Indian Institute of Technology Dharwad

Information Brochure

Ph.D. Admissions

Spring 2025-26

Version 1.1

Contents

Section I

General Information on

Admission Process

A. SCHEDULE OF Ph.D. ADMISSION

Sr. No.	Description	Relevant dates*
1.	Applications open	This information will be updated on the institute website
2.	Last Date to apply online	
3.	Announcement of shortlist of eligible candidates	
4.	Interview Schedule	
5.	Declaration of provisional list of selected & waitlisted candidates	
6.	Admission process for recommended candidates	
7.	Admission for waitlisted candidates	

All potential candidates are requested to keep visiting the institute website regularly for updated information about the admission process. **All the updates regarding the admission process will be made available on the institute website under section Admissions >> Ph.D. Candidates are advised to keep visiting the website at regular intervals for all updated information regarding the admission process.**
All queries regarding the admission process may be directed to **pgadmissions@iitdh.ac.in**

B. APPLICATION CATEGORIES & FINANCIAL SUPPORT

IIT Dharwad admits Ph.D. candidates as full-time students with research scholarship or Teaching Assistantship (TA) or Project Assistantship (PA). Also, part-time externally sponsored research scholars or institute staff can be admitted. However, **each department may not have openings in all the following modes of support.** More details can be found in the department-specific section of this document.

B.1. Teaching Assistantship (TA)

Funded by the Ministry of Education (MoE), Government of India, the TAs are expected to assist in the academic/administrative work for the smooth functioning of the Institute. Students under this category are entitled to financial support as per the MoE 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 defense, whichever is earlier. At present, the monthly rate of assistantship is ₹37,000/- for the first 2 years and an enhanced rate of ₹42,000/- for the remaining 3 years and HRA as per rules. It is subject to revision as per the directives of the Ministry of Education (MoE).
2. The students awarded with Teaching Assistantship 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 and research performance.
4. As per MoE 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 must resign from their current job and submit a relieving letter from their employer before joining the program.
5. Students getting assistantships from the Institute may join projects sponsored by external agencies and obtain corresponding fellowships in lieu of TA ship.
6. The reservation to various social categories is applicable as per the Govt. of India

norms.

B.2. Fellowship Awardee (FA)

B.2.1. Description – FA

The financial support under this category is provided by various Government / Semi-Government schemes (for example, CSIR, UGC, DAE, DST, DBT, NBHM, etc.) and some other organizations. A valid Junior Research fellowship (JRF) award letter from the Government / Semi-Government agencies (e.g. CSIR / UGC / DAE / DST / DBT / NBHM / (confirmed) DST INSPIRE, etc.) is required for the execution of this fellowship.

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

B.2.2. PMRF: A Brief Note on Prime Minister's Research Fellowship

The Prime Minister's Research Fellows (PMRF) Scheme has been designed to improve 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 that 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.2.3. Visvesvaraya Ph.D. Fellowship

Visvesvaraya Ph.D. Scheme is an institutional scheme where Ph.D. seats are allocated to the institutions, and the institutions enroll Ph.D. candidates on these seats following their admission procedures.

Fellowship: ₹38,750 monthly in 1st & 2nd year and @₹43,750 per month in 3rd, 4th and 5th years of Ph.D.. (Support till Ph.D. completion or 5 years whichever is earlier)
Research Contingency Grant Support: An amount of ₹1,20,000/- Year/Full-time Ph.D. candidate for support duration of Ph.D. candidate

Other benefits are - Support for attending International Conference and visiting a lab abroad, HRA benefits (if the hostel is not available)
(Reference link - https://Ph.D..digitalindiacorporation.in/eligibility-criteria)

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 with at least two years of work experience in the relevant area and desirous of pursuing Ph.D. program while in employment

may apply for admission as external candidates**. 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. Along with the application, 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 program 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. Program. The coursework requirement is likely to be a period of 1-2 semesters. Depending on the student's background and the program 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, meetings between them should be arranged at least once 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 program by a Research Progress Committee (RPC) nominated by the concerned Department Postgraduate Committee (DPGC).
6. At the time of joining the program, 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.

B.5. Institute Staff (IS) for Ph.D.

Existing permanent employees of IIT Dharwad can be admitted under the category Institute Staff subject to fulfillment of conditions mentioned in the Ph.D. Rule Book.
The competence of these candidates will be assessed along with the regular candidates.

B.6. College Teacher (CT) Ph.D.

Teachers from the AICTE/UGC approved colleges in the vicinity of IIT Dharwad with a minimum of 2 years of work experience can apply in this category. After fulfilling the coursework requirement at the Institute, these candidates will be allowed to register for Ph.D. The admissions are based on the following norms:

1. The competence of these candidates will be assessed along with the regular candidates.
2. Along with the application, the candidate should submit a no objection certificate (NOC) 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 program 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. Program. The coursework requirement is likely to be a period of 1-2 semesters. Depending on the student's background and the program requirements, an additional semester may be needed to complete the coursework/qualifier examination.

4. The Ph.D. registration of a CT 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 program by a Research Progress Committee (RPC) nominated by the concerned Department Postgraduate Committee (DPGC).
5. At the time of joining the program, 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.

B.7. Sponsored Candidates (SF) Ph.D.

This is a full-time Ph.D. admission category where the candidates are fully funded by their parent organisation. They are not eligible for any financial support from the institute (IIT Dharwad).

1. The competence of these candidates will be assessed along with the regular candidates.
2. Along with the application, the candidate should submit a no objection certificate (NOC) from the organization in which he/she is employed giving an undertaking that the candidate would be released from the normal duties during the Ph.D. program.
3. The candidate is required to be at the Institute as a full-time student.
4. At the time of joining the program, 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 Ph.D. program.

B.8. Quality Improvement Programme (QIP) Ph.D.

The Government of India launched the Quality Improvement Programme in 1970. One of the main objectives of the programme is to upgrade the expertise and capabilities of the faculty members of the degree and diploma level institutions in the country. The programme is implemented and monitored by All India Council for Technical Education.

The eligibility for admission under QIP Ph.D. scheme is as follows: -
* Full time regular / permanent faculty members of AICTE approved Degree / Diploma Level institutes having
(a) Three-year teaching experience at polytechnic/graduate level institutes.
(b) A Master degree in the appropriate branch.

Candidates seeking admission to the Ph.D. program under the Quality Improvement Program (QIP) at IIT Dharwad must apply through the AICTE QIP portal.

All the details regarding QIP can be found in https://qip.aicte.gov.in/home
Guidelines: https://qipapi.aicte.gov.in/files/scheme_guidelines/qip__scheme_guidelines__2025.pdf

C. GENERAL GUIDELINES FOR APPLYING ONLINE

1. Please read all the instructions given in the brochure carefully before filling in the application form.

2. The link for the online application will be updated on the website.

3. Click on Register/ Signup, and provide your details. Please note that the phone number and email ID that you provide while registering should be valid till the admission process is completed. All the communication will be through this email ID.

4. After registration, you will get an email with your User ID/Username and along with a link to set your password. Set a new password by clicking on the link. Note down your User ID and password for future reference.

5. Login using your User ID and password. >> Fill out the form step by step >> Keep all the documents ready in soft copy>> Pay the application fee through the IIT Dh e-pay facility. (LINK available in application form (https://epay.iitdh.ac.in/Payment/AdvanceFee > User ID and Date of Birth to be filled [User ID will be generated after Register/Signup the application])) >> Note down e-pay transaction No.>> Fill the remaining details in CIMS application>> Note down the submission ID for future reference and you will get a mail confirmation of the application.

6. This information brochure and future updates regarding the admission process will be made available on the institute website under the section Academics >> Admissions >> Ph.D.

7. The application fee is as follows: Please visit the link given below and choose "Application Fee (M.Tech./M.Tech.(R)/Ph.D.)", **fill in all the particulars and choose an amount based on your social category. Please submit and note down the transaction reference number to be mentioned in the application form as well as for future reference.** https://epay.iitdh.ac.in/Payment/AdvanceFee

Gen/Gen (EWS)/OBC/ all other candidates	₹ 200/-
Women/SC/ST/PwD category candidates	₹ 100/-

8. The Application Form without valid online payment details will not be considered. Application FEE once paid is Non-Refundable.

9. An applicant needs to pay the application fee only once irrespective of the number of departments the applicant is applying to.

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

- Passport size photograph [50 kb to 200 kb ,JPEG/PNG formats only]
- Identity Proof (Adhaar Card, Voter ID Card, Passport etc.)
- Educational qualification details from secondary school onwards.
- NET/GATE/Other relevant qualifying examination details (if applicable).
- Fellowship related documents, e.g., JRF Award Letter, (if applicable).
- Research Proposal (For applicants in the Department of HEART)
- List of fellowships/ awards (if applicable).
- Details of the Publications (if applicable).

- Sponsorship Letter and CV of co-supervisor if you are applying under 'EX' category. (merged as a single PDF)(if applicable).

11. Every department may offer only some modes of financial support/application categories. Please ensure that you meet the eligibility criteria for that category/ mode. Refer to the brochure for further details.

12. Choose your Department and eligibility for the Application carefully after going through the brochure. Once you proceed to the next page, these options can not be modified.

13. Please verify all your details before clicking on the 'Submit' button. Applications once submitted can not be modified. **Your application is liable to be rejected for incomplete/ false information.**

14. You can apply for multiple departments. Separate applications should be submitted for each department.

15. **Keep checking the institute website and your emails regularly for any communication from the institute regarding the selection process. It is the candidate's responsibility to be aware of the schedule of various events related to the admission process.**

16. The Shortlisted candidates' list will be uploaded on the institute website as per the schedule given.

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

18. **Please note that the candidates (if selected) should be able to produce all relevant documents within a short period of notice. If the documents are not produced within the deadline, the admission is liable to be cancelled.**

19. The candidates who secure admission under OBC-NCL and EWS categories are required to produce the OBC-NCL/ EWS certificate issued **after 01 April 2025**. The certificate should be produced at the time of admission. The category certificate must be in the **format applicable to Central Government institutions**, and the state Government formats will not be accepted under any circumstances.

20. The SC/ST/PwD candidates who attend interviews **in person** at IIT Dharwad are eligible for **Travel Fare reimbursement i.e. AC-III Tier in train**. Candidates can also travel by public bus (taxi, chartered bus, etc. not admissible) or air, however the claim will be limited to AC-III tier fare if higher in other modes. The tickets should only be booked through the IRCTC website.

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 a 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).
Are hostel rooms furnished	Each student will be provided with 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	Bicycles are permitted on campus. Motorized vehicle permission is as per Institute norms as amended from time to time.
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 tentative fee applicable for admission to the Ph.D. program is provided below for reference purposes.

E.1 Details of Applicable Fee for Admission:

Sl. No.	Fee Amount (In ₹)	General/EWS/OBC	SC/ST/ Divyangjan
A. One-time payment at the time of Admission			
1	Admission Fee	300.00	300.00
2	Academics Service Charges	1,200.00	1,200.00
3	Alumni Lifetime Membership	2,000.00	2,000.00
4	Convocation fee	3,000.00	3,000.00
Sub-Total (A)		**6,500.00**	**6,500.00**
B. Semester Fee			
1	Registration Fee	1,500.00	1,500.00
2	Tuition Fee	#2500.00	## Nil
3	Examination Fee	2,000.00	2,000.00
4	Library	500.00	500.00
5	Gymkhana Fee	3,000.00	3,000.00
6	Hostel Room Rent	1,000.00	1,000.00
7	Electricity & Water Charges	2,500.00	2,500.00
8	Medical and Wellness Fee	2,500.00	2,500.00
9	Student Benevolent Fund	1,000.00	1,000.00
10	Hostel Establishment and Service Charge	2,500.00	2,500.00
11	Mess Establishment and Service Charges	1,500.00	1,500.00
12	Student Activity Establishment charges	2,000.00	2,000.00
Sub-Total (B)		**22,500.00**	**20,000.00**
Mess Advance		**24,500.00**	**24,500.00**
Medical Insurance Premium (MIP)		**1,500.00**	**1,500.00**
C. Deposits (Refundable) to be paid at the time of Admission			
1	Library Deposit	1,000.00	1,000.00
2	Institute Deposit	5,000.00	5,000.00
3	Mess Deposit	5,000.00	5,000.00
Sub-Total (C)		**11,000.00**	**11,000.00**
GRAND TOTAL FEE (A + B + Mess Advance + MIP + C)		**₹ 66,000.00**	**₹ 63,500.00**

Note:

a. #IIT Dharwad reserves the right to revise the Tuition Fee-Statutory Fee (in future).

b. ##All the SC/ST/Divyangjan students are exempted from payment of Tuition fee.

c. All the students are required to pay the entire fee as per the fee circular. The students who wish to reside outside may be permitted to do so with the permission of the institute only after reporting to the campus. The respective fee components related to the hostel and mess advance will be reimbursed later with the approval of the competent authority.

d. The tuition fee for the EX and SF category will be ₹ 25,000/-.

Section II

Department-Specific Information

F. DEPARTMENT OF BIOLOGICAL SCIENCES AND BIOENGINEERING (BSBE)

F.1. Eligibility for admission

F.1.1. Qualifying Degree

- **BS/BE/B.Tech. or equivalent 4-years degree** in Bioinformatics/Chemistry /Biotechnology/Microbiology/life-sciences or other allied biology subjects with valid GATE score.
- **M.Tech./M.Sc.** or equivalent in Bioinformatics/Chemistry/ Biotechnology/ Microbiology/Life-Sciences or other allied biology subjects.
- M.Sc. students must have qualified GATE or **CSIR/UGC-NET-LS** for the TA category.
- M.Tech. students are exempted from GATE qualification for TA category.
- Junior Research Fellowship (JRF) of CSIR/UGC/DST INSPIRE/DBT/MHRD/ICMR or any other relevant funding agencies is mandatory for FA category.

Mere fulfilling the eligibility criterion does not guarantee shortlisting or final selection.

F.1.2. Minimum score in the qualifying degree

For General/OBC-NCL category candidates and/or for candidates where no concession in academic performance is called for, the eligibility criteria in the qualifying degree (M.Tech. /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.

F.1.3. Eligibility of applicants in the final phase of getting the qualifying degree

Students who are in the final phase of receiving the above-mentioned qualifying degree and who are likely to graduate before commencement of Spring 2025-26 semester of IIT Dharwad are also eligible to apply. However, if offered, admission to those candidates would be provisional. To join the academic program at IIT Dharwad, such candidates need to furnish necessary documents regarding completion of the degree on the date of joining mentioned in Section A above. They need to meet the criteria specified in the 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 section A should be used to determine eligibility for application and same to be reported in the online application.

F.2. Modality of the selection process

The selection process will consist of an offline interview process. Shortlisted candidates will be called for onsite interview/s at BSBE Department IIT Dharwad. The interview process will involve two rounds (Rounds I and II). Candidates will be evaluated based on their performance in these interviews. For the syllabus, please refer to the section below.

F.3. Syllabus

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

Bioinformatics: Statistics, Descriptive statistics, Correlation and regression, basic machine learning, Hypothesis Testing, Probability theory,

Biophysics: 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.4. Focus area of research

1. Lifestyle Disease Biology (Cancer, neurodegenerative and cardiovascular).
2. Infectious disease biology (Spectroscopy, Host-pathogen interactions)

F.5.1 Teaching Assistantship (TA)

In this call, applications under the TA category are invited only in the “Lifestyle Disease Biology” research area.

F.5.2 Fellowship Awardee (FA)

In this call, applications are invited in all research areas under the FA category.

G. DEPARTMENT OF CHEMICAL ENGINEERING (CE)

G.1. Eligibility for admission

G.1.1 Qualifying Degree

- M.Tech./M.E./ M.S.(Engg.)/M.Sc or equivalent degree in Chemical Engineering or any related stream. M.Tech. (or equivalent degree) students are exempted from GATE qualification for TA category.
- M.Sc. students must have a valid GATE score/ CSIR/UGC-NET-LS for TA category.
- Junior Research Fellowship (JRF) of CSIR/UGC/DST INSPIRE/DBT/MHRD/ICMR or any other relevant funding agencies is mandatory for FA category.
- Candidates in the final year of their qualifying degree may be considered for admission to the Ph.D. programme, provided they graduate before the registration date specified by the Institute.
- 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.
- Sponsored Candidates (SF): The sponsored candidates receive their funding from their parent organizations.

G.1.2. Minimum score in the qualifying degree

For General/OBC-NCL 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./M.S. (Engg.)/ M.Sc):

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.

G.1.3. Eligibility of applicants in the final phase of getting the qualifying degree

Students who are in the final phase of receiving the above-mentioned qualifying degree and who are likely to graduate before commencement of Spring 2025-26 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 Section A above. They need to meet the criteria specified in the 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 section A should be used to determine eligibility for application and same to be reported in the online application. Externally sponsored Ph.D. (EX) applicants may also apply for the admission. The candidates will be shortlisted as per the rules and regulations applicable to EX category. The detailed guidelines and requirements are mentioned in Section B.4

G.2. Modality of selection process

Our Ph.D. selection process is highly competitive, and only eligible applicants will be permitted to the interview. The process is designed to evaluate the applicant's research potential, academic background, and motivation for pursuing a Ph.D. in Chemical Engineering. The interview will be conducted online and will involve an informal discussion about the applicant's research interests and academic background. This will also provide an opportunity for applicants to interact with our faculty members and gain a deeper understanding of our research programs.

G.3. Syllabus

- For candidates from Chemical Engineering and related fields: GATE syllabus
- For candidates other than Chemical Engineering: GATE/NET syllabus relevant to their respective fields.

G.4. Focus area of research

The following research areas are floated in the Department of Chemical Engineering for the Ph.D. program this semester. Applicants have to choose at least one of these research areas and fill in the application form. We encourage all eligible applicants to apply for our program and look forward to welcoming the most promising candidates to our department.

1. **Energy Storage and Conversion:** Electrochemical and photoelectrochemical water splitting, electrochemical CO_2 reduction, NH_3 synthesis, and methane oxidation, batteries, supercapacitors, fuel cells, design of cathode materials, and Solid-State Electrolytes Biocatalytic approach for CO_2 capture and Conversion, Biofuel production.

2. **Advanced Materials:** Nanomaterials (Magnetic, metallic, polymeric, semiconductor, composites, and carbon-based), Smart and Functional Materials (Shape memory alloys and polymers, self-healing materials, phase change materials, piezoelectric and magnetostrictive materials), Biomaterials (Bioinspired and biocompatible materials, drug delivery systems, antimicrobial coatings, and implants), Energy and Sustainable Materials (Materials for energy storage-batteries, supercapacitors, photovoltaic materials, hydrogen storage materials, thermoelectric and piezoelectric energy harvesting), Advanced Polymers and Composites (High-performance polymer composites, conductive polymers, biodegradable and sustainable polymers, lightweight aerospace and automotive composites), Optical Materials (Plasmonic and photonic materials, advanced coatings for optical applications, 2D materials for optoelectronic devices), Ceramics and

High-Performance Materials (Advanced refractory materials, transparent ceramics for optical applications, ceramic-matrix composites), AI-driven predictive modeling for new materials, machine learning for materials discovery, modeling, and simulation of materials formation, Gas separation Membranes: Synthesis and modelling of ultra-thin membranes for gas separation

3. **Computational Fluid Dynamics (CFD) and Machine Learning (ML):** Microplastics Separation from Industrial wastewater; Slurry Transport in Industrial pipelines; Thermal Management of Li-ion Battery with CFD & Machine Learning (ML); Gas–liquid two-phase flow patterns in a polymer–electrolyte membrane (PEM) fuel cells; CFD coupled with population balance modeling (CFD-PBM) for gas-solid (i.e., fluidization) and liquid-solid (i.e., slurry) flows; Microfluidics; Droplet based separation of rare earths; ML-integrated droplet microfluidics; Droplet Coalescence, splitting and mixing; Janus droplet formation and dynamics; Taylor bubble dynamics in a concentric annulus, Machine learning for advanced energy materialS, AI for materials discovery,

4. **Computer Aided Soft Matter Design and Engineering:** First Principles and AI aided Drug and Material Design, Drug and Material Formulation, Controlled Drug Release and Drug Delivery Systems, Molecular Simulation, Enzymes for Pharma API Synthesis, Protein and Polymeric Membrane based Separation

5. **Sustainable Waste Valorization:** Research focuses on electronic waste, biomass, plastics, and spent batteries, emphasizing selective metal and resource recovery, catalyst design and development, kinetic modeling, and the design of sustainable processes with zero solid and liquid discharge.

6. **Process modelling, simulation, and analysis**
   Optimization and sustainability analysis of processes for waste utilization

G.5. Interview Instructions

If you have been shortlisted for the interview process, you will be invited to participate in an online interview. The online interview will be conducted via Google Meet, and you will receive detailed instructions and a link to access the interview prior to the scheduled date. Here are some important guidelines to follow during the online interview:

1. Technical requirements: Make sure you have a reliable internet connection and a functioning webcam and microphone on your computer or device. You should also test your equipment and internet connection in advance to ensure that they are working properly.
2. Log in to the video conferencing software at least 10 minutes prior to the scheduled interview time.
3. During the interview, speak clearly, maintain good eye contact, and be professional in your demeanor. Remember to listen carefully to the interviewer's questions and respond thoughtfully.
4. Find a quiet and distraction-free space for the interview to avoid windy noise. Turn off any notifications on your phone or computer to minimize disruptions.
5. Ensure that equipment is charged to avoid power issues.
6. Do not record interviews in any form. Any such act will be considered as a violation of the pledge you signed online and may invite punitive action from IIT Dharwad.

H. DEPARTMENT OF CHEMISTRY

H.1. Eligibility for Admission

H.1.1. Qualifying Degree

M.Sc. or equivalent degree in any area of

The candidates must also fulfill **any one** the following additional requirements:

- **Valid GATE Score or CSIR/UGC-NET-LS** or M.Phil or M.Tech./M.E. or equivalent degree in chemistry or related fields (for **TA category**)
- **Junior Research Fellowship** (JRF) of CSIR/ UGC/ DST INSPIRE/ DBT/ MHRD/ ICMR/ ICAR or any other relevant funding agencies (**for FA category**)

Positions are available in TA, PA, and FA categories. Note: The PA and FA category vacancies are open to all social categories.

H.1.2. Minimum score in the qualifying degree

For General/OBC category candidates and/or for candidates where no concession in academic performance is called for, the eligibility criteria in the qualifying degree 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).

For SC/ST/PwD category candidates, a relaxation of 5% in the qualifying degree is applicable.

H.2. Modality of the Selection Process

Only the eligible applicants are permitted to participate in the selection process. One round of online interview will be conducted for the final selection after initial shortlisting of the candidates based on above criteria.

H.3. Syllabus

- Organic Chemistry
  Recommended textbooks: J. Clayden, N. Greeves, S. Warren
- Inorganic Chemistry
  Recommended textbooks: J. E. Huheey, E. A. Keiter, R. L. Keiter
- Physical Chemistry
  Recommended textbooks: Atkins' Physical Chemistry
- Spectroscopy
  Recommended textbooks: C. N. Banwell and D. L. Pavia

H.4. Focus area of research

The broad areas of research will include organic chemistry, biochemistry, and chemical biology, organometallic chemistry, bioinorganic chemistry, organic electronics, π-conjugated

organic systems and computational chemistry. Students will have exposure to different interdisciplinary areas of chemistry, protein biochemistry and material science. The Department of Chemistry admits Ph.D. candidates under the Teaching Assistantship (TA) and Fellowship Assistantship (FA) category for this round of admissions in the following research areas.

1. Organic Chemistry: Asymmetric synthesis and catalysis, CH activation of functional π-conjugated organic compounds, and bioorganic and medicinal chemistry are three currently active domains under this research area. Here, students will get exposure to different synthetic methodologies and various analytical techniques to characterize different organic molecules which have important relevance in electronics, LEDs, catalysis, and drug designing, and pharmaceutical industries.

Research supervisors: **PRof. Rajeswara Rao**, **Prof. Nilkamal Mahanta**

2. Physical Chemistry: The field of physical chemistry is crucial for advancing our molecular and atomic-level understanding of chemical reactions through the application of physics principles. This discipline bridges experimental observations and theoretical predictions, aiding in the development of novel applications in a wide range of scientific domains. Current research interests primarily focus on areas such as the design of organic electrodes for batteries and nitrogen reduction catalysts, computational material science, photochemistry, non-adiabatic dynamics, and polaritonic chemistry. A variety of theoretical tools, including density functional theory (DFT), molecular dynamics simulations, quantum dynamics, QM/MM, and multi-reference electronic structure methods are employed to gain deeper insights into these complex chemical processes.

Research supervisors: **Prof. Sudhir Kumar Sahoo,** and **Prof. Mahesh Gudem**.

3. Inorganic Chemistry: Inorganic nanomaterials and new metal complexes have garnered significant attention for their diverse applications across various fields, including natural sciences, chemical industries, and biomedicine. Research teams of inorganic chemistry are currently engaged in developing metal complexes, atom precise metal nanomaterials and metal containing polymers for their application in catalysis, energy relevant small molecule activation, and sensing harmful gasses. Employing modern spectroscopic and experimental techniques, mechanistic pathways of the process are being investigated to generate new concepts. Researchers get exposure to learn various scientific skills: (i) expertise of inorganic, organometallics, nanocluster; (ii) multi-steps organic, metal-complex, and atom-precise metal nanocluster synthesis; (iii) use of Schlenk line and glove box to handle air and moisture sensitive reagents and reactions steps; (iv) isotopic labeling experiments etc.

Research supervisors: **PRof. Rajeswara Rao**, and **Prof. Kundan K. Singh**.

4. Biological Chemistry: Enzymes are nature's chemists that carry out remarkable chemical reactions, particularly in the synthesis of antibiotics and other important compounds. Research groups are actively working on: (a) study of the organic chemistry of enzymes/proteins involved in the synthesis of biologically active compounds (anticancer, antibacterial, antifungal etc.) and enzyme mechanisms (such as C-H activation, C-C bond formation, molecular rearrangement, amide bond activation, peptide bond formation etc.) involved in the synthesis of these natural products; Students will be exposed to different interdisciplinary principles and techniques of protein biochemistry and chemical biology in this field; (b) study of

metalloenzymatic chemical processes (heme and non-heme oxygenases) using newly lab made structural and functional model complexes. This allows one to gain expertise of synthesis (sensitive multistep ligand and metal complex), hands-on experience of various spectroscopic characterization techniques, and application.

Research supervisors: **Prof. Nilkamal Mahanta**, and **Prof. Kundan K. Singh**.

H.5. Project assistantship (PA)

Code: AU2025_CHE_01

Title: "Design and Synthesis of Metal Nanoclusters Using Redox-Active and Ambiphilic Ligands: Exploring Ligand-Induced Reactivity" (This project involves synthesis, characterization, and applications of metal-nanoclusters).

Broad domain of research: Inorganic, nanomaterial, catalysis

Requirement: The candidate should have a master's degree in chemistry and should have an interest in learning new skills and techniques. Good communication skills are desirable.

Type of funding support – Sponsored project (₹37000/- for the first two years and Rs 42,000/- after two years; additional 20% HRA is applicable if the candidate is staying outside the campus)

Duration: 3 years (after the project is over, the student will be supported from other sources)

No of position: 1

I. DEPARTMENT OF CIVIL AND INFRASTRUCTURE ENGINEERING (CIE)

I.1. Eligibility Criteria

I.1.1. Qualifying Degree

M.Tech./M.E. or equivalent degree in civil engineering or civil and infrastructure engineering or civil and environmental engineering or any related stream.

I.1.2. Minimum Score in Qualifying Degree and GATE Qualification

For General/OBC/EWS 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.):

- 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).
- Candidates must qualify in GATE at least once (Candidate need not to have a valid GATE score) OR Candidate must have CGPA $\geq$ 8.0 (or equivalent percentage) in master's OR Candidate must have one SCI indexed journal publication.

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. However, candidates must qualify in GATE at least once (Candidate need not to have a valid GATE score) OR Candidate must have CGPA $\geq$ 8.0 (or equivalent percentage) in master's OR Candidate must have one SCI indexed journal publication.

I.2. Eligibility of applicants in the final phase of getting the qualifying degree

Students who are in the final phase of receiving the above-mentioned qualifying degree and who are likely to graduate before commencement of Academic Semester (2025-2026) 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 Section A above. They need to meet the criteria specified in the 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, should be used to determine eligibility for application and same to be reported in the online application.

I.3. Modality of selection process

Only eligible applicants are permitted to participate in the selection process. The shortlisted candidates will be called for interview by the respective panel based on the research area preference mentioned in the admission form. The selection process would involve two rounds (online mode).

Round 1: Candidates must make a presentation of their own research work for 10 minutes

duration. Instructions: (a) The First slide must contain candidates' brief biodata. (b) The last slide must contain a prospective Ph.D. research problem statement.

Round 2: Round 1 selected candidate will be called for a technical interview. The technical interview will be based on GATE syllabus (Civil Engineering or Equivalent Streams).

The candidates are encouraged to check the Institute Website from time to time. Selection committee decisions are final in all matters including any disciplinary matters/malpractice.

I.4. Research Areas for TA, PA, FA, Institute Staff, EX, QIP and CT Categories

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

1. Structural Engineering and Materials / Net-zero Energy Efficient Infrastructure
2. Transportation Engineering / Water Resources Engineering / Environmental Engineering
3. Geotechnical Engineering

The candidates can apply to one or more categories (TA, PA, FA, EX and CT) as per their eligibility.

I.4.1. Teaching Assistantship (TA)

In this call, applications are invited in all streams as mentioned-above.

I.4.2. Fellowship Awardee (FA)

In this call, applications are invited under Visvesvaraya Ph.D. fellowship scheme in the following domain.

- Structural Engineering and Materials

Number of Vacancies: 01 (One)*

I.4.3. Project Assistantship (PA)

In this call, applications are invited in following projects/domains.

- Broad Domain of Research: Structural Engineering and Materials, Structural Fire Engineering*

Duration: 3 Years
Number of Vacancies: 03 (Three)*

- Broad Domain of Research: Unsaturated Soil Mechanics (Geotechnical Engineering)*

Duration: 3 Years
Number of Vacancies: 01 (One)*

- Broad Domain of Research: Pavement Materials (Transportation Engineering)*

Duration: 3 Years
Number of Vacancies: 02 (Two)*

Note:

*The selection for this position is subject to the approval of the project, availability of vacancy and availability of funds.

I.4.4. Institute Staff

The institute staff can apply for the Ph.D. if they fulfill the eligibility criteria. It is mandatory to follow the institute's guidelines while applying. The applications are invited for all research areas/streams as mentioned-above.

I.4.5. Externally Sponsored (EX)

In this call, applications are invited under EX category for all research areas/streams mentioned above. The candidates will be shortlisted as per the rules and regulations applicable to EX category and above-mentioned eligibility criteria.

I.4.6. College Teacher (CT)

In this call, applications are invited under the CT category for all research areas/streams mentioned above. 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. The candidates will be shortlisted as per the rules and regulations applicable to CT category and above-mentioned eligibility criteria.

J. DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (CSE)

J.1. Qualifying Degree

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

M.Sc. in Computer Science/Mathematics/Statistics or equivalent with a **valid GATE score or valid UGC/CSIR NET JRF/LS scorecard**

J.1.1 Minimum score in the qualifying degree

For General/OBC-NCL 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.):

- 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).

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.1.2 Eligibility of applicants in the final phase of getting the qualifying degree

Students who are in the final phase of receiving the above-mentioned qualifying degree and who are likely to graduate before commencement of Spring 2025-26 semester of IIT Dharwad are also eligible to apply. However, if offered, 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 Section A above. They need to meet the criteria specified in the 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 section A should be used to determine eligibility for application and same to be reported in the online application.

J.2. Modality of selection process

Only eligible applicants are permitted to participate in the selection process. The selection process would involve two rounds; round-1: An online interview to test the aptitude, programming skills and knowledge of discrete structures, data structures and algorithms of the candidate; round-2: The shortlisted candidates from round-1 will be called for interview (online) by the respective panel based on the research area preference mentioned in the admission form. The candidates are encouraged to check the Institute website https://www.iitdh.ac.in/doctoral-0 from time to time. Selection committee decisions are final in all matters including any disciplinary matters/malpractice.

J.3. Focus area of research

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

1. Computer Networks, IoT and Security (CN):

- 5G/IoT Networks, AI Driven Networking, Network Virtualization, Network/Cyber Security, Blockchains, Software Defined Networks, Network Function Virtualization, Data Center Networking.

2. Computer Systems and Programming:

- Approximate Computing, Edge-Cloud systems, Modeling and characterization of heterogeneous processors, Runtime Verification of Hardware and Efficient Computer Architectures, Parallel Computing, Compilers and Translation Systems, Programming models and runtime systems.

3. Machine learning (ML) and Artificial Intelligence (AI):

- Machine Learning (ML), Deep Learning (DL), Reinforcement Learning (RL), Computer Vision, Stochastic Control and Optimization, Bayesian Optimization, Text Mining, Speech and Audio Processing.
- Handwriting and Document Processing, Natural Language Processing, Machine Translation, LLMs, AI Chatbot Assistant, Computer Vision, ML for Cyber Physical Systems, AR/VR/MX, Mining large data streams, ML for Cyber Security, Big Data Analytics, Distributed data processing.

4. Systems for Machine Learning (SysML)

- Application of neural networks on Edge devices, Hardware for machine learning systems; GPU/TPU/NPU/ML systems and software stack, quantized and low precision machine learning.

5. Theoretical Computer Science (TCS):

- Algorithms, Concurrency, Formal Verification, Graph Theory, Logic.

J.4.1. Teaching Assistantship (TA)

The applicant may be asked to indicate the choice of research topics in the order of preference.

J.4.2. Externally Sponsored (EX)

In this call, applications are invited under EX category for all research areas (1) - (5).

J.4.3. Project Assistantship (PA)

There are no PA positions available this time.

J.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. In
- **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 grammar 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.

K. DEPARTMENT OF ELECTRICAL, ELECTRONICS AND COMMUNICATION ENGINEERING (EECE)

K.1. Eligibility Criterion

K.1.1. Qualifying Degree

M.Tech., M.S., M.E. or equivalent degree in Electrical Engineering, Electronics and Communication Engineering, Electrical and Electronics Engineering, Instrumentation Engineering, Computer Science and Engineering, or any related stream.
OR
M.Sc. in Mathematics/ Statistics or equivalent with valid GATE score or valid **UGC/CSIR NET JRF/LS** scorecard.

K.1.2. Minimum score in the qualifying degree

For General/OBC category candidates and/or for candidates where no concession in academic performance is called for, the eligibility criteria in the qualifying degree (M.Tech./M.E/MSc) is as follows:

- 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).

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.

K.1.3. Eligibility for Admission - Direct Ph.D.

Students can apply for the Ph.D. program directly after completing their B.Tech./B.E degrees for a direct Ph.D. program. The following are the eligibility criteria for the same:

A. B.Tech. in one of the following streams:

- Electrical Engineering,
- Electronics and communication Engineering,
- Instrumentation engineering
- Instrumentation and control engineering
- Tele-communication engineering
- Electronics and Telecommunication engineering
- Electrical and Electronics
- Computer Science
- Data Science and Artificial Intelligence

B. A valid GATE score in one of the following papers

- Electrical Engineering (GATE Paper code: EE)
- Electronics and Communication Engineering (GATE Paper code: EC)
- Instrumentation Engineering (GATE Paper code: IN)
- Data Science and Artificial Intelligence (GATE Paper code: DA)
- Computer Science & Information Technology (GATE Paper code: CS)

Valid GATE score is essential for all the candidates, except for candidates who have B.Tech. or equivalent degree from IITs or BS degree from IISc with a minimum CPI/CGPA of 8.0 on the scale of 10.

K.1.4. Eligibility of applicants who are in the final phase of getting the qualifying degree

Students who are in the final phase of receiving the above-mentioned qualifying degree and who are likely to graduate before commencement of Spring 2025-26 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 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.

K.1.5. Application Categories and Financial Support

The Department of Electrical, Electronics and Communication Engineering offers admission to Ph.D. programs under TA, PA, FA, EX, CT, and Institute Staff categories. The department will try to accommodate the candidates' order of preferences for these categories, but does not guarantee the same. The details of each application category are given in Section APPLICATION CATEGORIES & FINANCIAL SUPPORT of this document.
Note: **The PA, EX, FA, CT, and Institute staff category vacancies are open to all social categories. The openings in the PA category are subject to availability of positions in the department.**

K.2. Guidelines for Shortlisted Candidates

K.2.1. Selection Process

There will be two rounds of interviews via video conferencing. All the eligible candidates are invited for the first round of interviews. The candidate shortlisted after the first-round will be interviewed in the second round. Syllabus for the interview is given in Section K.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/Ph.D..
The selection committee decision is final in all matters including any disciplinary matters/malpractice.

K.3. Research Areas

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

1. Microelectronics and VLSI

- ***VLSI Circuits:*** Including but not limited to, Analog / Mixed signal / RF Integrated Circuits and Systems, Power management and Energy harvesting circuits, Digital signal processing for digital VLSI, and AI/ML hardware accelerators design, etc.

- ***Electronic Devices:*** Including but not limited to Gas sensors, Nano-electronics, Flexible devices, GaN-based High-electron mobility transistors (HEMTs), Silicon Carbide (SiC) Power Diodes, Semiconductor Radiation Detectors etc.

2. Communication, Signal Processing, and Machine Learning

- ***Communication Technologies:*** Including but not limited to, physical and medium access control layer technologies in next generation wireless systems, internet of things, multiple access methods, multi-input multi-output systems, millimeter wave communications, low-latency and energy harvesting based communications, machine learning and blockchain oriented resource allocation in 6G, quantum communication.

- ***Signal Processing and Machine Learning:*** Including but not limited to, speech and natural language processing, image processing and computer vision, and machine learning and deep learning for signal processing.

3. Power Electronics, Energy, and Power Systems

- ***Power systems:*** Grid-connected renewables and flexible loads, grid-forming technology, autonomous microgrids and smart grids, power system stability, control, and protection.

- ***Power Electronics and Drives:*** Converters for grid-interfacing, modular and multi-level inverters, power converters for electric vehicles, DC circuit breakers for medium-voltage applications, design of wide-bandgap device-based converters, modeling, and controls for advanced power electronics.

- ***Magnetics:*** Design of electric machines, magnetics for power-electronics, multiphysics optimization, eddy-current devices, Condition monitoring, characterization of magnetic components, rotational and stress-induced losses.

4. Control and Robotics

- Including but not limited to Control of Robots through Speech Signals, Autonomous Vehicles, Control for Differential Games, Control of Structures etc.

K.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:

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 and sampling theorem.
LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros and frequency response.
Random processes: basics of probability, random variables, CDF, PDF, random processes, mathematical expectation, conditional probability, and conditional expectation.

3. Communication:
Random processes: Basics of probability, random variables, CDF, PDF, random processes, mathematical expectation, conditional probability, and conditional expectation.
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: 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 3: 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, Power System Protection.

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, P&Q Control.

L. DEPARTMENT OF MATHEMATICS

L.1 Eligibility Criteria

L.1.1. Qualifying degree

M.Sc. in Mathematical Science, M. Phil in Mathematical Science (or equivalent degree).

L.1.2. Minimum score required in the qualifying degree

Category	Educational qualification
General/ General (EWS)	The eligibility criteria in the qualifying degree is First Class, as specified by the candidate's Institution/University (recognized by GOI). If the Institution/University does not specify the division/class, then one of the following will be considered as the eligibility criteria: (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).
OBC-NCL	Same as General
SC/ST/PWD	A relaxation of 5% in the qualifying degree is applicable

L.1.3. The candidates who do not have M.Phil. degree must also fulfill ONE of the following additional requirements:

1. Valid GATE score.
2. Junior Research Fellowship in Mathematical Sciences from CSIR, UGC, DST (INSPIRE fellowship), NBHM are encouraged to apply, and they are exempted from possessing a valid GATE score.

L.1.4. 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 2025-26 semester of IIT Dharwad are also eligible to apply. However, if offered, 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. They need to meet the criteria specified in section 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.

L.1.5. Application categories and Financial Support

1. The Department of Mathematics admits Ph.D. candidates under the full-time research scholarship - Teaching Assistantship (TA), Fellowship Awards (FA), and Project Assistantship (PA) .

Note:
The selection under PA category is subject to the approval of the project, availability of vacancy and availability of funds.

L.2 Guidelines for shortlisted applicants

L.2.1. Modality of the selection process

Only the short-listed applicants are permitted to participate in the selection process. The selection process will have two rounds (round 1 and round 2) of tests in the form of interviews or written exams.

- Round 1 is compulsory for everyone.
- Candidates qualifying in round 1, will be invited for round 2.

L.3 Research Topics

Algebra and Number theory

L.4 Syllabus

Topics for round 1:

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, 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. Spectral theorems.

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, Riemann zeta function.

Algebra

Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's phi-function. Groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Group actions, Sylow theorems. Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain, Chinese Remainder Theorem, Finite Fields.

Topics for round 2:

Apart from the topics mentioned above, candidates selected for the second round of interview can be asked questions from some the following advanced/additional topics related to candidates' areas of interest:

1. Field and Galois Theory
2. Rings and Modules
3. Elementary number theory

L.5 Focus area of research

Applications are invited for Commutative algebra, and Number theory.

M. DEPARTMENT OF MECHANICAL, MATERIALS AND AEROSPACE ENGINEERING

M.1 Eligibility for Admission - regular

M.Tech./M.E./M.Sc. (Engg.) or equivalent degree in Mechanical, Materials, Metallurgical, Aerospace, Civil, Biomedical, Electrical, Computer Science, Electronics, Chemical Engineering, or equivalent stream.

M.1.1 Qualifying criteria

The eligibility criteria in the qualifying degree (M.Tech./M.E./M.Sc. (Engg.) or equivalent):

- 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).

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.

M.2 Eligibility for Admission - Direct Ph.D.

Students can apply for the Ph.D. program directly after completing their B.Tech./B.E degrees for a direct Ph.D. program with a valid GATE score.

M.2.1. Qualifying criteria

B.Tech./B.E. or equivalent degree in Mechanical Engineering, Materials and Metallurgical Engineering, Aerospace Engineering, or other related streams.

● A valid GATE score in one of the following papers AE, ME, MT, PI, XE (A, B, C, D, E) *

*A valid GATE score is essential for candidates applying in the TA (Teaching Assistantship)

● 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).

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.

M.3. Institute Staff

The institute staff can apply for the Ph.D. if they fulfill the eligibility criteria. It is mandatory to follow the institute's guidelines while applying.

M.4. Areas of research for TA, FA, IS and External category

Department of MMAE, IIT Dharwad is looking for Ph.D. students in the following broad

research areas. Applicants should be interested in at least one of the following research areas, alphabetically listed below:

Computational Mechanics Stream: Computational Fluid Dynamics (CFD) and Heat Transfer, Finite Element Analysis (FEA) and Computational Solid Mechanics, Computational Materials Science, Continuum Modeling of Materials, High Performance Computing, Micromechanical Modeling of Materials, Discrete Dislocation Dynamics, Phase Field Modeling, Atomistic Modeling

Design Stream: Fracture mechanics, Mechanics of Composite Structures, Finite Element Analysis, Biomechanics, Multibody Kinematics and Dynamics, Tribology, Computer vision and augmented reality, Reduced order Modeling, Soft Robotics, and Smart structures/actuators.

Manufacturing and Materials Stream: Metal forming, Additive manufacturing, Computational Materials Design, Physical and Mechanical Metallurgy, Computer Aided Manufacturing, Digital Twins, Dieless forming, Structural Materials for Aerospace and Automobile, Micromanufacturing, Advanced Machining Processes, Hybrid Machining Processes, Surface Texturing. Constitutive modeling of liquid state processing of metals and composites and severe plastic deformation, Foam casting, Alloy Development, Computational materials science, Self-clean/Superhydrophobic Coatings & Multifunctional coatings and adhesives, light-weight composites

Thermal and Fluids Stream: Atomization and sprays, Combustion and Thermoacoustics, Computational fluid dynamics, Fire dynamics, Multiphase flows, Drops and Bubbles, Surface Engineering and Interfacial Flows, Turbomachinery aerodynamics, Dynamics of thin films, Battery thermal management, Gas turbine blade cooling, Nonlinear Dynamics and Synchronization of Hydrodynamic/Thermoacoustic Instabilities, Reduced-order modeling, Machine Learning/Deep Learning based analysis of flow-flame dynamics, Energy conservation in buildings, Minimally Invasive Thermal Therapies, Energy Efficient Buildings.

M.5. Eligibility of applicants in the final phase of getting the qualifying degree

Students who are in the final phase of receiving the above-mentioned qualifying degree and who are likely to graduate before commencement of Spring 2025-26 semester of IIT Dharwad are also eligible to apply. However, if offered, 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 Section A above. They need to meet the criteria specified in the section 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.

M.6. Modality of selection process

Scrutiny round: Candidates may be shortlisted for the interview round based on seat, specialization availability and/or online examination.

First round of interview: An online interview based on prior experience/M.Tech. Project

will be conducted to assess the basic understanding related to your project and overall Mechanical Engineering. Meeting details will be shared in an email to the shortlisted candidates.

The interaction must be taken on a desktop/laptop PC with a webcam, a speaker, and a microphone. The candidates are not 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 of interview: Each applicant short-listed in the first round will undergo an online interview with technical questions. Your specific time slot will be communicated to you via email.

Access to books and online material is not permitted in this round, unless allowed by the interview panel.

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.

M.7. Dos and Don'ts

Dos:

- We recommend trying out a mock call session before the actual interview to ensure the audio-video setup is ready.
- Please plan to have at least 2GB of internet data (if not using WiFi) with you before the meeting. Also, try to locate yourself in a place with good internet speed (at least 2 Mbps) for quality video interaction. (Laptops/tablets typically work very well for video conferencing).
- Have paper, pen/pencil, and calculators handy for any rough work.
- Keeping a glass /bottle of water ready may be a good idea.
- Ensure that the equipment's battery is charged to avoid power issues.
- It is mandatory to keep your video on when you are being interviewed (not during waiting).
- 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. o Stay muted unless you're speaking to reduce noise interference.
- Make sure you sit in a well-lit and quiet place (avoid sitting in a place such that a window/bright light source is behind you).
- Be mindful of what's going on behind you. Consider having a solid wall/blocking curtain behind you or turning on the virtual background (if available).

Don'ts:

- Record interviews in any form. Any such act will be considered a violation of the pledge you signed online and may invite punitive action from IIT Dharwad.
- Sit in windy/noisy surroundings during your interview.
- Ask about the results schedule. It is better to use interview time for other better inquiries as the results will be declared online as soon as possible.
- Leave your place in front of the camera during your interview.
- Take any kind of break during the interview, including restroom break.

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

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

M.8. Syllabus – Common for all streams

M.8.1. 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, Taylor series (in one and two variables), maxima and minima, Fourier series; gradient, divergence and curl, vector identities, directional derivatives, line, surface and volume integrals, applications of Gauss, Stokes and Green's theorems.

Differential equations: First Order Equations (linear and nonlinear); higher order linear differential equations with constant coefficients; Euler-Cauchy equation; initial and boundary value problems; Laplace transforms; solutions of heat, wave and Laplace's equations.

Complex variables: Analytic functions; Cauchy-Riemann equations; Cauchy's integral theorem and integral formula; Taylor and Laurent series.

Probability and Statistics: Definitions of probability, sampling theorems, conditional probability; mean, median, mode and standard deviation; random variables, binomial, Poisson and normal distributions.

Numerical Methods: Numerical solutions of linear and non-linear algebraic equations; integration by trapezoidal and Simpson's rules; single and multi-step methods for differential equations.

M.8.2. 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.

M.9. Syllabus – Specific to the selected stream

M.9.1. Computational Mechanics Stream

For Computational Fluid Dynamics and Heat Transfer: Basics of Fluid Mechanics, Basics of Heat and Mass Transfer, Navier-Stokes equations, Mathematical modeling, Partial Differential Equations (PDEs), Algebraic solution of PDEs, finite-difference method, Finite-Volume method, Basic C, C++, Matlab, or Python programming.

For Computational Materials Science: Deformation, Elastic and Plastic deformation, Stress and Strain tensors, Finite element analysis, Constitutive modeling, Multiscale modeling,

Defect dynamics, Dislocation mechanics and dynamics, Mechanical Equilibrium, Mechanics of Materials, Homogenization, Differential and Integral Calculus, Differential Operators, Scientific Programming language, Linear System of Equations, Matrix Algebra, Numerical methods, Fracture analysis, Density functional theory, Structure-property relationships, Cohesive zone modeling, All-atom simulations.Structure and properties of engineering materials, Crystal Imperfections, phase diagrams, heat treatment, stress-strain diagrams for engineering materials, Strengthening mechanisms, fracture mechanics, fractography, ductile to brittle transition, Mechanisms of high temperature deformation and failure, X-ray Diffraction, failure theories, fatigue strength and the S-N diagram, testing of materials

For Computational Solid Mechanics:
Engineering Mechanics: Free-body diagrams and equilibrium, impulse and momentum (linear and angular) and energy formulations;
Mechanics of Material: 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;
Advanced Solid Mechanics: Fundamentals of continuum mechanics, Stress equilibrium equations, Stress and Strain tensors, Constitutive modeling
Numerical methods: Numerical differentiation, numerical integration, Numerical error analysis, basic concepts in computer programming, algorithmic skills, salient matrix decomposition techniques such as matrix diagonalization (Eigen decomposition), QR, LU, Cholesky;

M.9.2. 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.

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.

M.9.3. Manufacturing and Materials Stream

Engineering Materials: Structure and properties of engineering materials, Crystal Imperfections, phase diagrams, heat treatment, stress-strain diagrams for engineering materials. Dislocation theory, Strengthening mechanisms, fracture mechanics, fractography, ductile to brittle transition. Fatigue, Mechanisms of high temperature deformation and failure, X-ray Diffraction.

Metal Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes, Plastic deformation by slip and twinning.

Sheet Metal working: Die and punch clearances, blanking, piercing, punching, bending, cup drawing, coining, embossing, incremental forming.

Metal Casting: Different types of casting, solidification and cooling, Pattern materials, allowances, types of patterns, cores, element of gating systems, types of gates, riser design considerations, casting defects.

Polymers and Composites: Thermoplastics, thermosets, elastomers and composites, gradient material, and related processes.

Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools, tool path generation, additive manufacturing.

M.9.4. 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 gray surfaces, view factors radiation network analysis.

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gasses; 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; vapor 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, Steam and gas turbines, axial flow compressors.

N. DEPARTMENT OF PHYSICS

N.1. Eligibility for Admission

N.1.1. Qualifying Degree

- M.Sc. or equivalent degree in Physics / Applied Physics / Photonics / Solid State Physics / or other topics in Physics.
- M.Tech. / M.S. in Optics / Optoelectronics / Photonics / Engineering Physics / Electrical Engineering/ Remote Sensing & GIS/ Geoinformatics or other topics in applied Physics

The candidates who do not have M.Tech. degree must also fulfill ONE of the following additional requirements:

➢ Valid GATE Score in Physics.

➢ Valid Junior Research Fellowship (JRF) or equivalent fellowship of CSIR / UGC / DST INSPIRE or any other funding agencies in Physical Sciences.

- Candidates with valid UGC-National Eligibility Test (NET) / Lectureship (LS) can be considered under the TA category.

- Candidates with a valid Joint Entrance Screening Test (JEST) score can be considered under the TA category.

N.1.2. Minimum score in the qualifying degree

For General / OBC category candidates and / or for candidates where no concession in academic performance is called for, the eligibility criteria in the qualifying degree 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 a scale of 0-10, with corresponding proportional requirements when the scales are other than 0-10 (for example, 4.8 on a scale of 0-8).

- A 5% relaxation in the qualifying degree is applicable for SC/ST/PwD category candidates.

N.2. Modality of Selection Process

N.2.1. Application Categories

The Department of Physics admits Ph.D. candidates under the full-time research scholarship - Teaching Assistantship (TA), Fellowship Awardee (FA), and Externally Sponsored (EX).

N.2.2. Guidelines for shortlisted candidates

For all the categories, based on the information provided by the applicants, a short-list of candidates for the selection process will be prepared. The list 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.

N.2.3. Interview

Only eligible applicants are permitted to participate in the selection process. The department will conduct two rounds of interviews for the shortlisted candidates. Both rounds will be conducted online. The first round of interviews (R1) is compulsory for all shortlisted candidates. After the first round of interviews, the department will call suitable candidate(s) for the second round of interviews (R2). The interview date and time for R1 and R2 will be emailed only to the shortlisted candidate(s). Applicants are advised to check the website regularly from time to time.

N.3. Syllabus

1. **Quantum Mechanics-** Wave-particle duality, Uncertainty Principle, Schrodinger's equation, Simple Problems in One Dimension, Harmonic Oscillators, Hydrogen Atom, Ladder Operators. Angular Momentum Operators, Addition of Angular Momentum, Time-independent perturbation theory and applications, Variational method, Time- dependent perturbation theory and Fermi's golden rule, Identical particles, Pauli exclusion principle, spin-statistics connection.

2. **Mathematical Physics-** Linear Vector space, Scalar product, Metric spaces, Linear operator, Matrix algebra, Eigenvalues and Eigenvector, Complex analysis - Complex numbers, Analytic function, Taylor and Laurent series, Special functions (Hermite, Bessel, Laguerre, and Legendre functions). Fourier series, Fourier, and Laplace transforms.

3. **Classical Mechanics-** Phase space dynamics, stability analysis, Central force motions, 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.

4. **Electromagnetic Theory-** Electrostatics- Gauss's law and its applications, Scalar potential, Electrostatic potential energy, Multipole expansion, Conducting matter, Dielectric Matter. Boundary Value Problems, Solution of Laplace's equation: Potential theory, Uniqueness, Separation of Variables in different coordinate systems, Solution of Poisson's equation using Green's function, Method of Images. Magnetostatics, Steady currents, Biot-Savart law, Ampere law, Magnetic vector potential, Magnetic multipoles, Electrodynamics Dynamic and Quasi-static fields General EM Fields Waves in vacuum and dispersive media, Special Theory of Relativity- Galilean relativity, Einstein's relativity, Lorentz transformation Four-vectors, Relativistic Kinematics Electromagnetic quantities, and Covariant Electrodynamics.

5. **Thermodynamics and Statistical Physics-** Zeroth law, First law, Second law, Carnot cycle, Clausius theorem, reversible work, and heat transfer. 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. Blackbody radiation and Planck's distribution law.

6. **Electronics-** Semiconductor basics, diodes, transistors, transistor models, biasing, amplifiers (CE, CC, Swamped), Darlington pairs, difference amplifiers, operational amplifiers, feedback, instrumentation amplifier, filters, JFETs and MOSFETs, Digital electronics: Logic gates, Boolean algebra, Karnaugh maps, flip flops, shift registers, adders, counters, ADC and DAC.

7. **Condensed Matter Physics-** Crystal structures, reciprocal lattice, X-ray, and electron diffraction. Lattice vibrations, Einstein and Debye models, phonons. Drude and Sommerfeld models. Block theorem, Empty lattice and nearly free electron model, tight-binding model, Density of states and Fermi surfaces. Semi classical model of electron dynamics. Concept of Effective mass.

8. **Nuclear and Particle Physics-** Basic properties of nuclei and interactions, nuclear binding energy, Nuclear moments, Nuclear models- independent particle model, shell model, Deuteron problem, Central and tensor forces, Radioactive decay-theory of alpha decay, Fermi theory of beta decay, gamma decay, Nuclear reactions- direct and compound reactions, Elementary particles- classification, symmetries and conserved quantum numbers, quark model.

9. **Atomic and Molecular Physics**- One-electron atom: Schrodinger equation, energy levels, interaction with electromagnetic fields, transition rates, density of states, dipole approximation, Zeeman and Stark effects; Multi-electron atoms: Helium atom, central field approximation, Thomas-Fermi model of the atom, Hartree-Fock method, L-S and J-J coupling, interaction with external fields; Molecular structure: Born-Oppenheimer approximation, Electronic structure of molecules, Hydrogen molecule ion, Approximate molecular orbital (MO) theory, homo and hetero-nuclear diatomic molecules, electronic term symbols, valence bond (VB) theory of diatomic molecules, comparison of VB and MO theories; Molecular spectra: Rotational, Vibrational and Electronic spectra.

10.**Optics-** Matrix formulation for lens, mirrors and combinations, image formation, brief introduction to primary monochromatic aberrations and chromatic aberrations, Fresnel and Fraunhofer diffraction, Two and Multiple beam interference, Michelson and Fabry-Perot interferometer, line width and coherence, multilayer thin films as antireflection coatings, Linear and elliptically polarized light, polarisers and retarders; birefringence, anisotropic media, principles of magneto-optics, electro-optics and acousto-optics.

N.4. Focus area of research

Ph. D. positions in the following two research areas are available in the Department of Physics during the Spring 2025-26 semester. Applicants have to choose at least one of these topics and mention those in the application form with appropriate order of preference under the relevant question.

Broad domain of research – Experimental Condensed Matter Physics and Material Science

Application category to apply (refer N.2.1) – FA / TA / EX

Eligible social category to apply – GEN, OBC-NCL, SC, and ST under TA/EX are considered; All categories under FA are considered.

Fee – refer section FEES, DEPOSITS & HOSTEL RENT

Type of funding support – FA/TA (Please find the funding related details in Section B)

Duration of funding - Please find the funding related details in Section B

A. Experimental Condensed Matter Physics- Candidates should be motivated to work in the area of experimental Condensed Matter Physics. They should have adequate knowledge in the topics- Superconductivity and Magnetism. The research work will involve study of some interesting properties related to the superconductors and permanent magnets. Candidates should be interested in the synthesis of single crystals and polycrystals of the superconductors/permanent magnets. The experimental work will involve structural, magnetic and transport characterization of these materials.

Topics-

- Superconductivity- Study of vortex dynamics, vortex phase transitions and phase diagrams in the single crystals of a variety of superconductors.
- Magnetism- Magnetic anisotropy, torque magnetometry studies in some rare-earth transition metal based permanent magnets. Study of magnetic anisotropy in rare-earth free magnets.
- Single crystal growth- Crystal growth of superconducting materials, rare-earth transition metal based permanent magnets and rare-earth free magnets.

B. Experimental Condensed Matter Physics- We invite motivated candidates to apply for a Ph.D. position in the field of experimental thin-film and perovskite photovoltaics. The project aims to develop next-generation, high-efficiency, lightweight, and stable perovskite solar cells through advanced thin-film deposition techniques, interface engineering, and scalable device integration. The successful candidate will work on the fabrication, characterization, and optimization of thin-film and perovskite solar cell architectures using physical vapor deposition (PVD), spin-coating, and advanced spectroscopy tools. The research will be carried out in collaboration with national and international partners working in photovoltaics and materials science. The work will also include device modeling, therefore prior knowledge of a programming language will be advantageous.

Tentative Topics-

- Thin-Film fundamentals and processing- Fabrication, Characterization and Tailoring for photonic devices
- Perovskite Photovoltaics- Modelling, Materials, Devices, Testing and Integration

What We Offer

- Access to state-of-the-art thin-film, spectroscopy, and photovoltaic characterization facilities
- Opportunity to publish in high-impact journals and present at international conferences
- Collaborative environment within a rapidly growing photovoltaics research group
- For details visit: www.thinpvlab.in

Broad domain of research – Photonics and Quantum Information

Application category to apply (refer N.2.1) – FA / TA / EX

Eligible social categories to apply (refer N.1.b) – GEN, OBC-NCL, SC, and ST under TA/EX are considered; All categories under FA are considered.

Fee – Refer to section FEES, DEPOSITS & HOSTEL RENT

Type of funding support – FA/TA/EX (Please find the funding related details in Section B)

Duration of funding - Please find the funding related details in Section B

Details for the area "Photonics" - Candidate should be highly motivated to work in the field of Laser Technology, Nonlinear Optics, and Quantum Optics, with the focus on experimental design/development/characterization of nonlinear frequency conversion/optical parametric oscillators/spontaneous parametric down conversion/optical devices/optical materials, together with theoretical modelling and simulations. Collaborative work may require national travel. Experimental working experience together with computer simulation skills, programming language (MATLAB, Python, C++, CUDA), graphing and analysis (Origin) abilities are desirable.

The Ph.D. position in the area of Photonics will provide the candidate with the opportunity to work in the state-of-the-art Photonics Laboratory equipped with sophisticated equipment and facilities, publications in international journals, participation in international conferences, collaboration with research groups across the globe, and many more.

Topic - Optical devices based on nonlinear frequency conversion across unprecedented wavelengths in all time scales; Optical Frequency Combs; Dynamics of optical parametric oscillators; Quantum devices; Photo-physical response, and investigation of various optical nonlinear materials.

Details for the area "Quantum Information Theory" - Candidates applying for this research area should be highly motivated to conduct theoretical research on topics at the intersection of quantum mechanics, quantum optics, many-body physics, and relativity. There are also opportunities to explore cutting-edge Quantum Technologies, including Quantum Artificial Intelligence, Quantum Computation, and Quantum Communication. A solid understanding of the foundations of quantum mechanics, quantum field theory, and quantum information science is essential. Additionally, candidates should be proficient in executing advanced computational programs using standard programming languages. Knowledge of the key principles in these fields, coupled with strong analytical and programming skills, will be highly advantageous.

Topic - Quantum information theory; its interface with quantum optics, relativity, and many-body physics; Quantum Communication; Quantum Computation, Quantum Artificial Intelligence.

Broad domain of research – Atomic, Molecular and Optical Physics, Remote Sensing

Application category to apply (refer N.2.1) – FA / TA / EX

Eligible social category to apply (refer N.1.b) – OBC-NCL, SC, and ST under TA/EX are considered; All categories under FA are considered.

Fee – Refer to section FEES, DEPOSITS & HOSTEL RENT

Type of funding support – FA/TA/EX (Please find the funding related details in Section B)

Duration of funding - Please find the funding related details in Section B

Details - The research work is related to studies of molecular dynamics in ultrafast timescales. The research work to be carried out is experimental in nature. A good background in Atomic, Molecular and Optical Physics and a strong aptitude for experimental work is necessary. The candidate will be involved in design and development of experimental facilities, performing experiments using femtosecond second lasers and advanced setups such as RIMS, COLTRIMS and VMI as well as theoretical modeling and simulations. Collaborative work will require national travels. The candidate should be highly motivated to work in the described area. Experience in working with lasers, high vacuum generation, time of flight mass spectroscopy etc. together with computer simulation skills, MATLAB programming are desirable.

Topic - Experimental Atomic and Molecular Physics

- Molecular dissociation dynamics due to dissociative ionization brought about the electron beams and lasers.
- Suppression or enhancement of ionization/fragmentation of molecules due to different excitation regimes by various ionizing agents.
- Strong field ionization and dissociation of molecules by intense femtosecond laser pulses.

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

(To be typed on letterhead of the Sponsoring Organization)

i. Name of the applicant:
ii. Name of the sponsoring organization:
iii. Address:
iv. Present Designation of the Applicant:
v. Present status of the applicant: (Permanent/Semi-permanent/Temporary)
vi. Division where research work is proposed to be done:
vii. Name of supervisor from the sponsoring organization:
viii. (Biodata of the supervisor to be enclosed giving details of designation, qualification, research experience, etc.)
ix. Details of facilities relevant to the research problem will be made available to the candidate by the organization.

Statement of proposed Co-supervisor (external)

If Shri / Kum. / Smt._____
is registered for the doctorate degree, I,_____,
agree to act as his/ her research Co-supervisor along with the research Supervisor from IIT Dharwad.

Date: Signature of proposed Co-supervisor (external)

Statement of sponsoring authority

If Shri. /Kum. / Smt. _____

is admitted to the Ph.D. program, we shall allow him/ her to undergo the program 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 program, 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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