Indian Institute of Technology Dharwad

॥ सा विद्या या विमुक्तये ॥
ಭಾ.ತಂ.ಸಂ. ಧಾರವಾಡ
भा. प्रौ. सं. धारवाड
I.I.T. DHARWAD

Information Brochure

Ph.D. Admissions

(For Indian Nationals)

Autumn 2024-25

Contents

A. SCHEDULE OF Ph.D. ADMISSION

Sr. No.	Description	Relevant dates*
1.	Applications open	08/04/2024
2.	Last Date to apply online	15/05/2024
3.	Announcement of shortlist of eligible candidates	17/05/2024 onwards
4.	Interview Schedule	18/05/2024 to 20/06/2024
5.	Declaration of provisional list of selected & waitlisted candidates	03/07/2024
6.	Admission process for recommended candidates	Till 10/07/2024
7.	Admission for waitlisted candidates	11//07/2024 onwards

***All deadlines are defined exactly to be at 5:00pm on the respective date.**
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 Academics >> Admissions >> Ph.D. Candidates are advised to keep visiting the website at regular intervals for all updated information regarding admission process.**

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 departmentspecific section in 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 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 defence, whichever is earlier. At present, the monthly rate of assistantshipis ₹37,000 for the first 2 years and 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 externalagencies 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.) are 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 as per 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 for improving the quality of research in various higher educational institutions in the country. With attractive fellowships, the scheme seeks to attract the best talent into research thereby realizing the vision of development through innovation. The scheme was announced in the Budget 2018-19. The institutes which can offer PMRF include all the IITs, all the IISERs, Indian Institute of Science, Bengaluru and some of the top Central Universities/NITs that offer science and/or technology degrees. The candidates will be selected through a rigorous selection process and their performance will be reviewed suitably through a national convention.

B.2.3 Visvesvaraya PhD Fellowship:

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

Fellowship: Rs. 38,750 monthly in 1st& 2nd year and @Rs. 43,750 per month in 3rd,4th and 5^{th} years of PhD. (Support till PhD completion or 5 years whichever is earlier

Research Contingency Grant Support: An amount of Rs. 1,20,000/Year/Full-time PhD candidate for support duration of PhD 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://phd.digitalindiacorporation.in/about-scheme)

B.3 Project Assistantship (PA)

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

B.4 Externally sponsored Ph.D. (EX)

The candidates employed in recognized R&D organizations and desirous of pursuing Ph.D. program while in employment may apply for admission as external candidates. **The option of external registration is for applicants who are working in well-equipped scientific institutions, laboratories, R&D establishments, and industrial organizations engaged in research activities. Persons working in colleges/universities are not eligible under this category.** After fulfilling the coursework requirement at the Institute, these candidates will be allowed toregister 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 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 yearfrom 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 for Ph.D.

Existing employees of IIT Dharwad can be admitted under the category Institute Staff subject to fulfillment of conditions mentioned in the PhD Rule Book.

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

C. GENERAL GUIDELINES for APPLYING ONLINE

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

2. **Please note that the application is to be filled in at one go.** There is no save and proceedoption. The application process flow is given below:

a. **The institute application form should be filled first,** the form contains general information such as your name, category, email id, contact details,address and most importantly preference for departments (especially for those candidates who want to apply for more than one department).

b. After the successful submission of the institute form, a Submission Id is generated and the same is to be noted for all future references.

c. After filling in the institute form, department specific application form shouldbe filled in.

Please note that it is mandatory to fill both institute and department specific application forms. Failure to submit both the forms leads to non- consideration of your application for the selection process.

Only the applicable single application fee should be paid per applicant irrespective of the number of the departments applicant is applying to.

3. Keep all the documents handy >> pay the application fee through SBI e collect facility.>> Note down SBI e collect reference No>> Start online application form>> Fill all particulars including SBI e collect reference No>> **Take a print/ save a pdf copy of preview of completed application form** for future reference >> Final submission of application form >> **Note down submission ID for future reference.**

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

5. You are required to submit the application form online. There are no downloadable forms available. After filling in the form, you are advised to take a print and keep the same for future reference.

6. The application fee is as follows: Please visit the link given below and choose "Application Fee (M.Tech/MS/PhD)", **fill all the particulars and chose 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.**
   State Bank Collect (onlinesbi.sbi)

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

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

8. Applicants may find it convenient to keep following information handy while filling the application form online (whichever relevant). This is especially important as the form cannot be saved and as such once started one needs to complete the entire form and submit:
    - Skype Id or Gmail Id for G-meet
    - Passport size photo whose size is less than 50 kb.
      Educational details from secondary school onwards
    - GATE qualification details
    - Statement of Purpose (pdf file)
    - List of fellowship/ awards
    - Publications
    - Sponsorship Letter and CV of co-supervisor if you are applying under 'EX' category.
    - JRF Award Letter if you are applying under 'FA' category, if applicable.
    - Any other achievements/information.

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

10. **Keeping 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.**

11. The Shortlisted candidates' list will be uploaded on the institute website as per the schedule given above in Section A.

12. 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 relevantdocuments.

13. **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.**

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) and has an attached bath & toilet.
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	NOT ALLOWED, however bicycles are permitted in the campus.
Climatic conditions	The weather at Dharwad is pleasant throughout the year. Generally, it will be raining in the months of June to September and weather will be windy and cold during the months of October to January. It is suggested that you carry protective clothing accordingly.

E. FEES, DEPOSITS & HOSTEL RENT

The tentative fee applicable for admission to PhD 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) (Annually)		**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. *Students not staying on the campus or not provided with married accommodation are not required to pay fee at sl. no. 6, 7, 10, 11 & Mess advance.

F. DEPARTMENT OF BIOLOGICAL SCIENCES AND BIOENGINEERING

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.
- **MTech/M.Sc.** or equivalent in Bioinformatics/ Chemistry/Biotechnology/Microbiology/life-sciences or other allied biology subjects.
- M.Sc. students must have qualified GATE for TA/PA category.
- MTech. 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.
- First Class degree in MTech or M.Sc or integrated post-graduate in Biotechnology/Biophysics/Computational Biology/Life Sciences/Bioinformatics or allied biology subjects with GATE or equivalent for PA 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 category candidates and/or for candidates where no concession in academic performance is called for, the eligibility criteria in the qualifying degree (MTech. /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 above mentioned qualifying degree and who are likely to graduate before commencement of Autumn 2024-25 semester of IIT Dharwad are also eligible to apply. However, if offered, admission to those candidates would be provisional. To join academic program at IIT Dharwad, such candidates need to furnish necessary documents regarding completion of the degree on the date of joining mentioned in 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 comprise of an offline interview process. All the eligible 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 in terviews, 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, Nano biotechnology, Genomics, and proteomics.

F.4 Focus area of research

1. Cancer biology
2. Metabolomics using Raman spectroscopy.
3. Neuroscience: Stress, Depression, Alzheimer's disease, and Neurodegeneration
4. Autophagy, Inflammation, and Host-Pathogen Interactions

F.5.1 Teaching Assistantship (TA)

In this call, applications are invited under TA category only for the research areas 3 and 4.

F.5.2 Fellowship Awardee (FA)

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

F.5.3 Project Assistantship (PA)

In this call, applications are invited under PA category for the research areas 1, 2 and 3. See the descriptions below.

Focus area of research: Metabolomics using Raman spectroscopy

Number of positions available: 01

Project title: Development of a heavy water-based Raman spectroscopic platform for identification of antibiotic resistant urinary tract infections
Funding agency: ICMR

Description: The project aims at validating the potentials of heavy water-based Raman spectroscopy for its potential utility as a tool for identifying antibiotic resistant bacteria. The candidate recruited under this project will be working in close collaboration with clinicians and data analysis.

Focus area of research: Cancer Biology
Number of positions available: 01

Project title: Understanding Pan-cancer Epithelial-Mesenchymal Plasticity: Biological and Clinical Implications of EMT-Associated LncRNAs

Funding agency: ICMR

Focus area of research: Neuroscience: Stress, Depression, Alzheimer's disease, and Neurodegeneration

Number of positions available: 01

Project title: Investigation of the role of astrocytes in driving stress responses and neuropsychiatric behavior

Funding agency: DBT-Wellcome Trust India Alliance

Project Description: Major depressive disorder (MDD) is a devastating illness afflicting over 20% of the population. MDD therapies are inadequate owing to our insufficient understanding of the underlying pathophysiology. Most of the research on MDD has focussed on neuronal dysfunction despite plenty of evidence showing astrocyte degeneration in MDD patients. Our understanding of astrocytes is hampered by the assumption that all astrocytes are nearly identical. Work from my lab has revealed structural plasticity in astrocytes after chronic stress and antidepressant treatments, which is induced in specific astrocyte subpopulations. This project aims at deeper understanding of astrocyte subpopulations and their role in MDD

G. DEPARTMENT OF CHEMICAL ENGINEERING

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 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.

G.1.2 Minimum score required 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./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 Autumn 2024-25 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.

G.2. Modality of selection process

Our PhD selection process is highly competitive and involves two rounds of interviews. Only eligible applicants will be permitted to participate in the selection process, which is designed to evaluate the applicant's research potential, academic background, and motivation for pursuing a PhD in Chemical Engineering. The first round of the interview process will be conducted in online mode and will consist of an informal discussion on the applicant's research interests and academic background. This round is aimed at evaluating the applicant's research potential and identifying candidates who have a strong foundation in the field of chemical

engineering based on fundamental questions. The second round of the interview process will be conducted a detailed online interview and will provide shortlisted candidates with the opportunity to interact with our faculty members and gain an in-depth understanding of our research programs. This round is designed to assess the applicant's research skills, scientific reasoning, and suitability for our PhD program.

G.3. Focus area of research

The following topics are floated in the Department of Chemical Engineering for the PhD program this semester. Applicants have to choose at least one of these topics and fill in the application form. The broad areas of research will be in the following fields: Our PhD program is aimed at developing the next generation of innovators and leaders in the field of chemical engineering. We encourage all eligible applicants to apply for our program and look forward to welcoming the most promising candidates to our department.

1. Multiphysics modeling of Li-ion batterie.
2. Modeling and simulation of a proton exchange membrane (PEM) fuel cell
3. First principal modeling to accelerate energy, environment, and healthcare innovations.
4. Advance membrane materials for CO_2 capture (Experimental and Simulations)
5. Design of novel electrolyte/electrode materials for energy storage devices (Molecular dynamics simulations)

G.4. First round interview Instructions:

If you have been shortlisted for the first and second round of 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 Chemistry and/or any other related areas.

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

- **Valid GATE Score** or M.Phil or M.Tech./M.E. or equivalent degree in chemistry (for **TA category**)
- **Junior Research Fellowship** (JRF) of CSIR/UGC/DST INSPIRE/DBT/MHRD/ICMR 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

1. For General/OBC category candidates and/or for candidates where no concession in academic performance is called for, the eligibility criteria in the qualifying degree is First Class, as specified by the candidate's Institution/University. If the Institution/University does not specify the division/class, then one of the following will be considered as the eligibility criteria:

- a minimum of 60% marks (without round off) in aggregate. (OR)
- a minimum Cumulative Grade Point Average (CGPA) or Cumulative Performance Index (CPI) of 6.0 on the scale of 0-10; with corresponding proportional requirements when the scales are other than on 0-10, (for example, 4.8 on a scale of 0-8).

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.

The selection process comprises two rounds of online interviews.

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, materials chemistry 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. **Functional π-conjugated compounds:** The π-conjugated compounds (oligomers, one-dimensional and two-dimensional polymers) are of great importance in semiconducting applications because electron delocalization along the π-conjugated backbone gives rise to interesting electronic and optical properties. Thus, the π-conjugated compounds have been well explored for various applications in molecular electronics such as organic field effect transistors (OFETs), Organic light emitting diodes (OLEDs), solar cells, fluorescent/resistive sensing and photocatalysis. Thus, our group is interested in developing new π-conjugated organic compounds using novel synthetic routes and exploring their applications in organic materials with a particular interest in fluorescent sensing and photocatalytic applications for organic transformations and hydrogen evolution.

2. **Bio-organic Chemistry and Chemical Biology:** Enzymes are nature's organic chemists that carry out remarkable chemical reactions, particularly in the synthesis of antibiotics and other important drug compounds. To study the enzyme reaction mechanisms, one requires sound knowledge of chemistry and biochemistry. Our area of research involves studying the organic chemistry of enzymes involved in the synthesis of biologically active compounds (anticancer, antibacterial, antifungal etc.). Some natural products that we focus in the lab are ribosomally synthesized and post-translationally modified (RiPP) peptide natural products, non-ribosomal natural products and nucleoside based compounds. All these have impressive antibacterial properties to combat antibiotic resistance, a global health threat nowadays. We study the chemistry of the enzyme mechanisms (such as C-H activation, C-C bond formation, molecular rearrangement, amide bond activation, peptide bond formation etc.) involved in synthesizing these natural products. We employ interdisciplinary techniques from chemistry (synthetic organic chemistry, physical organic chemistry, spectroscopic techniques, inorganic chemistry, and anaerobic techniques), biochemistry/chemical biology, protein chemistry, molecular biology, and microbiology during these studies. Suitable collaborations (such as for protein crystallography, complex organic synthesis, EPR techniques, proteomics, and synthetic biology etc.) will be initiated to gain insights into the molecular details of these enzymatic mechanisms. In addition, analog generation for medicinal chemistry, enzyme inhibitors development and structure- function elucidation of new compounds will also be undertaken in the future for drug design. Students will get exposure to synthesis, biochemistry, molecular biology, and various spectroscopic techniques.

3. Bioinorganic/small molecule activation/nanocluster/catalysis: There are plethora of metalloenzyme in biological world performing biochemical reactions efficiently and selectively. Their primary reaction center, called as active site, contains metal ion ligated by amino acid residues. Metal play's central role in execution of the chemical reaction whereas amino acid residues modulate the reactivity by steric and electronic control. Notably, nature uses earth abundant transition metals (e.g. Fe, Mn, Ni, Co, Cu, Zn) and small molecules (O_2, CO_2, H_2, N_2, H_2O, H_2S, NH_3, NO, N_2O, NO_2^-, NO_3^- *etc*.) as co-substate to construct chemical steps. On the other hand, chemists have developed transition-metal catalyst to empower organic transformations, such as asymmetric hydrogenation, oxidation, olefin metathesis, and carbon-carbon and carbon-heteroatom cross-coupling reactions, all are Nobel Prize winning reactions, however, uses some of the least available elements on earth (e.g. Rd, Ru, Pd).

Inspired by the natural systems, we are motivated to design and synthesize metal complexes of earth abundant metals (Mn, Fe, Co, Ni, Cu) using noble ligand motifs to perform various organic transformation and energy relevant small molecule activation (e.g. O_2, CO_2, NO_2^-, NO_3^- H_2O, H_2O_2). Various spectroscopic tools (NMR, UV-vis, EPR, IR, GC, ESI-Mass, Potentiostat etc.) will be employed to characterize and evaluate the catalytic performances of the system. Further, a detail mechanistic investigation allows us to translate acquired information to develop a new model catalysts of metal nanoclusters (NCs). Due to its ultra-nano size (< 2 nm), NCs shows molecule like properties with a discrete energy level, unlike nanoparticles (NPs). Also, compared to conventional catalysts of NPs, metal NCs have well-defined structures in both the arrangement of metal atoms in the core as well as the ligand-binding modes on the surface. Hence, it provides unprecedented opportunities for understanding catalytic mechanisms at the atomic level and bridge the knowledge gap between homogeneous model catalysts and real-world nano catalysts.

Researcher will get exposure to learn following professional and scientific skills:

- Research expertise in bio-inorganic, inorganic, organometallics, nanocluster.
- Multi-steps organic, metal-complex, and atom-precise nanocluster synthesis.
- Use of Schlenk line and glove box to handle air and moisture sensitive reagents and reactions steps.
- Isotopic labeling experiments.
- Energy relevant small molecules (O_2, CO_2, H_2O) activation by transition metal complex.
- Extensive working experience in chemical, electrochemical, and photochemical reactions.
- Learning of chemical kinetics using UV-vis spectrometer.
- Scientific writing and oral communication skill.
- Mentorship to undergraduate students.
- Hands-on experience in UV-vis spectrophotometer, potentiostat, NMR, GC-MS, IR *etc*.
- Purification of organic compounds by chromatographic techniques and their structural elucidation by various spectroscopic tools.

- Mechanistic studies for catalytic reactions (generation and characterization of reactive intermediates).

4. **Computational Chemistry:** We employ density functional theory (DFT) based computational techniques to study various problems in chemistry and material science. Our current research interests are designing electrocatalysts for nitrogen reduction reactions to ammonia. In this project, we will be employing high-throughput based calculations in conjunction with molecular dynamics simulations for rational catalysts design. We are also interested in studying the covalent organic frameworks based organic electrodes for alkali ion batteries using computational methods.

5. **Polaritonic & Excited-State Chemistry:** Precise control over any chemical process to modify the final outcome of the reaction has always been a chemist's dream. Recent advancements in cavity quantum electrodynamics and its potential applications to molecular systems have shown that strong light-matter interaction in optical cavities influences the ground and excited state chemical processes. In the presence of an optical cavity, the molecular states can couple to the cavity vacuum field and form light-matter states called as "polaritons". These polaritonic states manipulate the potential energy surfaces and modify the chemical reactivity. The chemistry involving light-matter interaction, referred as photochemistry when the coupling is small and no cavity is present, is generally complex to investigate theoretically. Unlike to the ground-state chemistry, photochemical reactions are largely governed by the crossings of potential energy surfaces, which results the involvement of multiple electronic states and creates additional theoretical complications in understanding the mechanistic details. Our research involves the theoretical exploration of excited-state chemistry and polaritonic phenomenon in molecules by employing multi-reference electronic structure methods (CASSCF, CASPT2 and MRCI) along with QM/MM and quantum dynamics simulations.

H.5. Project assistantship (PA)

Code: AU2024_CHE_01

Title: Biochemical and mechanistic investigation of Malayamycin A biosynthesis: A promising C-nucleoside natural product with potent antifungal properties

Description: This project involves characterization of various interesting enzymes/proteins involved in the biosynthesis of the antifungal natural product Malayamycin using various interdisciplinary techniques from organic chemistry, biochemistry, and molecular biology.

Broad domain of research: Bioorganic chemistry, chemical biology, and protein biochemistry

Requirement: The candidate should have a master's degree in any area of chemistry, biochemistry, biotechnology, or related life science fields and should have an interest in learning new interdisciplinary chemical biology techniques. Good communication skills are desirable.

Type of funding support – Sponsored project (Rs. 37000/- for the first two years and Rs 42,000/- after two years; additional 18% 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

I.1 Qualifying Degree

M.Tech. or equivalent degree in Civil Engineering with the specialization of Geotechnical Engineering or Structural Engineering (or any other equivalent PG specialization in Civil Engineering)

I.1.1. Minimum score required in the qualifying degree and GATE Qualification

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 (MTech. /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).
- Candidate must qualify in GATE at least once (Candidate need not to have a valid GATE score) OR Candidate must have CGPA > 8.0 in master's from IIT or NITs OR Candidate must have one SCI indexed journal publication as a first/second author.

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, candidate must qualify in GATE at least once (Candidate need not to have a valid GATE score) OR Candidate must have at least one SCI indexed journal publication as a first/second author.

I.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 Autumn 2024 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 awarded 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.

I.2. 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 selectionprocess 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 the Civil Engineering GATE equivalent syllabus.

The candidates 0are encouraged to check the Institute Website from time to time. Selection committee decisions are final in all matters including any disciplinary matters/malpractice.

I.3. Focus area of research

Geotechnical Engineering: Unsaturated soils, Energy Geotechnics, Geotechnical Earthquake Engineering, Slopes and Landslides, Ground Improvement Techniques, Geosynthetics, Retaining Walls and Deep Excavations, Pavement Geotechnics, Buried Pipelines.

Structural Engineering: Structural Dynamics, Earthquake Engineering, Structural Fire Engineering, Steel Structures, Light Weight Portable Structures, Multi-Hazards, Retrofitting of Structures, High Strength Concrete.

I.4. Teaching Assistantship (TA)

The positions mentioned below are available for **OBC-NCL and EWS categories only.**

I.4.1. Position 1

Code – AU24_Civil_PhD_TA1
Broad domain of research – Geotechnical Engineering

I.4.2. Position 2

Code – AU24_Civil_PhD_TA2
Broad domain of research – Structural Engineering

I.4. Externally Sponsored (EX)

In this call, applications are invited under EX category for all research areas mentioned above. The candidates will be shortlisted as per the rules mentioned in B.4 section and I.1 Section.

I.5. Visvesvaraya PhD Fellowship

The fellowship supports research conducted in the domain of Electronic System Design and Manufacturing (ESDM) and IT/IT-enabled services.
Fellowship, Research Contingency Grant Support, Support for attending International Conferences and visiting a lab abroad, and HRA benefits (if the hostel is not available) can be found in the section B.2.3 of brochure and the reference link given below.
(Reference - https://phd.digitalindiacorporation.in/about-scheme)

J. DEPARTMENT OF COMPUTER SCIENCE AND ENGG.

J.1. Qualifying Degree

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

J.1.1 Minimum score in the qualifying degree

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

- 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 Autumn 2024-25 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. **Data Science and Artificial Intelligence (DSAI):** Machine Learning (ML), Deep Learning (DL), Reinforcement Learning (RL), Stochastic Control and Optimization, Bayesian Optimization, Text Mining, Speech and Audio Processing,

Handwriting, and Document Processing, Natural Language Processing, ML for Cyber Physical Systems, Mining large data streams, ML for Cyber Security, Big Data Analytics, Distributed data processing.

2. **Computer/Communication Networks (CN):** 5G/IoT Networks, AI Driven Networking, Network Virtualization, Network/Cyber Security, Blockchains, Software Defined Networks, Network Function Virtualization, Data Center Networking.
3. **Embedded systems and Computer Architecture (ESCA):** Reliability and robustness of Advanced driver assistance systems (ADAS), Modeling and characterization of heterogeneous processors, Runtime Verification of Hardware and Efficient Computer Architectures
4. **Theoretical Computer Science (TCS):** Algorithms, Concurrency, Formal Verification, Graph Theory, Logic.
5. **High Performance Computing and Programming Languages (HPCPL):** Parallel Computing, Compilers and Translation Systems, Programming models and runtime systems.
6. **Machine Learning for Systems (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.

J.4. Teaching Assistantship (TA)

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

J.5. Externally Sponsored (EX)

In this call, applications are invited under EX category for all research areas (1) -(6).

J.6. Project Assistantship (PA)

Code: AU2024_CSE_01
Title: Multimicrophone processing for sound source localization and tracking in robot applications
Description: This project involves development of signal processing, artificial intelligence and deep learning-based algorithms for sound source localization and tracking
Broad domain of research: Speech Processing, Natural Language Processing, machine learning and deep learning.
Requirement: The candidate should have exposure to the basics of probability, signal processing and good programming skills in python.
Type of funding support – PA (Rs. 37000/-; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)
Duration of funding - 3 years, **Number of openings:** 1

Code: AU2024_CSE_02
Title: Development of Standalone Speech to Speech Translator for Indian Languages
Description: This project involves development of artificial intelligence and deep learning-based systems (speech recognition, machine translation, text to speech and speech to speech translation) for selected Indian languages.
Broad domain of research: Speech Processing, Natural Language Processing, machine learning and deep learning.
Requirement: The candidate should have exposure to the basics of probability, signal processing and good programming skills in python.

Type of funding support – PA (Rs. 37000/-; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)
Duration of funding - 3 years, **Number of openings:** 1

J.7. Visvesvaraya PhD Fellowship

The fellowship supports research conducted in the domain of Electronic System Design and Manufacturing (ESDM) and IT/IT-enabled services.
Fellowship, Research Contingency Grant Support, Support for attending International Conferences and visiting a lab abroad, and HRA benefits (if the hostel is not available) can be found in the section B.2.3 of brochure and the reference link given below.
(Reference - https://phd.digitalindiacorporation.in/about-scheme)

J.8. 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

K.1. Eligibility Criterion

K.1.1. Qualifying Degree

M.Tech., MS, ME or equivalent degree in Electrical Engineering, Electronics and Communication Engineering, Electrical and Electronics Engineering, Instrumentation Engineering, Computer Science and Engineering, or any related stream.

OR

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

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):

- 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 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 Autumn 2024-25 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.1.4. Application Categories and Financial Support

The Department of Electrical, Electronics and Communication Engineering offers admission to PhD programs under TA, PA, FA, EX, and Institute Staff categories. The details of each application category are given in Section APPLICATION CATEGORIES & FINANCIAL SUPPORT of this document.

Note: **The PA, EX, FA, Institute staff category vacancies are open to all social categories.**

K.2. Guidelines for Shortlisted Candidates

K.2.1. SELECTION PROCESS

All the eligible candidates are invited for the first round of interviews via video conferencing. After the first-round interviews, a shortlist will be announced for the second round of interviews. The shortlisted candidates will be asked to attend the second round of interview. **Note that the second round of interviews will be offline, and the candidates must report to the institute for the same**. Institute will provide accommodation for the second round with nominal charges. 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/ms.
The selection committee decision is final in all matters including any disciplinary matters/malpractice.

K.3. Research Areas

K.3.1. For TA, FA, EX, and Institute Staff categories

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

1. **Microelectronics and VLSI:** 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 etc.

2. **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.

3. **Communication Technologies:** Including but not limited to, physical and medium access control (MAC) layer technologies in Next Generation Wireless Systems (5G and beyond), Internet of Things (IoT), novel multiple access methods like non-orthogonal multiple access (NOMA), massive multi-input multi-output (MIMO) systems, millimeter wave (mmWave) communications, energy harvesting based communications and low-latency communications, Machine Learning (ML) and Blockchain (BC) oriented resource allocation in 6G, Quantum Communication etc.

4. **Signal Processing and Machine Learning:** Machine learning for signal processing, Deep Learning for signal processing, speech and natural language processing, biomedical signal and image processing and optical character recognition, handwriting recognition and document processing, bioinformatics, Computer Vision, and Satellite Image Analysis and Edge computing accelerator for ML/AI applications.

5. **Power & Energy Systems:**
   a) Power systems: Power system stability and control; Distributed Energy Resources (Solar PV/Wind/BESS), Grid-Tied Inverters and Control, Grid Forming Technology, Cyber Security and Game Theory Applications in Smart Grid. Microgrid operation and reliability, Sustainable Transportation (G2V andV2X of EVs)

b) Power Electronics and Drives: Converters for grid-interfacing, modular and multi-level inverters, power converters for Electric Vehicles (Chargers, Drivetrains, Power Supplies); DC Circuit Breakers for medium-voltage applications (renewables, aircraft, shipboard, etc.), Design of Wide-bandgap device-based converters (GaN and SiC based topologies); Modeling and Controls for Advanced Power Electronics (soft-switched and resonant converters, distributed control, etc)

c) Electrical Machines and Magnetic Components: Multiphysics optimization, Permanent magnet machines, Machines with segmented cores, Rotational losses, Magnetic characterization tools for soft-magnetic materials, FEM analysis of magnetic components, and Condition monitoring.

6. 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.3.2 For PA category

Applications are called in following broad domains.

1. Microelectronics and VLSI – 2 positions
2. Signal processing and Machine learning. – 1 position

K.3.3. Visvesvaraya PhD Fellowship

The fellowship supports research conducted in the domain of Electronic System Design and Manufacturing (ESDM) and IT/IT-enabled services.
Fellowship, Research Contingency Grant Support, Support for attending International Conferences and visiting a lab abroad, and HRA benefits (if the hostel is not available) can be found in the section B.2.3 of brochure and the reference link given below.
(Reference - https://phd.digitalindiacorporation.in/about-scheme)

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:**
   a. **Continuous-time signals:** Fourier series and Fourier transform representations, sampling theorem and applications.
   b. **Discrete-time signals:** discrete-time Fourier transform (DTFT), DFT, FFT, z- transform and sampling theorem.
   c. **LTI systems:** definition and properties, causality, stability, impulse

response, convolution, poles and zeros and frequency response.

d. **Random processes:** basics of probability, random variables, CDF, PDF, random processes, mathematical expectation, conditional probability, and conditional expectation.

3. Communication:

a. **Random processes:** Basics of probability, random variables, CDF, PDF, random processes, mathematical expectation, conditional probability, and conditional expectation.

b. **Digital communications:** Digital modulation schemes, MAP and ML decoding, notions of bandwidth, SNR and BER for digital modulation, fundamentals of error correction codes (e.g.: Linear Block Codes like Hamming code).

Stream 2: 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 HUMANITIES, ECONOMICS, ARTS AND RURAL TECHNOLOGIES (HEART)

[Formerly Department of Humanities and Social Science (HSS)]

Online Applications are invited for admission into the Ph.D. Program **(in Economics, English and Philosophy)** in the Department of Humanities, Economics, Arts and Rural technologies (HEART) (formerly Department of Humanities and Social Sciences). The minimum eligibility criteria are as follows:

L.1 Eligibility for Admission

L.1.1 Qualifying Degree (Economics)

1. Master's degree in economics or Any Other Relevant Discipline
2. UGC-NET/GATE Qualified in Economics
   UGC-NET/JRF Qualified Candidates are encouraged to apply.
3. Candidates who do not have UGC-NET or GATE are also eligible to apply, provided they have a minimum of 2 years of professional experience (acquired after obtaining the qualifying degree).

Qualifying Degree (English)

1. M.A. in English
2. UGC-NET/GATE Qualified or M.Phil. in English
   UGC-NET/JRF Qualified Candidates are encouraged to apply.
3. Candidates who do not have UGC-NET/GATE or M.Phil. are also eligible to apply, provided they have minimum of 2 years of professional experience (acquired after obtaining the qualifying degree (M.A. English)).

Qualifying Degree (Philosophy)

1. M.A. in Philosophy
2. UGC-NET/GATE Qualified or M.Phil. in Philosophy
   UGC-NET/JRF Qualified Candidates are encouraged to apply.
3. Candidates who do not have UGC-NET or M.Phil. are also eligible to apply, provided they have a minimum of 2 years of professional experience (acquired after obtaining the qualifying degree (M.A. Philosophy)).

L.1.2 Minimum score in the qualifying degree

Category	Minimum Eligibility
General	55% aggregate overall in master's degree, (without round off), or CPI 5.5 on the scale of 10
OBC	55% aggregate overall in master's degree, (without round off), or CPI 5.5 on the scale of 10
SC	50% aggregate overall in master's degree, (without round off), or CPI 5 on the scale of 10
ST	50% aggregate overall in master's degree, (without round off), or CPI 5 on the scale of 10
PwD	50% aggregate overall in master's degree, (without round off), or CPI 5 on the scale of 10

Please Note: Corresponding proportional requirements are applicable when the scales are other than on 0-10 (for example, 4.8 on a scale of 0-8 for General Category Candidates). For SC/ST/PwD category candidates, a relaxation of 5% in the qualifying degree is applicable.

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

Students who are in the final phase of receiving above mentioned qualifying degree and who are likely to graduate before commencement of Autumn 2024 semester of IIT Dharwad are also eligible to apply. However, if offered, admission to those candidates would be provisional. To join academic program at IIT Dharwad, such candidates need to furnish necessary documents regarding completion of the degree on the date of joining mentioned in Section A above. They need to meet the criteria specified in section above considering updated score in the qualifying degree. In the meanwhile, the aggregate academic performance announced by the respective university till the last date for submission mentioned in above section should be used to determine eligibility for application and same to be reported in the online application.

L.2 Modality of the Selection Process

Only the short-listed applicants are permitted to participate in the selection process.
The applicant needs to submit a Research Proposal (Word Limit: 1500-2000).
The selection process consists of either online screening tests and/or interviews.
Candidates will be offered a PhD position based on their performances in the selection process.

L.3 Focus Area of Research

Economics:

1. **International Finance, Open-Economy Macroeconomics, Monetary Economics, and International Trade.**
2. **Applied Microeconomic Theory, Applied Game Theory, Climate Change and Sports Studies.**
3. **Energy Economics, Urban Economics and Environmental Economics.**

Broad Domain of Research:

1. International Finance, Open-Economy Macroeconomics, Monetary Economics, and International Trade.
2. Microeconomics.
3. Applied Developmental Economics

Eligible Social Category to Apply for TA Positions – All Categories
(i.e., GEN/OBC(NCL)/SC/ST/PwD/EWS)
Eligible Social Category to Apply for Fellowship Awardees–All Categories
Fee – refer section FEES, DEPOSITS & HOSTEL RENT
Type of Funding Support – FA/TA/Institute Staff (Please find the funding related details in Section B)
Duration of Funding - Please find the funding related details in Section B

English: Literature and Literary Theory, Gender Studies, Interdisciplinary Literary Studies

Broad Domain of Research –
Gender Studies, Literature, Literary Theory, Cultural Studies, South Asian Literature, Feminist Philosophy, Literature and Psychoanalysis, Popular Culture, Holocaust Studies, Dalit Studies, Indian Literature

Eligible Social Category to Apply for TA Positions – All Categories
(i.e., GEN/OBC(NCL)/SC/ST/PwD/EWS)
Eligible Social Category to Apply for Fellowship Awardees– All Categories
Fee – refer section FEES, DEPOSITS & HOSTEL RENT
Type of Funding Support – FA/TA/ Institute Staff (Please find the funding related details in Section B)

Philosophy: Analytic Philosophy

Broad Domain of Research –
Ethics: AI and Ethics, Ethics of Technology
Metaphysics: Modality, Philosophical Logic, Ontology

Eligible Social Category to Apply for TA Positions –OBC(NCL)/SC/ST/PwD.
Eligible Social Category to Apply for Fellowship Awardees – All categories.
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

L.4 Syllabus

Economics: Consumer Behaviour, Production and Costs, Market Environments –Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly.

National Income Accounting Methods, Classical Model, Keynesian Model, IS-LM Model, Fiscal and Monetary Policies, Solow Growth Model, Inflation, Index Numbers, Indian Money Market and RBI's Monetary Policy.

Vectors and matrices, matrix operations, determinants. Functions, limits, continuity, differentiation of functions of one or more variables. Unconstrained optimization, definite and indefinite integrals, integration by parts and integration by substitution. Constrained and Unconstrained Optimization: First and Second order conditions.

Elementary probability theory, conditional probability, Bayes' theorem, probability distributions –Binomial, Poisson, Uniform and Normal, measures of central tendency, skewness, kurtosis, dispersion, correlation and regression, Assumptions of the CLRM and properties of the estimators, OLS, Violations of CLRM assumptions.

The Standard Theory of International Trade, Offer Curves, and the Terms of Trade, The Heckscher - Ohlin Theory, Economies of Scale, Imperfect Competition and International Trade, Trade Restrictions: Tariffs and Nontariff Trade Barriers, Economic Integration, The Balance of Payments, Foreign Markets and Exchange Rate Determination, The International

Monetary System and Macroeconomic Policy Coordination, Economic Crises.

Suggested Readings:

I. Intermediate Microeconomics by Hal R. Varian
II. Microeconomic Analysis by Hal R. Varian
III. Macroeconomics by Rudiger Dornbusch & Stanley Fischer
IV. Principles of Macroeconomics by N. Gregory Mankiw
V. Fundamental Methods of Mathematical Economics by Alpha C. Chiang
VI. John E. Freund's Mathematical Statistics with Applications
VII. Introductory Econometrics: A Modern Approach by Jeffrey Wooldridge
VIII. Basic Econometrics by Damodar N. Gujarati
IX. International Economics by Dominick Salvatore

English: The shortlisting process will include a defence of the research proposal shared by the candidate. Candidates are expected to have training in literary and critical theories, textual analysis and research methods.

Philosophy: Shortlisting process will involve a defence of the research proposal shared by the candidate.

History of Philosophy

Rationalism of Descartes, Spinoza, and Leibniz

Empiricism of Locke, Hume, and Berkeley.

Branches of Philosophy

a. Ethics: Trolley Problem and Normative Ethics, Utilitarianism, Immanuel Kant's Deontology and Virtue Ethics
b. Epistemology: Traditional analysis of knowledge (Justified True Belief Account (JTB)), Edmund Gettier's Counterexamples to JTB account and the problem of Skepticism.
c. Metaphysics: Causality, Freewill, Modality and Universals & Particulars
d. Logic: Basics of First Order Sentential/Propositional Logic

M. DEPARTMENT OF MATHEMATICS

M.1 Eligibility Criteria

M.1.a. Qualifying degree

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

M.1.b. 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 (NC)	Same as general
SC/ST/PWD	A relaxation of 5% in the qualifying degree is applicable

M.1.c. 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.

M.1.d. Eligibility of applicants in the final phase of getting the qualifying degree

Students who are in the final phase of receiving above mentioned qualifying degree and who are likely to graduate before commencement of Autumn 2024-25 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 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.1.e. Application categories and Financial Support

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

2. Project assistantship (PA):

Code: AUS_MA_01

Title: Fractional parts of powers real algebraic numbers and related problems

Description: This project involves studying Diophantine approximation problems, such as study of Fractional parts of powers real algebraic numbers, period length of continued fraction expansion

Broad domain of research: Transcendental Number Theory, Diophantine Approximation

Requirement: The candidate should have exposure to the basics of Elementary Number theory course, Field and Galois Theory

Type of funding support: JRF (Rs. 31000/-for the first two years and Rs. 35000 for the third year, and Contingency Rs. 30000 for three years)

Duration of funding: 3 years, **Number of openings**: 1

M.2 Guidelines for shortlisted applicants

M.2.a. 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.

M.3 Research Topics:

1. Commutative algebra
2. Number theory.
3. Representation theory.

M.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
4. Basic combinatorics

M.5 Focus area of research

Applications are invited for Commutative algebra, Number theory, and Representation theory.

N. DEPARTMENT OF MECHANICAL, MATERIALS AND AEROSPACE ENGINEERING

N.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.

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.

N.2 Eligibility for Admission - direct PhD

Students can apply for the PhD program directly after completing their B.Tech/B.E degrees for a direct PhD program.

Qualifying criteria

B.Tech./B.E. or equivalent degree in Mechanical Engineering or Materials and Metallurgical Engineering or 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) *

*Valid GATE score is essential for candidates applying in TA (Teaching Assistantship) and PA (Project Assistantship) category.

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.

Increased credit requirement

The direct PhD candidate will have to complete between 46 and 60 Credits (excluding the seminar course).

N.3. Focus area of research

Department of MMAE, IIT Dharwad is looking for PhD students in the following broad research areas. Applicants should be interested in at least one of the following research areas.

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.

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, Digital Twins, 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, Computational materials science, Self-clean/Superhydrophobic Coatings & Multifunctional coatings and adhesives, light-weight composites

N.4 Information on project category

The following projects are seeking PhD scholars in the project category:
Project ID: 24AU_MMAE_PhD_PA01
Broad area: Aerospace Propulsion, Thermo-fluids, Combustion, Renewable fuels, Thermoacoustic, Instabilities and Nonlinear dynamics.
Eligible social category to apply – All categories.
Fee – Please see the section "Fees, deposits & hostel rent".
Duration of the funding - 3 years subject to availability of funds.
Stipend: The proposed stipend Rs. 37,000/- per month for the first two years and 42,000 /- for third year + 18% HRA if the hostel facility is not available
Number of openings: 1
Topic: Thermoacoustic characteristics of 3D printed LPG/H_2 fueled triple-swirl turbulent burners using optical diagnostics.
Brief Description:
India is importing nearly 80% of the fuel at the present level, which significantly impacts the country's economy. The demand for alternative fuels is increasing due to rising energy demand, depleting conventional fuel sources, and concurrent demand for clean energy from combustion. Hydrogen is an excellent alternative fuel for combustion applications due to its clean-burning properties. Fuel flexibility research is critical for adapting to fuel blending in gas turbine applications. The thermoacoustic characteristics of a 3D printed LPG/H_2 fueled triple-swirl turbulent burner will be analyzed using optical diagnostics such as planar laser-induced fluorescence (PLIF), stereo particle image velocimetry (SPIV), and high-speed imaging. Further, data analytical tools including but not limited to nonlinear time series analysis, machine learning and deep learning methods will be employed to analyze the high-speed flow and flame images.

Project ID: 24AU_MMAE_PhD_PA02
Broad area: Fluid Mechanics, Multiphase Flow, Computational Fluid Dynamics
Eligible social category to apply – All categories.
Fee – Please see section "Fees, deposits & hostel rent."
Duration of the funding - 3 years subject to availability of funds
Stipend: The proposed stipend Rs. 37,000/- per month for the first two years and 42,000 /-

for third year + 18% HRA if the hostel facility is not available
Number of openings: 1
Topic: Inertial Coalescence in liquid-liquid extraction for clean energy production
Brief Description:
The collision of liquid drops is ubiquitous in promising industrial applications related to zero carbon emission such as production of clean energy using liquid-liquid extraction. The project involves numerical, experimental, and theoretical investigation of droplet coalescence in an inertial flow. The project will focus on both pre-coalescence and post-coalescence dynamics of viscous drops for both viscous and viscoelastic surrounding medium. The candidate will work in collaboration with IISc Bengaluru, IFPEN (Lyon, France) and IMFT (Toulouse, France). The candidate will also can visit France and carry out a part of the research work at IFPEN, Lyon, France.

Project ID: **24AU_MMAE_PhD_PA03**

Broad area: Experimental aerodynamics, supersonic flows, shock-boundary layer interaction
Eligible social category to apply – All categories
Fee – Please see section "Fees, deposits & hostel rent"
Duration of the funding - 3 years subject to availability of funds.
Stipend: The proposed stipend Rs. 37,000/- per month for the first two years and 42,000 /- for third year + 18% HRA if the hostel facility is not available
Number of openings: 1
Topic: Shock-boundary layer interactions relevant to gas turbine flows
Brief Description:

This predominantly experimental study pertains to an oscillating oblique shock wave and the boundary layer in the transonic regime. The student working in this project is expected to have a good understanding of basics from the subjects of fluid dynamics and thermodynamics, with knowledge of aerodynamics and gas dynamics being preferable. The student is also expected to have an inclination towards performing experiments and an aptitude for data processing, visualization, and analysis.

Project ID: 24AU_MMAE_PhD_PA04

Broad area: Experimental study of liquid jets injected into high temperature cross flows
Eligible social category to apply – All categories
Fee – Please see section "Fees, deposits & hostel rent"
Duration of the funding - 3 years subject to availability of funds.
Stipend: The proposed stipend Rs. 37,000/- per month for the first two years and 42,000 /- for third year + 18% HRA if the hostel facility is not available
Number of openings: 1
Topic: Experimental study of liquid jets injected into high temperature cross flows
Brief Description: Experimental study of liquid jets injected into high temperature cross flows.

N.5. Visvesvaraya PhD Fellowship

The fellowship supports research conducted in the domain of Electronic System Design and Manufacturing (ESDM) and IT/IT-enabled services.
Fellowship, Research Contingency Grant Support, Support for attending International Conferences and visiting a lab abroad, and HRA benefits (if the hostel is not available) can be found in the section B.2.3 of brochure and the reference link given below.
(Reference - https://phd.digitalindiacorporation.in/about-scheme)

N.6. Institute Staff

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

N.7. 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 Autumn 2024-25 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.

N.8. 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/MTech Project will be conducted to assess the basic understanding related to the project and overall Mechanical Engineering. The duration of this will be **max.** 10 mins. You will be given a time-slot window (about 1–3 hours) during which we may contact you anytime. The interaction must be taken on a desktop or 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 interview (online), with technical questions, for a duration of approximately 45 minutes. Access to books and online material is not permitted in this round, unless allowed by the interview panel.

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

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

N.9. 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 data with you before the meeting. Also, try to locate

yourself in a place with good internet speed (at least 1.5 Mbps) for a good quality video interaction. Laptops/tablets are preferred for video conferencing.
- Have paper and pen or pencil calculators handy for any rough work.
- Keeping a glass of water ready may be a good idea.
- Ensure that equipment is charged to avoid power issues.
- Ensure that the place from where you are attending the interview is conducive for effective interaction online. (less environmental noise, adequate lighting)
- 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 eye level.
- Stay muted unless you're talking to reduce background noise.
- 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. Think about having a solid wall/nice curtain behind you or turning on the virtual background (if available).

Don'ts:

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

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

N.10. Syllabus – Specific to the selected stream

N.10.1. Design Stream

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

Engineering Mechanics: Free-body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion; kinematics and dynamics of particles and of rigid bodies in plane motion; impulse and momentum (linear and angular) and energy formulations, collisions.

Mechanics of Materials: Stress and strain, elastic constants, Poisson's ratio; Mohr's circle for plane stress and plane strain; thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; energy methods; thermal stresses; strain gauges and rosettes; testing of materials with universal testing machine; testing of hardness and impact strength.

Theory of Machines: Displacement, velocity, and acceleration analysis of plane mechanisms;

dynamic analysis of linkages; cams; gears and gear trains; flywheels and governors; balancing of reciprocating and rotating masses; gyroscope. Vibrations: Free and forced vibration of single degree of freedom systems, effect of damping; vibration isolation; resonance; critical speeds of shafts.

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

Machine Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted, and welded joints; shafts, gears, rolling and sliding contact bearings, brakes and clutches, springs.

N.10.2. Fluid-Thermal Stream

Fluid Mechanics: Fluid properties; fluid statics, manometry, buoyancy, forces on submerged bodies, stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; dimensional analysis; viscous flow of incompressible fluids, boundary layer, elementary turbulent flow, flow through pipes, head losses in pipes and bends, flow in convergent-divergent channels, vorticity and stream-functions, elementary Computational Fluid Dynamics, finite-difference approximation to the first and second order partial derivatives.

Heat-Transfer: Modes of heat transfer; one dimensional heat conduction, resistance concept and electrical analogy, heat transfer through fins; unsteady heat conduction, lumped parameter system, Heisler's charts; thermal boundary layer, dimensionless parameters in free and forced convective heat transfer, heat transfer correlations for flow over flat plates and through pipes, effect of turbulence; heat exchanger performance, LMTD and NTU methods; radiative heat transfer, Stefan- Boltzmann law, Wien's displacement law, black and grey surfaces, view factors radiation network analysis.

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamic property charts and tables, availability, and irreversibility; thermodynamic relations.

Applications Power Engineering: Air and gas compressors; vapour and gas power cycles, concepts of regeneration and reheat. I.C. Engines: Air-standard Otto, Diesel, and dual cycles. Refrigeration and air-conditioning: Vapour and gas refrigeration and heat pump cycles; properties of moist air, psychrometric chart, basic psychrometric processes.

Turbomachinery: Impulse and reaction principles, velocity diagrams, Pelton-wheel, Francis and Kaplan turbines, Steam and gas turbines, axial flow compressors.

N.10.3. 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.

N.11. Syllabus – Common for all streams

N.11.1. 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.

N.11.2. 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.

O. DEPARTMENT OF PHYSICS

O.1. Eligibility for Admission

O.1.a. Qualifying Degree

- M.Sc. or equivalent degree in Physics/Applied Physics/Photonics/Solid State Physics/or other topics in Physics.
- M.Tech. / MS in Optics/Optoelectronics/Photonics/ Engineering Physics/Electrical Engineering/ or other topics in applied Physics
- M.Phil. in Physics.

The candidates who do not have M. Tech. / M. Phil. 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.

O.1.b. Minimum score in the qualifying degree

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

O.2. Modality of Selection Process

O.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 Project Assistantship (PA).

O.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.

O.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 the rounds will be in **online mode**. The first round of interview (R1) is compulsory for all shortlisted candidates. If the department finds any candidate(s) suitable, then they may conduct a second round of interview (R2) for the candidate(s) found suitable in the first round of interview. The date and time for the interview will be notified to the shortlisted candidate(s) by email. Applicants are advised to check the website regularly from time to time.

O.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.

O.4. Focus area of research

Ph. D. positions in the following four research areas are available in the Department of Physics during the Autumn 2024-25 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 – Quantum Information Theory

Eligible social category to apply.

- FA-All categories
- TA – All categories.

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
Details for the area "Quantum Information Theory" - Candidates applying for these positions should be highly motivated to perform theoretical research in the topics related to foundations of quantum mechanics, quantum optics, many body physics, relativity and at their interfaces. There is also scoped to work in the topics related to quantum computation and quantum communication. Familiarity with the foundations of quantum mechanics and quantum information is desired. The candidate having adequate knowledge to execute higher level computational programs using one of the standard programming languages is also desired.
Topic - Quantum information theory; its interface with quantum optics, relativity, and many body physics; Quantum Communication; Quantum Computation.

Broad domain of research – Experimental Condensed Matter Physics

Eligible social category to apply –All categories.
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
Details- 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 also 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.

Topic- Experimental Condensed Matter Physics

- 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.

Broad domain of research – Experimental Material Science

Eligible social category to apply – for TA/FA - All categories.
Fee – FEES, DEPOSITS & HOSTEL RENT
Type of funding support – FA/TA (Please find the funding related details is Section B)
Duration of funding - Please find the funding related details in Section B
Details- We are looking for highly motivated PhD students with a strong interest in experimental research work to develop and test third generation high-efficiency halide perovskite solar cells using solution processed methods. The research group is a multi-disciplinary research group that studies physics, material science and device engineering with the aim to develop innovations that will lead to inexpensive, stability and higher device

efficiencies. The work will also include device modeling, therefore prior knowledge of a programming language and strong background in mathematics will be advantageous. The student will be embedded in a collaborative research work involving groups spreading pan India.
Topic-

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

O.5. Visvesvaraya PhD Fellowship

The fellowship supports research conducted in the domain of Electronic System Design and Manufacturing (ESDM) and IT/IT-enabled services.
Fellowship, Research Contingency Grant Support, Support for attending International Conferences and visiting a lab abroad, and HRA benefits (if the hostel is not available) can be found in the section B.2.3 of brochure and the reference link given below.
(Reference - https://phd.digitalindiacorporation.in/about-scheme)

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

(To be typed on letterhead of the Sponsoring Organization)

Name of the applicant:

_____

Name of the sponsoring organization:

_____

Address:

_____

Present Designation of the applicant:

_____

Present status of the applicant: (Permanent/Semi-permanent/Temporary)

_____

Division where research work is proposed to be done:

_____

Name of supervisor from the sponsoring organization:

_____

(Biodata of supervisor to be enclosed giving details of designation, qualification, research experience etc.)

Details of facilities relevant to the research problem will be made available to thecandidate 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 fromIIT Dharwad.

Date: Signature of proposed Co-supervisor (external)

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Statement of sponsoring authority

If Shri. /Kum. / Smt. _____

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

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 afaculty member of IIT Dharwad as the Supervisor.

Date: Signature and Seal of the Sponsoring Authority

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