), as specified in as given in Section A.4, in the qualifying degree: M.Phil or M.Sc. or equivalent degree with NET qualification (JRF)/Valid GATE/Awarded Fellowship.

B.2.2. Problem statements with brief description

1. π -Conjugated polycyclic aromatic hydrocarbons: NIR absorbing and emitting materials and Organic open shell biradical molecules

- The electron delocalization along the polycyclic aromatic structure gives rise to interesting electronic and optical properties. With the discovery of graphene, the research on the PAHs have gained a new impetus with the prospect of its application in molecular electronics such as organic field effect transistors (OFETs), Organic light emitting diodes (OLEDs) and solar cells. Apart of the semiconducting device applications, PAHs have also been utilized extensively for the fluorescence based applications and sensors etc. Despite of high importance of PAHs in various fields, the highly π -conjugated systems suffer photo- and air-instability and often involves tedious synthesis. Therefore, developing new and stable PAHs with superior semiconducting properties and NIR absorbing/emitting properties via various simplified synthetic strategies as well as addressing the factors influencing the stability are of inevitable importance. In addition, organic open shell biradicals, a subclass of the above mentioned molecules are also of great interest in spintronic device applications and boosting the solar cell theoretical efficiency. Thus, our group is interested in developing photo- and air-stable π -conjugated organic systems and exploit their applications in organic materials.
- **Essential Skills:** General/Organic/Inorganic Chemistry

2. π -Conjugated two-dimensional crystalline/amorphous organic porous polymers

- Two-dimensional (2D) materials have received wide attention since the demonstration of high charge mobility in graphene, that is often named a discovery of the century in solid state physics. Despite its many remarkable properties, graphene is a zero-band gap polymer which makes its application in

semiconducting devices difficult if not impossible and further any chemical modification of graphene introduces sp^3 defects which break π -conjugation and thereby destroy the special electronic properties of the material. Therefore, the 2D conjugated polymers constructed of organic building blocks are envisaged to be potential alternative candidates to graphene in terms of introducing bandgap and ease of altering electronic topology. To date, several 2D π -conjugated polymers have been synthesized as crystalline covalent organic frameworks (COFs) or amorphous porous organic polymers. One general problem of all approaches is a lack of versatile building blocks (monomers) capable to maintain direct π -conjugations in several directions, and, as a result, very limited electron delocalization in the currently accessible 2D polymers. Thus, we would like to design and synthesis 2D-organic polymers which will have efficient two-dimensional electronic delocalization and evaluate the electronic properties of these materials.

- **Essential Skills:** General/Organic/Inorganic Chemistry

B.2.3. Syllabus for the written test

Coordination chemistry, Organometallic chemistry, Photochemistry, Organic name reactions, Molecular spectroscopy.

B.3. Department of Computer Science and Engineering (CSE)

B.3.1. Eligibility for Admission

- Students with MSc Degree: Valid GATE score or CSIR/UGC fellowship
- Students with M.Tech. Degree: GATE score

B.3.2. Broad Research Areas

- 1. Theoretical computer science**
- 2. Formal methods**
- 3. Concurrency**
- 4. Automata theory**

B.3.3. Syllabus for the written test

- Discrete Mathematics: Sets and relations, counting techniques, pigeon hole principle, partial orders.
- Elementary probability theory
- Automata theory: Regular languages, context-free languages, Turing machines, computable and non-computable functions.
- Algorithms: O notation, recurrence relations, sorting and searching (bubble sort, insertion sort, merge sort, quick sort, heap sort, binary search).
- Data Structures: Lists, stacks, queues, heaps, binary search trees.
- Graphs: basic definitions, trees, bipartite graphs, matching in bipartite graphs, breadth first search, depth first search, minimum spanning trees, shortest paths.
- Algorithmic Techniques: dynamic programming, greedy algorithms, divide and conquer
- Logic: Boolean logic, Boolean circuits, truth tables

Suggested Book Reading:

1. How to solve it, by R G Drome. Prentice-Hall
2. Graph Theory, by Frank Harary. Narosa
3. Algorithm Design, by Jon Kleinberg and Eva Tardos. Pearson
4. Elements of Discrete Mathematics, by C. Liu. McGraw Hill

5. Introduction to Automata theory, Languages and computation, by John Hopcroft and Jeffrey Ullman. Addison-Wesley.

B.4. Department of Electrical Engineering (EE)

B.4.1. Eligibility for Admission

First Class or 60% marks (55% marks for SC/ST), as specified in as given in Section A.4, in the qualifying degree: M.Tech./M.E. or equivalent degree in Electrical Engineering, Electronics and Telecommunication/Communication Engineering, Instrumentation, Control, Mechanical Engineering, Aerospace Engineering and Computer Science and Engineering.

B.4.2. Communication Engineering

Broad Research Areas

- Caching in heterogeneous cellular networks
- Placing and control of VMs in next generation wireless systems
- Distributed stochastic optimization
- Channel estimation in mm-Wave communication
- Incentive mechanism design for next generation wireless systems

Problem Statements with Brief Description

1. Caching Policies in Heterogeneous Cellular Networks with “Probably Approximately” Good Performance

- Unprecedented increase in the demand for data from multimedia devices such as smartphones and tablets, especially in a country like India, has increased the mobile data traffic by several folds. For example, 64% of the total mobile data traffic is mainly due to video applications alone, which is expected to continuously increase in the next decade as well. A well-known way of supporting this data demand is by increasing the data capacity of both the backhaul links as well as the cellular Downlink (DL)/Uplink (UL) networks. However, the cost incurred in increasing the BW of the backhaul links turns out to be uneconomical. One potential solution is to bring the data closer to the user by storing the data either in the Base Station (BS) or at the devices by anticipating for the users’ demand; this is termed as caching. Caching depends on the users’ request patterns, and mobility. Broadly, an important question to ask is which file should be stored where? This research work focuses on

answering this question by formulating an optimization problem, and providing a solution that is practical and has provably good performance.

2. Mechanism Design for Future Cellular Systems

- One of the key technology enablers for the next generation wireless systems is co-operation using direct point-to-point links across user nodes, for example LTE-direct. This cooperation can be in the form of users acting as relays or the users storing the “relevant” files and serving to the nearby nodes when requested. However, the extent of co-operation depends on the incentive that each node gets. For example, storing a particular file and serving them incurs a cost. Users are encouraged to store and serve the requested files through incentives provided by the cellular operator. However, this leads to conflict since other users can also potentially provide the same file for less cost. This conflict will be modeled using a game theoretic approach, and the performance of the entire system will be investigated.
- **Essential Skills:** The candidates should have a graduate level understanding of probability theory, wireless communications, detection and estimation theory. More importantly, the students should have an inclination towards analytical thinking.
- **Desirable Skills:** A graduate level understanding of optimization theory (convex), information theory, matrix theory, and game theory would be desirable.

B.4.3. Control and Computing

Broad Research Areas

- Linear Systems Theory
- Optimal Control and Optimization
- Control of Multi-agent Systems
- Dynamical Games
- (Semi-) Autonomous Vehicles and Robotics

Problem Statements with Brief Description

1. Control for Multi-Player Pursuit Evasion Games

- Multi-agent systems have recently found applications in various applications from diverse fields of agriculture, communication, traffic modeling and control, surveillance, defence, event monitoring, space exploration and so on. Many of the applications demand the components from both cooperative and non-cooperative local control of the agents simultaneously, which brings the problem of distributed control of multi-agent systems in the domain of game theory. This problem is mainly focussed on developing control strategies analytically. In addition, some simulation environment and experimental test-beds using UAVs and/or UGVs is required to be developed for testing the proposed theoretical results.
- **Essential skills:** The candidates are expected to have understanding and orientation towards mathematical control theory and optimization.
- **Desirable skills:** Good knowledge in embedded programming, robotics and hands-on experience in electronic circuit building. Exposure to MATLAB and open source counterparts like Scilab/Octave, Robot Operating Systems and physics simulation engines like Gazebo.

2. Human-in-Loop Control of Multi-Agent Systems

- Distributed Automatic Control design for multi-agent systems has been an important and interesting area for quite a long time now. However, on a closer look, it is observed that selective human intervention, due to better prediction capability, may effectively improve the performance of control systems while making the control mechanism simpler. In this project, the objective is to formally inculcate human control component in the control system and design control systems such that, best of both manual and automatic control while avoiding the negative impacts of these components. The theoretical component of this project is planned to be complemented with experiments on a semi-autonomous vehicle, that can be built at IIT Dharwad, with the involvement of B. Tech. students and project staffs.
- **Essential skills:** The candidates are expected to have understanding and orientation towards mathematical control theory and optimization.
- **Desirable skills:** Good knowledge in embedded programming, robotics and hands-on experience in electronic circuit building. Exposure to MATLAB and open source counterparts like Scilab/Octave, Robot Operating Systems and physics simulation engines like Gazebo.

B.4.4. Signal Processing

Broad Research Areas

- Speech signal processing
- Speech enhancement
- Speaker recognition
- Speech recognition
- Signal processing for speech and hearing disorders
- Signature verification
- Handwriting processing
- Biometrics
- Audio processing
- Biomedical signal processing
- Biomedical image processing
- Signal processing for communication

B.4.5. Syllabus for the Written Test

The candidates are encouraged to prepare for the topics mentioned in the syllabus keeping in mind the research problems described above.

Engineering Mathematics

- **Linear Algebra:** Matrix Algebra, Systems of linear equations, Eigenvalues, Eigenvectors.
- **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.
- **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.
- **Complex variables:** Analytic functions, Cauchy's integral theorem, Cauchy's integral formula, Taylor series, Laurent series, Residue theorem, Solution integrals.
- **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.

- **Numerical Methods:** Solutions of nonlinear algebraic equations, Single and Multi-step methods for differential equations.
- **Transform Theory:** Fourier Transform, Laplace Transform, z-Transform.

Communication

- **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;
- **Information theory:** entropy, mutual information and channel capacity theorem;
- **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 Systems

- 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

Networks, Signals and Systems

- **Network solution methods:** nodal and mesh analysis
- **Network theorems:** superposition, Thevenin and Norton's, maximum power transfer; 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;
- **Linear 2-port network parameters:** driving point and transfer functions; State equations for networks. Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals;

- **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.

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, multi-stage, 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.

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; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

B.5. Department of Humanities and Social Sciences (HSS)

B.5.1. Eligibility for Admission

- M. Phil or Master's degree in English with a minimum CPI of 5.5.0 (out of 10) or 55% of marks.
- UGC-NET/JRF candidates are encouraged to apply.

B.5.2. Broad Research Areas

The department invites research in the broader domains of literary studies and literary theory in English. Areas such as Women's writing, feminist philosophy and discourse, as well as the larger field of Gender Studies are also emphasized on for future research. The department encourages original and critical thinking through literature in English (including translations).

The broad research areas are:

- 1. English Literary Studies (Including Translations) and Literary Theory**
- 2. Gender Studies**

B.5.3. Essential skills

Candidates must have completed a Master's degree in English with a training in Literature and Literary Theory.

B.5.4. Syllabus for the Written Test

- Literary Theory and Criticism
- Analysis/Appreciation
- Detailed Research Plan/Proposal/Interests

B.6. Department of Mathematics (MA)

B.6.1. Eligibility for Admission

- M. Phil or Master's degree in Mathematics with a minimum CPI of 6.0 (out of 10) or 60% of marks.
- Candidates must fulfill one of the following additional requirements:
 - Valid Gate score
 - UGC/CSIR NET qualified or NBHM or equivalent qualification
 - DST-INSPIRE Fellowship.

B.6.2. Broad Research Area

1. Computational Physics

B.6.3. Essential skills

The candidate should be proficient in programming and debugging large scale computer codes.

B.6.4. Syllabus for the Written Test

Analysis

Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem, Heine Borel theorem. Continuity, uniform continuity, differentiability, mean value theorem. Sequences and series of functions, uniform convergence. Riemann sums and Riemann integral, Improper Integrals. Monotonic functions, types of discontinuity, functions of bounded variation, Lebesgue measure, Lebesgue integral. Functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, inverse and implicit function theorems. Metric spaces, compactness, connectedness. Normed linear Spaces. Spaces of continuous functions as examples.

Linear Algebra

Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations. Algebra of matrices, rank and determinant of matrices, linear equations.

Eigenvalues and eigenvectors, Cayley Hamilton theorem. Matrix representation of linear transformations. Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms. Inner product spaces, orthonormal basis. Quadratic forms, reduction and classification of quadratic forms.

Complex Analysis

Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations. Contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, Maximum modulus principle, Schwarz lemma, Open mapping theorem. Taylor series, Laurent series, calculus of residues. Conformal mappings, Mobius transformation.

Ordinary Differential Equations (ODEs)

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs. General theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.

Partial Differential Equations (PDEs)

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs. Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

Numerical Analysis

Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Numerical Linear Algebra: Fundamentals of matrix theory; least squares problems; computer arithmetic, conditioning and stability; direct and iterative methods for linear systems; eigenvalue problems.

Calculus of Variations

Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema. Variational methods for boundary value problems in ordinary and partial differential equations.

Linear Integral Equations

Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels. Characteristic numbers and eigenfunctions, resolvent kernel.

B.7. Department of Mechanical Engineering (ME)

B.7.1. Eligibility for Admission

First Class or 60% marks (55% marks for SC/ST), as specified in the General Eligibility Criterion, in the qualifying degree: M.Tech./M.E. or equivalent degree in Mechanical Engineering or Aerospace Engineering.

B.7.2. Problem Statement with Brief Description

1. Computational solid mechanics

- Computational mechanics has evolved over last half of the previous century to tackle problems ranging from simple 1D problems to complex engineering problems. Various computational methods have been employed to solve specific problems in engineering. Extension of these methods beyond the specific problems is not thoroughly explored. In this context, application of these methods to engineering problems in elasticity offers a scope with potential utility.
- **Desired skills:** Fluent in Programming like MATLAB and a knowledge of CAE tools.

2. Pool fires: Experimental and numerical

- Pool fire accidents are not uncommon in industry, storage rooms of hazardous chemicals and also during the transportation of materials. The proposed research work is to investigate pool fires both experimentally and numerically. The basic work is that it provides a basis for the fire parameters that help to formulate industrial safety standards. This subject also deals with the radiation from an external fire to the fuel bed.
- **Desired skills:** Good experimental and analytical skills along with knowledge in CFD packages

3. Impingement of fluid jet on the particle bed

- **Statement:** A significant local scour is observed when fluid jets impinge upon material (e.g. the plunging water flow found under dam spillways leading to the erosion of the channel bed and to the possible weakening of engineered structures, erosion of hydraulic turbines due to silt). Jet-induced scour may also be desirable, e.g. high-velocity water jets to mobilize accumulated sediment particles, abrasive-jet machining, removal of layers (sometimes selective layers) of coatings from substrate surfaces. Hence, it is important to understand the erosion of material (e.g. that of loose or bonded bed of granular particles), by the action of fluid jet impingement.
- **Methodology:** Here, simulation studies on impingement of fluid jet (with/without suspended particles) on the particle bed is proposed in order to

characterize erosion. For this purpose, a high performance algorithm is to be developed which comprises of the kinetic theory based numerical technique, referred as the lattice Boltzmann method (LBM). It is then necessary to be coupled with the particle based discrete element method (DEM) representing the finite size of particles in the problem. Thus, the DEM-LBM coupled simulations are proposed to be employed to understand wet impact (i.e. fluid jet to the DEM particle bed), wherein it is necessary to model the two phases (liquid phase for the jet fluid and solid phase corresponding to the particle bed).

4. Impact of hydrophilic and hydrophobic bodies onto a liquid-air interface

- **Statement:** 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 is important in many applications such as industrial coating. A combined experimental and numerical investigations of the impact is proposed. This work shows a good potential for fluid mechanics analysis in natural phenomena.
- **Methodology:** For the experimental part of the research, simple table-top set-up using flow visualizations techniques (high-speed camera) and PIV software to obtain the instantaneous velocity field is proposed. For the simulation part of the research work, a two-phase (air and water) LBM algorithm with a correct representation of the liquid interface (sharp or diffused) coupled with DEM type algorithm is proposed for this class of fluid-structure interaction problems.

B.7.3. Syllabus for the Written Test

GATE-2017 Mechanical Syllabus

http://gate.iitr.ernet.in/wp-content/uploads/2016/07/Syllabi_GATE2017.pdf

B.8. Department of Physics (PH)

B.8.1. Eligibility for Admission

- M. Phil or Master's degree in Physical Sciences with a minimum CPI of 6.0 (out of 10) or 60% of marks.
- Should possess valid GATE score.
- Candidates with M. Phil degree are exempted from written test and possessing valid GATE score.
- CSIR, UGC, DST (INSPIRE fellowship), etc. fellows are encouraged to apply.

B.8.2. Broad Research Areas

- Quantum Information Theory and its interface with Quantum Optics and Many-Body Physics.
- Quantum Communications.

B.8.3. Problem Statement with Brief Description

1. Quantum Information Theory

- Quantum correlations - characterization and quantification
- Monogamy of quantum correlations
- Foundations of quantum mechanics

2. Quantum Communications

- Quantum dense coding
- Quantum teleportation
- Quantum cryptography

3. Many-body Physics

- Quantum criticality in many-body system using quantum information tools
- Statistical properties of quantum correlations in many-body systems

4. Quantum Optics

- Continuous variable quantum information theory
- Continuous variable quantum cryptography

B.8.4. Essential Skills

Candidates should have thorough knowledge in the master's level subjects, especially in Quantum Physics and Mathematical Physics.

B.8.5. Desirable Skills

Candidates may have adequate knowledge at the master's level subjects of Many-Body Physics or Quantum Optics or related fields. The candidate may possess the programming skills, to develop scientific codes, in any of the computer languages.

B.8.6. Syllabus for the Written Test

Mathematical Methods of Physics

- Dimensional analysis. Vector algebra and vector calculus. Linear algebra, matrices, Cayley-Hamilton Theorem. Eigenvalues and eigenvectors. Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.
- Green's function. Partial differential equations (Laplace, wave and heat equations in two and three dimensions). Elements of computational techniques: root of functions, interpolation, extrapolation, integration by trapezoid and Simpson's rule, Solution of first order differential equation using Runge-Kutta method. Finite difference methods. Tensors. Introductory group theory: $SU(2)$, $O(3)$.

Classical Mechanics

- Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body Collisions – scattering in laboratory and Centre of mass frames. Rigid body dynamics- moment of inertia tensor. Non-inertial frames and pseudoforces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of

relativity- Lorentz transformations, relativistic kinematics and mass–energy equivalence.

- Dynamical systems, Phase space dynamics, stability analysis. Poisson brackets and canonical transformations. Symmetry, invariance and Noether's theorem. Hamilton-Jacobi theory.

Quantum Mechanics

- Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time-independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection.
- Spin-orbit coupling, fine structure. WKB approximation. Elementary theory of scattering: phase shifts, partial waves, Born approximation. Relativistic quantum mechanics: Klein-Gordon and Dirac equations. Semi-classical theory of radiation.

Electromagnetic Theory

- Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields.
- Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation- from moving charges and dipoles and retarded potentials.

Atomic & Molecular Physics

- Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

Thermodynamic and Statistical Physics

- Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, chemical potential, phase equilibria. Phase space, micro- and macro-states. Micro-canonical, canonical and grand- canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law.
- First- and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation. Diffusion equation. Random walk and Brownian motion. Introduction to nonequilibrium processes.

Electronics and Experimental Methods

- Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (registers, counters, comparators and similar circuits). A/D and D/A converters. Microprocessor and microcontroller basics. Data interpretation and analysis. Precision and accuracy. Error analysis, propagation of errors. Least squares fitting,
- Linear and nonlinear curve fitting, chi-square test. Transducers (temperature, pressure/vacuum, magnetic fields, vibration, optical, and particle detectors). Measurement and control. Signal conditioning and recovery. Impedance matching, amplification (Op-amp based, instrumentation amp, feedback), filtering and noise reduction, shielding and grounding. Fourier transforms, lock-in detector, box-car integrator, modulation techniques. High frequency devices (including generators and detectors).

Condensed Matter Physics

- Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.

APPENDIX I

Sponsorship Letter for Full-time Ph.D. Candidates (SW)

(To be typed on letterhead of the sponsoring organization)

To

The Director,

Indian Institute of Technology Dharwad.

Sub: Sponsoring of an Employee for Ph.D. programme

Dear Sir,

We hereby sponsor the candidature of Shri./ Smt./ Kum _____,
employed in our organization as _____ (designation) for joining his / her
Ph.D. Programme in _____ at your Institute as a full-time candidate.

He/ She is employee of our organization since_____. We shall bear the total expenses of his
/ her studies. We shall fully relieve him/ her of his/ her duties in the organization during the
entire period of the Ph.D. programme, to enable him/ her to devote full-time to his/ her studies
in the Institute.

Signature and Seal of the Sponsoring Authority

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APPENDIX II

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 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

APPENDIX III

**No Objection Certificate from College/University for Ph.D. Applicant under College
Teacher Category (CT)**

(To be typed on letterhead of the College/University)

Dear Sir,

This is to certify that Shri./Smt./Kum. _____ is an employee of our College/
University since _____ and is currently serving as _____
(designation).

Our College/University has no objection to his/her application in the _____
(department) to join the Ph.D. Programme at IIT Dharwad, under College Teacher (CT)
category.

Further, if selected, the College/University has "NO OBJECTION" to allow Shri./Smt./Kum.
_____ to undergo the programme of studies and also to fulfil
the coursework requirements at IIT Dharwad.

Signature & Seal of the Head of the College/University

[Bio-data of proposed Co-supervisor (external), which is optional, to be enclosed giving details
of designation, qualification, research experience, etc.]

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