INDIAN INSTITUTE OF TECHNOLOGY DHARWAD

॥ सा विद्या या विमुक्तये ॥

भारतीय प्रौद्योगिकी संस्थान धारवाड

Indian Institute of Technology Dharwad

Information Brochure

(For Indian National applicants)

Ph.D. Admissions

Spring Semester 2020-21

Contents

A. SCHEDULE OF Ph.D. ADMISSION (Tentative)

Serial No.	Description	Relevant dates
1	Last Date to apply online	22-Nov-2020
2	Announcement of shortlist and Online Interview Schedule (tentatively)	24-Nov-2020
3	Online Interview ends	11-Dec-2020
4	Declaration of final list of selected candidates	18-Dec-2020
5	Spot admission starts	26-Dec-2020
6	Spot admission closes	28-Dec-2020

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

B. APPLICATION CATEGORIES & FINANCIAL SUPPORT

IIT Dharwad admits Ph.D. candidates under the full time research scholarship or Teaching Assistantship (TA) and part-time externally sponsored research scholars. However, **each department may not have opening in all the following modes of support.** More details can be found in the Appendix section corresponding to the department.

B.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./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.

B.2 Fellowship Awardee (FA)

B.2.a Description – FA

The financial support under this category is provided by various Govt. / Semi Govt. schemes (CSIR, UGC, DAE, DST, DBT, NBHM, etc.) and some other organizations.

A valid Junior Research fellowship (JRF) award letter from the Govt. / Semi Govt. agencies (e.g. CSIR / UGC / DAE / DST / DBT / NBHM / (confirmed) DST INSPIRE, etc.) is required for the execution of this fellowship.

The amount and duration of the fellowship will be as specified by the awarding agency. The disbursement and continuation of the fellowship will be subject to as per the norms specified by the awarding agency or specified by IIT Dharwad, as deemed fit.

B.2.b PMRF: A brief Note on Prime Minister's Research Fellowship

The Prime Minister's Research Fellows (PMRF) Scheme has been designed for improving the quality of research in various higher educational institutions in the country. With attractive fellowships, the scheme seeks to attract the best talent into research thereby realizing the vision of development through innovation. The scheme was announced in the Budget 2018-19. The institutes which can offer PMRF include all the IITs, all the IISERs, Indian Institute of Science, Bengaluru and some of the top Central Universities/NITs that offer science and/or technology degrees. The candidates will be selected through a rigorous selection process and their performance will be reviewed suitably through a national convention.

B.3 Project Assistantship (PA)

Funded from projects sponsored by industries and government funding agencies. Under this category, candidates will be paid fellowship as per the rules & regulations of the governing project.

B.4 Externally sponsored 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 his 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 students will have to produce a "Relieving certificate" from his / her employer that he / she has been fully relieved from normal duties during the semester(s) to complete the course work and other academic work at IIT Dharwad.

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

C. GENERAL GUIDELINES for APPLYING ONLINE

1. Please read all the instructions given in the brochure carefully before filing 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 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 >> Ph.D.
4. 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.
5. The application fee is as follows:

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

6. 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: **SBI - Main Branch, Dharwad**
IFSC: **SBIN-0000833**

7. 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.**

8. Applicants may find it convenient to keep following information handy while filling the application form online (whichever relevant):

   i) Skype Id / Gmail Id for G-meet

   ii) passport size photo whose size is less than 50 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) Statement of Purpose (pdf file)

   vii) proof of application fee payment (pdf file)

   viii) list of fellowship/ awards

   ix) publications

   x) any other achievements/information.

9. Amendments to the form will not be possible once the last date to apply online is over. However, amendments can be considered if the applicant resubmits the entire form without making repeat fee payment before the deadline.

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 – NCL (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 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 (if) 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.

D. INFORMATION PERTAINING TO HOSTELS

About IIT Dharwad	Kindly visit the website https://www.iitdh.ac.in/ for available facilities
Hostel Room Allocation (on sharing basis)	You will be allotted room in the hostel & the room key will be handed over on your arrival at the Institute. Each room will accommodate roughly two/four students (depending on the prevailing conditions) and has an attached bath & toilet.
Are hostel rooms furnished	Each student will be provided a cot, chair & study table and wardrobe. Students can purchase mattress/bedding, bucket, etc. locally. Arrangements will be made for on-campus shopping for these items.
Possession of motorized vehicle	NOT ALLOWED, however bicycle is permitted in the campus.
Climatic conditions	The weather at Dharwad is pleasant throughout the year. Generally, it will be raining in the months of June to September and weather will be windy and cold during the months of October to January. It is suggested that you carry protective clothing accordingly.

E. FEES, DEPOSITS & HOSTEL RENT

The fee applicable for admission to Ph.D. programmes (as collected during the Autumn Semester 2020-21) is provided below for reference purpose only:

S. No.	Fee Description	Amount (in INR) General/OBC/EWS	Amount (in INR) SC/ST/PwD
A. One-time payment at the time of admission			
1	Admission fee	2,200.00	2,200.00
2	Thesis fee	2500.00	2500.00
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)	**9,600.00**	**9,600.00**
B. Per semester fee			
1^	Tuition Fee-Statutory fee	2500.00	00.00
2	Examination fee	1,000.00	1,000.00
3	Registration fee	750.00	750.00
4*	Gymkhana fee	525.00	525.00
5	Student benevolent fund	500.00	500.00
6*	Medical fee	450.00	450.00
7	Hostel room rent	-	-
8	Electricity & water charges	-	-
9	Hostel establishment charges	3,000.00	3,000.00
10	Mess establishment charges	1,550.00	1,550.00
	Sub-total (B)	**10,275.00**	**7,775.00**
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)		**22,875.00**	**20,375.00**

NOTE:

Note:

- All the SC/ST/PwD-Divyangjan students are exempted from payment of Tuition fee.
- The Hostel Room rent (Rs.2,000/-), Electricity & water charges (Rs.3,000/-) and Mess Fee advance (Rs.26,000/-) have not been charged presently for Autumn Semester.
- *The Gymkhana Fee & Medical Fee have been partially charged (i.e. 30% each of the actual cost).
- The reduction in fee is due to the present COVID-19 conditions and if in case the students are required to join the Institute in future (during Semester), then the reduced portion will be required to be paid on further notice (on pro-rata basis, wherever applicable).
- ^IIT Dharwad reserves the right to revise the Tuition Fee-Statutory Fee (in future).

Kindly note that the above-mentioned fee structure is applicable for TA category students. The tuition fee and other heads may differ in case of other categories (Project/FA/External etc.). The details of the applicable fee structure are available on our website at https://iitdh.ac.in/academic_circulars.php

The fee structure will also be made available to the selected candidates at the time of announcement of results for this round of admission.

F. DEPARTMENT OF BIOSCIENCES AND BIOENGINEERING

F.1 Qualifying degree

F.1.a Qualifying Degree

M.Tech./M.Phil./MSc or equivalent in Bioinformatics/ Chemistry / Biotechnology/ Microbiology or other allied biology subject, Computer Science / Electrical Engineering.

F.1.b 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:

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.

Candidates with M.Sc. or equivalent degree MUST fulfil any one of the following:

1. Valid GATE score
2. Junior Research Fellowship (JRF) of CSIR/ UGC/ NBHM/ DBT/ ICAR/ ICMR/ ICPR/ PMRF or DST INSPIRE Fellowship

F.1.c 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 Spring 2020 semester of IIT Dharwad are also eligible to apply. However, if offered, the admission to those candidates would be provisional. To join 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 sections above considering 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 above section should be used to determine eligibility for application and same to be reported in the online application.

F.2. Application Categories and Financial Support

The Department of Biosciences and Bioengineering admits Ph.D. candidates under the full-time research scholarship or Teaching Assistantship (TA), Project Staff-Teaching/Research Assistantship through Project (PS-TAP/RAP), Govt./Semi Govt. Fellowship Award (FA) (QIP, CSIR, UGC, DAE, DST Inspire, DBT, NBHM, PMRF etc.), and externally sponsored research scholars.

F.3. Research Topics

Project title 1: Development of a disposable optical sensing platform for objective cancer therapeutic drug monitoring through body fluids.

Project title 2: To develop a heavy water-based sensing platform for identifying antimicrobial resistance.

Project title 3: Understanding the role of RNA binding Proteins in cancer development.

Essential Skills: Candidates should have basic knowledge of Biostatistics, Biotechnology, Chemical synthesis, and Microbiology.

Desirable Skill: Candidates ought to have experience in cell culture, and molecular biology to work on interdisciplinary areas across biology, chemistry, and engineering.

F.4. Syllabus

For the written test, the following syllabus will be followed. Candidates can expect questions based on aptitude and reasoning as well.

Bioinformatics and Biophysics: Basics of programming, Statistics, Descriptive statistics, Correlation and regression, basic machine learning, Hypothesis Testing, Probability theory, Raman spectroscopy, Absorption spectroscopy, Fluorescence spectroscopy, and NMR.

Biochemistry, Microbiology, 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, 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.

F.5. Selection process/criteria

Round 1: All the eligible candidates will be invited for preliminary screening.

Round 2: Top 10-15 candidates selected from Round 1 will be invited for the second session of online interaction.

The final list of main and waitlist candidates will be decided by performance in round 2.

F.6. Timeline/interview schedule

Round 1: Will be announced on the website.

Round 2: Will be announced on the website.

G. DEPARTMENT OF CHEMISTRY

G.1 Eligibility for Admission

G.1.a Qualifying Degree

M.Sc. or equivalent degree in Chemistry/Biochemistry and other related areas

The candidates must also fulfill ONE of the following additional requirements:

- Junior Research Fellowship (JRF) of CSIR/UGC/DST INSPIRE/DBT/MHRD/ICMR or any other funding agencies.

G.1.b Minimum score in the qualifying degree

1. 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 is First Class, as specified by the candidate's Institution/University. If the Institution/University does not specify the division/class, then one of the following will be considered as the eligibility criteria:
    - a minimum of 60% marks (without round off) in aggregate. (OR)
    - 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).
2. For SC/ST/PwD category candidates, a relaxation of 5% in the qualifying degree is applicable.

G.1.c 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 Spring 2021 semester of IIT Dharwad are also eligible to apply. However, if offered, the admission to those candidates would be provisional. To join 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 above considering 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 above section should be used to determine eligibility for application and same to be reported in the online application.

G.1.d Application Categories and Financial Support

The Department of Chemistry admits Ph.D. candidates under the Govt./Semi Govt. Fellowship Award (FA) (QIP, CSIR, UGC, DAE, DST Inspire, DBT, NBHM, PMRF etc.).

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.

G.1.e Modality of the Selection Process

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

- The selection process consists of one round of online interview and interaction.

G.2. Syllabus

- Fundamental principles of chemistry
  Recommended textbooks: J. Clayden, L. G. Wade, J. D. Lee and P. Atkins

- Organometallic chemistry: Metals aryls and alkyls, p-bound ligands etc, oxidative addition-reductive elimination, applications to organic chemistry
  Recommended textbooks: R.H. Crabtree and BD Gupta and A. J. Elias

- Spectroscopy: Rotational, vibrational and electronic spectroscopy, NMR and mass spectrometry
  Recommended textbooks: C. N. Banwell, D. L. Pavia and H. Gunther

- Organic name reactions: Reactions and their mechanisms
  Recommended textbooks: W. Carruthers and J. Clayden

- Basic Bioorganic chemistry and Biochemistry: Biomolecules (proteins, carbohydrates, nucleic acids and fatty acids) and their chemistry, biomimetic chemistry, metabolic pathways, biosynthesis of biomolecules, enzymes mechanisms, metalloenzymes, central dogma of life, basic concepts of medicinal chemistry
  Recommended textbooks: Voet and Voet, Lehninger, Hermann Dugas

G.3. Research Topics

The three research topics are broadly classified as given below. The applicant may be asked to indicate the choice of the research topics in the order of preference.

1. Organic chemistry of the enzyme catalysed reactions in antibiotic compounds:

Enzymes are nature's organic chemists that carry out remarkable chemical reactions, particularly in the synthesis of antibiotics and other important drug compounds. To study the enzyme reaction mechanisms, one requires sound knowledge of chemistry and biochemistry**.** One particular area of interest is the ribosomally synthesized and post-translationally modified (RiPP) peptide natural products which show unique antibiotic properties. In today's world, the emergence of antibiotic resistance in bacteria is proving to be a serious and increasing threat to human health. Therefore, discovery of new structural motifs with novel antibacterial targets exhibiting activity against multi-drug resistant pathogens is of utmost importance. RiPP natural products, produced by bacteria, are an emerging class of peptide derived compounds with diverse structural features exhibiting wide array of bioactivities ranging from antibacterial to anticancer properties. RiPP precursor peptides are direct ribosomal gene products that undergo various post-translational modifications (PTMs) by enzymes to synthesize the mature, structurally complex antibiotics. We would like to study the chemistry of the enzyme mechanisms (such as C-H activation, C-C bond formation, molecular rearrangement, amide bond activation etc.) involved in synthesizing these natural products. One class of enzymes involved is called radical S-Adenosylmethionine (rSAM) enzymes that contain [4Fe-4S] clusters and

carry out fascinating transformations using organic radical mediated chemistry. Recently, they were shown to catalyze reactions via an organometallic (Fe-C) intermediate as well. We would employ interdisciplinary techniques from chemistry (synthetic organic chemistry, physical organic chemistry, spectroscopic techniques, inorganic chemistry and anaerobic techniques), biochemistry/chemical biology, protein chemistry, and molecular biology/microbiology during these studies and suitable collaborations (such as for protein crystallography, complex synthesis, EPR techniques, proteomics, and synthetic biology etc.) will be initiated to gain insights into the molecular details of these mechanisms. In addition, analog generation for medicinal chemistry, enzyme inhibitors development and structure-function elucidation of new compounds will also be undertaken in the future.

2. Tryptophan derived bioactive natural products: Investigation of the chemistry of the biosynthesis pathways, and elucidation of structure and function

Tryptophan, the most chemically complex and the least abundant of the 20 common proteinogenic amino acids, is a biosynthetic precursor to many complex microbial natural products (such as antibiotic pyrrolnitirin), which are promising scaffolds for drug discovery and development. The chemical features of tryptophan, including its ability to undergo chemistry at almost every atom makes it a unique biological precursor for the generation of chemical complexity. Recently it was discovered that tryptophan leads to the formation of a few novel anticancer compounds of highly functionalized alkaloid family which were shown to induce DNA single and double strand breaks and metal dependent DNA complex formation. Moreover, they also cause several chromosomal aberrations, and blocks the synthesis of DNA and RNA by inhibiting topoisomerase II. Our goal would be to study the chemistry of the biosynthetic machineries (synthesis by enzymes in a biological set up) of such natural products *in-vitro*, understand the fundamental principles of the complex organic/inorganic chemical reactions (they also involve metalloenzymes) and characterize the molecular details of these proteins using various techniques from chemistry (synthetic chemistry, bioorganic/bioinorganic and biophysical chemistry) and biology (protein biochemistry, bioinformatics, molecular and cell biology). This investigation will also enable us to create variants of such compounds as potential anticancer agents by using chemo-enzymatic methods. In addition, bioinformatics/genomics guided discovery and structural characterization of new microbial antibiotic/anticancer compounds, determination of mode of the action, and related structure-activity relationship studies will also be taken up in the future.

3. π-conjugated compounds (oligomers, one-dimensional and two-dimensional polymers) for organic electronics:

The π-conjugated compounds (oligomers, one-dimensional and two-dimensional polymers) are of great importance in organic electronics because electron delocalization along the π-conjugated backbone gives rise to interesting electronic and optical properties. Thus, the π-conjugated compounds have been well explored for various application in molecular electronics such as organic field effect transistors (OFETs), Organic light emitting diodes (OLEDs), solar cells, fluorescence-based sensing and photocatalysis. In spite of high advancement of organic electronics, the performance of π-conjugated compounds is not yet par with that of their inorganic counterparts. This

is due to lack of stability, lack of pancromatic photo-absorption and efficient π-delocalization etc. Therefore, developing novel 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. Thus, our group is interested in developing new π-conjugated organic systems (oligomers, one-dimensional and two-dimensional polymers) with various novel synthetic routes and explore their applications in organic materials with a particular interest in photocatalytic applications for organic transformations and hydrogen evolution.

Essential Skills: General/Organic/Inorganic Chemistry

H. DEPARTMENT OF COMPUTER SCIENCE AND ENGG.

H.1 Qualifying Degree

M.Tech. or equivalent degree in Computer Science and Engineering or any related stream.

H.1.a 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.

H.1.b Eligibility of applicants 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 H.1.a above considering 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.

H.2 Guidelines for shortlisted candidates

The precise guidelines related to the selection process will be intimated at the time of announcement of shortlisted candidates on Institute Website.

H.3. Modality of selection process

Only the short-listed applicants are permitted to participate in the selection process. The selection process may consist of online screening tests, written tests and/or interviews. Candidates will be offered a PhD position based on their performances as mentioned above.

The selection process will happen over two stages, details of which will be intimated in due course of time on the Institute Website. Applicants are advised to check the website regularly from time to time.

H.4 Focus area of research

The research topics are broadly classified as given below. The applicant may be asked to indicate the choice of the research topics in the order of preference.

1. **Theoretical Computer Science:** Algorithms, Concurrency, Formal Verification, and Graph Theory.
2. **AI and Data Science:** Machine Learning (ML), Deep Learning (DL), Reinforcement Learning (RL), Stochastic Control and Optimisation, Bayesian Optimization, Text Mining, Speech and Audio Processing, Handwriting and Document Processing, ML for Cyber Physical Systems, Mining large data streams, ML for Cyber Security, Big Data Analytics, Distributed data processing.
3. **Embedded systems and Computer Architecture: Application** of neural networks on Edge devices, Reliability and Security of Autonomous vehicles, Modeling and characterization of heterogeneous processors, Efficient Computer Architectures
4. **Computer/Communication Networks:** 5G/IoT Networks, AI Driven Networking, Network Virtualization, Network/Cyber Security, Blockchains, Software Defined Networks, Network Function Virtualization, Data Center Networking
5. **High Performance Computing and Programming Languages:** Parallel Computing, Compilers and Translation Systems, Programming models and runtime systems.

In this call, applications are invited only for research areas (2)-(5). Only exceptional candidates will be considered for research areas (1). The applicant may be asked to indicate the choice of the research topics in the order of preference.

H.5. Syllabus

- **Discrete Mathematics:** Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions, Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and Eigenvectors, LU decomposition. Calculus: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration. Probability: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.
- **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).
- **Programming and Data Structures:** Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.
- **Algorithms:** Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, shortest paths.
- **Theory of Computation:** Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing

machines and undecidability.

- **Compiler Design:** Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.
- **Operating System:** Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.
- **Computer Networks:** Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

I. DEPARTMENT OF ELECTRICAL ENGINEERING

I.1 Eligibility Criterion

I.1.a 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, MSc in Mathematics and Statistics with valid GATE or NET scores or any related stream

I.1.b 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):

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.

I.1.c 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 Spring 2021 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 at IIT Dharwad. They need to meet the criteria specified in section I.1.b. 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 should be used to determine eligibility for application and same to be reported in the online application.

I.1.d Application Categories and Financial Support

The Department of Electrical Engineering has vacant seats only under TA and EX categories.

I.2. Guidelines for Shortlisted Candidates

I.2.a. Modality of Selection Process

All the eligible candidates are invited for the first round of interviews via video conferencing. After the first round interviews, another shortlist will be announced for the second round of interviews. The shortlisted candidates will be asked to attend the second round of interview via video conferencing. Syllabus for the interview is given Section I.4 of this document.

The interview slot (date and starting time) specific to each candidate will be communicated online at https://www.iitdh.ac.in/academics_phd.php.

Selection committee decision is final in all matters including any disciplinary matters/malpractice.

Dos and Don'ts

Dos:

1. Ensure that you have participated in a mock call session before the actual interview to set-right the audio-video set up.
2. Please plan to have at least 2 GB of data with you before the meeting. Also, try to locate yourself in a place with good internet speed (at least 1.5 Mbps) for a good quality video interaction. Laptops/tablets are preferred for video conferencing.
3. Accessing any technical resource (notes, book, internet, including peers or mentors) is not allowed during interview unless explicitly mentioned by the committee.
4. Have paper and pen/pencil handy.
5. Ensure that your equipment for video conferencing is charged to avoid power issues.
6. Ensure that the place from where you are attending the interview is conducive for effective interaction online.
7. Best practices while in online meetings:
    - Sign in to the online client 10-15 minutes ahead of scheduled meeting time and stay signed in
    - Turn your camera on and have your camera at your eye level
    - Make sure you sit in a well-lit and quiet place
    - Be mindful of what's going on behind you. Think about having a solid wall/nice curtain behind you or turning on the virtual background (if available).

Don’ts:

1. Avoid windy noisy surroundings during interview
2. Do not record interviews in any form. Any such act will be considered as violation of the pledge you signed online and may invite punitive action from IIT Dharwad.
3. Do not ask about the schedule of the results. It is better to use interview time for other better inquiries as the results will be declared online as soon as possible.
4. Do not leave your place in front of the camera for the entire duration of the interview.
5. Don’t have anyone else around you. Any interaction with someone else other than the interview panel during the interview will be considered as a suspicious activity.

I.3. Research Topics

The research areas are broadly classified in seven streams as described below. **The applicant MUST indicate the choice of the research topics in 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
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, Machine Learning (ML) and Blockchain (BC) oriented resource allocation in 6G, Quantum Communication etc.
3. **Control and Robotics:** Including but not limited to Control of Robots through Speech Signals, Autonomous Vehicles, Control for Differential Games, Control of Structures etc.
4. **Electronic Devices:** Including but not limited to Gas sensors, Nano-electronics etc.
5. **Mixed signal ASIC Design:** This area is related to practical mixed signal integrated circuits. Topic could be one of high speed interconnects, circuits and systems for instrumentation, design for testability of mixed signal circuits etc. Work will include the design of integrated circuits, from concept formulation to verification of ideas in hardware with a prototype chip.
6. **Embedded Systems and Architecture:** This area is an intersection of Embedded Systems, Computer architecture and Systems-on-chip design. Research problems will include modeling and characterization of heterogeneous processors, Power and thermal management of processors, Convolutional Neural Networks (CNN) on edge devices, Reliability and Security of Hardware and Architectures using Non-Volatile Memories.
7. **Power & 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; Electrical drives for Electrical Vehicles.

I.4. Interview Syllabus

All applicants should choose one stream for the interview while submitting the online application form.

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 and Laplace 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; 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, Power System Stability, 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.

J. DEPARTMENT OF MECHANICAL ENGINEERING

J.1 Eligibility for Admission

J.1.a Qualifying Degree

M.Tech./M.E./M.Sc.(Engg.) or equivalent degree in Mechanical Engineering or equivalent stream.

J.1.b 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.

J.1.c Eligibility of applicants 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 Spring 2021 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 J.1.b 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.

J.2 Guidelines for shortlisted candidates

The precise guidelines related to the selection process, documents required, etc. will be intimated at the time of announcement of shortlisted candidates on the Institute Website.

J.3 Modality of selection process

Only the short-listed and confirmed applicants are permitted to participate in the selection process. The selection process may consist of online screening tests, written tests and/or interviews. Candidates will be offered a PhD position based on their performances as mentioned above. Selection process of first round of interviews via an online test. After the first round, a list of shortlisted candidates will be displayed on the website. The shortlisted candidates will be asked to attend the second round of interview via video conferencing.

First round: An online test will be conducted based on the common and stream-specific syllabi mentioned in this brochure. The duration of the test will be between one to two hours and the test must be taken on a desktop or laptop PC with a webcam, a speaker and a microphone. The candidates

are allowed to refer to their books and any online material during the test. The candidates are not permitted to communicate with any person during the test. The candidates may be remotely proctored via the webcam and screen-sharing options.

Second round Interview: Each applicant will undergo an interview, with mostly technical questions, for a duration of approximately 45 minutes. Access to books and online material is not permitted in this round, unless allowed by the interview panel.

You will be given a time-slot window (about 1–3 hours) during which we may connect with you anytime. Your specific time-slot will be communicated to you.

The interactions in the above rounds may be recorded by IIT Dharwad. Any suspicious activity indicating cheating during the first or second rounds of selection will be grounds for disqualification of candidature.

J.4 Dos and Don'ts

Dos:

1) Please participate in a mock call session before the actual interview to ensure the audio-video set up is ready. Example, a pre-lunch slot mock call starts at 9:00 am.

2) Please plan to have at least 2GB of data with you before the meeting. Also, try to locate yourself in a place with good internet speed (at least1.5Mbps) for a good quality video interaction. Laptops/tablets are preferred for video conferencing.

3) Have paper and pen or pencil calculators handy for any rough work.

4) Keeping a glass of water ready may be a good idea.

5) Ensure that equipment is charged to avoid power issues.

6) Ensure that the place from where you are attending the interview is conducive for effective interaction online.

7) Best Practices while in online meetings:

- Sign in to the online client (Google Meet App/Desktop) 10-15 minutes ahead of scheduled meeting time and stay signed in
- Turn your camera on and have your camera at the eye level
- Stay muted unless you're talking to reduce background noise
- Make sure you sit in a well-lit and quiet place
- Be mindful of what's going on behind you. Think about having a solid wall/nice curtain behind you or turning on the virtual background (if available).

Don'ts:

a) Avoid windy noisy surroundings during interview

b) Do not record interviews in any form. Any such act will be considered as violation of the pledge you signed online and may invite punitive action from IIT Dharwad.

c) Do not ask about the schedule of the results. It is better to use interview time for other better

inquiries as the results will be declared online as soon as possible.

d) Do not leave your place in front of the camera for the entire duration of the interview.

e) Prepare yourself to avoid any kind of break during interview, including restroom-break

f) Do not have anyone else around you. Any interaction with someone else other than the interview panel during the interview will be considered as a suspicious activity.

Note - For any matter related to the selection process, the decision of the selection committee would be considered as the final decision.

J.5 Focus area of research

Following topics are floated in the Department of Mechanical Engineering for the PhD program this semester. Applicants have to choose at least one of these topics and fill in the application form.

Thermal Stream: J.5.a, J.5.b

Design Stream: J.5.c

J.5.a Fluid mechanics of turbomachinery components with flow control

Due to the advances made in understanding the fluid dynamics of various industrial components, the present-day turbomachines have reached a stage where additional increase in component efficiencies is increasingly difficult to achieve. Hence, traditional designs can no longer meet the increasing performance requirements motivating alteration of the flow using flow control. The present study envisages the use of shape optimization techniques to implement flow control in simple turbomachine flows and study their aerodynamic performance. The researcher should have a sound knowledge of fluid mechanics, engineering mathematics and an aptitude for experiments and programming.

J.5.b Fluid mechanics and combustion dynamics of laminar/turbulent combustion systems

The research pertains to the fundamental and application-based investigation of combustion dynamics, thermoacoustic instabilities, hydrodynamic instabilities, and flame stabilization problems that are of interest to the aerospace community. It is expected to analyse these phenomena through both numerical projects and experiments in laminar and turbulent combustion systems. The complex interactions of fluid mechanics, acoustics and combustion will be studied from complex networks and synchronization framework to develop and test new methods of controlling combustion instabilities.

J.5.c Needle-tissue interaction modelling

Accurate modelling of the forces arising from needle insertion is possible only when the components of different forces can be separated. The force is highest when the viscoelastic material is punctured. The forces are defined such that force due to stiffness is just before the puncture of the material;friction and cutting forces are after the puncture event. The cutting force is inclusive of the

plastic deformation of the material occurring from the act of cutting by the needle tip as well as a force resulting from the stiffness of the viscoelastic material. Similarly, the friction force is dependent on the viscoelastic material stiffness.

J.6 Syllabus – Common for all streams

J.6.a Engineering Mathematics

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,Taylorseries (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.

J.6.b Analytical reasoning

Verbal reasoning: reading comprehension, drawing inferences based on multiple facts stated in short paragraphs.

Non-verbal reasoning: inductive, logical, abstract, diagrammatic and spatial reasoning.

J.7 Syllabus – Specific to the selected stream

J.7.a Design Stream

Engineering Graphics: Orthographic projections of lines, planes and solids, true length and true angle, sections of solids and intersections of solids, solid modeling.

Engineering Mechanics: Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; 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.

Control Systems: Automatic Control, Use of Feedback, Automatic Assembly and Robots, Mechatronic Systems, Control System Design.

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.

J.7.b 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, behavior 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.

K. DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES

The Department of Humanities and Social Sciences is not inviting applications for Spring 20-21 semester.

L. DEPARTMENT OF MATHEMATICS

The Department of Mathematics is not inviting applications for Spring 20-21 semester.

M. DEPARTMENT OF PHYSICS

The Department of Physics is not inviting applications for Spring 20-21 semester.

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)

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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

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