

Indian Institute of Technology Dharwad



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Information Brochure

(For Indian Nationals)

Ph.D. Admissions

Spring Semester 2022-23

Contents

A.	SCHEDULE OF Ph.D. ADMISSION	5
B.	APPLICATION CATEGORIES & FINANCIAL SUPPORT	5
B.1	Teaching Assistantship (TA).....	5
B.2	Fellowship Awardee (FA)	6
B.2.1	Description – FA.....	6
B.2.2	PMRF: A brief Note on Prime Minister’s Research Fellowship	6
B.3	Project Assistantship (PA).....	6
B.4	Externally sponsored Ph.D. (EX)	6
B.5	Institute Staff for Ph.D.	7
C.	GENERAL GUIDELINES for APPLYING ONLINE	7
D.	INFORMATION PERTAINING TO HOSTELS	9
E.	FEES, DEPOSITS & HOSTEL RENT	10
E.1	Details of Applicable Fee for Admission:	10
E.1.1	TA Category.....	10
E.1.2	PA/EX/FA Category	11
F.	DEPARTMENT OF BIOLOGICAL SCIENCES AND BIOENGINEERING.....	14
F.1	ELIGIBILITY FOR ADMISSION	14
F.1.1	Qualifying Degree.....	14
F.1.2	Minimum score in the qualifying degree	14
F.1.3	Eligibility of applicants in the final phase of getting the qualifying degree	14
F.2	MODALITY OF THE SELECTION PROCESS.....	14
F.3	SYLLABUS	15
F.4	RESEARCH TOPICS	15
F.5	Focus area of research	15
F.5.1	Position 1	15
F.5.1	Position 2	16
F.5.1	Position 3	16
F.5.1	Position 4	16
G.	DEPARTMENT OF CHEMISTRY	17
G.1	Eligibility for Admission.....	17
G.1.1	Qualifying Degree.....	17

G.1.2	Minimum score in the qualifying degree	17
G.2	Modality of the Selection Process	17
G.3	Syllabus	18
G.4	Focus area of research	18
H.	DEPARTMENT OF CIVIL ENGINEERING	19
H.1	Qualifying Degree	19
H.1.1.	Minimum score required in the qualifying degree and GATE Qualification.....	19
H.2.	Modality of selection process.....	19
H.3.	Focus area of research.....	20
H.3.1.	Position 1.....	20
H.3.2.	Position 2.....	20
H.3.3.	Position 3.....	20
H.3.4.	Position 4.....	20
I.	DEPARTMENT OF COMPUTER SCIENCE AND ENGG.	21
I.1.	Qualifying Degree	21
I.1.1	Minimum score in the qualifying degree.....	21
I.1.2	Eligibility of applicants in the final phase of getting the qualifying degree.....	21
I.2.	Modality of selection process	21
I.3.	Focus area of research	21
I.4.	Teaching Assistantship (TA)	22
I.5.	Externally Sponsored (EX).....	22
I.6	Project Assistantship (PA).....	22
I.7.	Syllabus	22
J.	DEPARTMENT OF ELECTRICAL ENGINEERING	24
J.1.	Eligibility Criterion	24
J.1.1.	Qualifying Degree	24
J.1.2.	Minimum score in the qualifying degree	24
J.1.3.	Eligibility of applicants who are in the final phase of getting the qualifying degree	24
J.1.4.	Application Categories and Financial Support.....	24
J.2.	Guidelines for Shortlisted Candidates	25
J.2.1.	Modality of Selection Process	25
J.3.	Research Areas	25
J.3.1.	For TA, FA, and EX categories.....	25
J.4.	Interview Syllabus.....	26

J.5. For PA category (Project Funded Positions)	27
K. DEPARTMENT OF MECHANICAL MATERIALS AND AEROSPACE ENGINEERING	
.....	28
K.1 Eligibility for Admission.....	28
K.1.1. Qualifying Degree.....	28
K.1.2. Minimum score in the qualifying degree	28
K.1.3. Eligibility of applicants in the final phase of getting the qualifying degree.....	28
K.2. Modality of selection process.....	28
K.3. Dos and Don'ts.....	29
K.4. Focus area of research.....	30
K.4.1. Position 1.....	30
K.4.2. Position 2.....	30
K.4.3. Position 3.....	31
K.4.4. Position 4.....	31
K.4.5. Position 5.....	32
K.4.6. Position 6.....	32
K.4.7. Position 7.....	33
K.4.8. Position 8.....	33
K.4.9. Position 9	34
K.4.10. Position 10.....	34
K.4.11. Position 11.....	35
K.4.12. Position 12.....	35
K.5. Syllabus – Common for all streams	35
K.5.1. Engineering Mathematics.....	35
K.5.2. Analytical reasoning.....	36
K.6. Syllabus – Specific to the selected stream	36
K.6.1. Design Stream	36
K.6.2. Fluid-Thermal Stream	36
K.6.3. Manufacturing and Materials Stream.....	37
L. Appendix A: Sponsorship Certificate for Ph.D. External Registration (EX)	38

A. SCHEDULE OF Ph.D. ADMISSION

Sr. No.	Description	Relevant dates*
1.	Applications open	14-October-2022
2.	Last Date to apply online	10-November-2022
3.	Announcement of shortlist of eligible candidates	15-November-2022
4.	Online Interview Schedule	16-November-2022 to 30 th November 2022
5.	Declaration of provisional list of selected & waitlisted candidates	09-December 2022
6.	Admission process for recommended candidates	10-December 2022 to 15-December 2022
7.	Admission for waitlisted candidates	17-December 2022 to 27-December 2022

***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. **Future updates regarding the admission process will be made available on the [institute website](#) under section Academics >> Admissions >> [Ph.D.](#)**

B. APPLICATION CATEGORIES & FINANCIAL SUPPORT

IIT Dharwad admits Ph.D. candidates as full time students with research scholarship or Teaching Assistantship (TA) or Project Assistantship (PA). Also, part-time externally sponsored research scholars or IIT Dharwad 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 the 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 submission, whichever is earlier. At present, the monthly rate of assistantship is ₹31,000 for the first 2 years and enhanced rate of ₹35,000/- for the remaining 3 years and HRA as per rules.
2. 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 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 have to resign from the current job and submit a relieving letter from their employer before joining the programme.
5. Students getting assistantships from the Institute may join projects sponsored by external agencies and obtain corresponding fellowships in lieu of TA ship.

B.2 Fellowship Awardee (FA)

B.2.1 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. The PhD scholars selected in this round of admission may have opportunity to apply for PMRF fellowship.

B.3 Project Assistantship (PA)

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

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

The candidates employed in recognized R&D organizations and desirous of pursuing Ph.D. programme while in employment may apply for admission as external candidates. The option of external registration is for applicants who are working in well-equipped scientific institutions, laboratories, R&D establishments and industrial organizations engaged in research based activities. Persons working in colleges/universities are not eligible under this category. After fulfilling the coursework requirement at the Institute, these candidates will be allowed to register for Ph.D. with a Supervisor (internal) from the Institute and a Co-supervisor (external) from their parent organization where they will be doing the research work. The admissions are based on the following norms:

1. The competence of these candidates will be assessed along with the regular candidates.
2. 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 programme and available to the candidate.
3. The candidate is required to be at the Institute as a full-time student for the coursework

(and qualifier examination, if applicable) of his/her Ph.D. Programme. The coursework requirement is likely to be a period of 1-2 semesters. Depending on the student's background and the programme requirements, an additional semester may be needed to complete the coursework/qualifier examination.

4. To promote interaction between the internal supervisor and external co-supervisor, meetings between them should be arranged at least once in a year in the Institute or in the sponsoring organization.
5. The Ph.D. registration of an external candidate would be reviewed at the end of each year from the date of registration in terms of his progress in courses / seminars / approved research programme by a Research Progress Committee (RPC) nominated by the concerned Department Postgraduate Committee (DPGC).
6. At the time of joining the programme, the students will have to produce a “Relieving certificate” from his / her employer that he / she has been fully relieved from normal duties during the semester(s) to complete the course work and other academic work at IIT Dharwad.

B.5 Institute Staff for Ph.D.

Existing employee 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 the 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 up the application form.
2. Please note that the application is to be filled at one go. There is no save and proceed option. 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 to be noted for all future references.
 - c. After filling the institute form, department specific application form should be filled.

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 >> Final submission of application form >> Note down submission ID for future reference

4. The procedure to pay the application fee is made available on the website and application form.
5. This information brochure and future updates regarding the admission process will be made available on the institute website under section Academics >> Admissions >> Ph.D.
6. You are required to submit the application form online. There are no downloadable forms available. After filling the form, you are advised to take a print and keep the same for future reference.
7. The application fee is as follows:

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

8. **The Application Form without valid online payment details will not be considered. Application FEE once paid is Non-Refundable.**
9. 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.
10. 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.
11. Keep checking the institute website and your emails regularly for any communication from the institute regarding the selection process.
12. The Shortlisted candidates' list will be uploaded on the institute website as per the schedule given above in Section A.
13. Candidates (if) called for written test / interview should bring with them Photo ID Card, Printed Copy of Online Application Form, Photocopies of Academic Transcripts, Degree Certificates & Experience Certificates, Caste Certificate (if applicable), PwD Certificate (if applicable), EWS Certificate (if applicable), Thesis/Dissertation/Report/Publications and all other relevant documents.
14. **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 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 fee applicable for admission to Ph.D. programmes (as collected during the Autumn Semester 2022-23) is **provided below for reference purpose only**: **The actual fee applicable for Spring 2022-23 will be made available to the candidates at the time of declaration of results.**

E.1 Details of Applicable Fee for Admission:

E.1.1 TA Category

S. No.	Fee Amount (In Rs.)	For General/ General (EWS)/OBC (NCL)	For SC/ST/PwD
A. One-time payment at the time of Admission			
1.	Admission Fee	2,200.00	2,200.00
2.	Thesis Fee	2,500.00	2,500.00
3.	Medical Examination	400.00	400.00
4.	Provisional Certificate	500.00	500.00
5.	Student Welfare Fund	1,000.00	1,000.00
6.	Modernisation & Upgradation	2,500.00	2,500.00
7.	Identity Card	500.00	500.00
Sub-Total (A)		9,600.00	9,600.00
B. Semester Fee			
^1.	Tuition Fee – Statutory Fee	2,500.00	Nil
2.	Examination Fee	1,000.00	1,000.00
3.	Registration Fee	750.00	750.00
4.	Gymkhana Fee	1,750.00	1,750.00
5.	Student Benevolent Fund	500.00	500.00
6.	Medical Fee	1,500.00	1,500.00
*7.	Hostel Room Rent	2,000.00	2,000.00
*8.	Electricity & Water Charges	3,000.00	3,000.00
*9.	Hostel Establishment Charges	3,000.00	3,000.00
*10.	Mess Establishment Charges	1,550.00	1,550.00
Sub-Total (B)		17,550.00	15,050.00
*11.	Mess Fee Advance	26,000.00	26,000.00
C. Deposits (Refundable) to be paid at the time of Admission			
1.	Institute Security Deposit	1,000.00	1,000.00
2.	Library Security Deposit	1,000.00	1,000.00
3.	Mess Security Deposit	1,000.00	1,000.00
Sub-Total (C)		3,000.00	3,000.00
GRAND TOTAL FEE (A + B + C+ Mess Advance)		56,150.00	53,650.00

E.1.2 PA/EX/FA Category

S. No.	Fee Amount (In Rs.)	For General/ General (EWS)/OBC (NCL)	For SC/ST/PwD
A. One-time payment at the time of Admission			
1.	Admission Fee	2,200.00	2,200.00
2.	Thesis Fee	2,500.00	2,500.00
3.	Medical Examination	400.00	400.00
4.	Provisional Certificate	500.00	500.00
5.	Student Welfare Fund	1,000.00	1,000.00
6.	Modernisation & Upgradation	2,500.00	2,500.00
7.	Identity Card	500.00	500.00
Sub-Total (A)		9,600.00	9,600.00
B. Semester Fee			
^1.	Tuition Fee – Statutory Fee	25,000.00	Nil
2.	Examination Fee	1,000.00	1,000.00
3.	Registration Fee	750.00	750.00
4.	Gymkhana Fee	1,750.00	1,750.00
5.	Student Benevolent Fund	500.00	500.00
6.	Medical Fee	1,500.00	1,500.00
*7.	Hostel Room Rent	2,000.00	2,000.00
*8.	Electricity & Water Charges	3,000.00	3,000.00
*9.	Hostel Establishment Charges	3,000.00	3,000.00
*10.	Mess Establishment Charges	1,550.00	1,550.00
Sub-Total (B)		40,050.00	15,050.00
*11.	Mess Fee Advance	26,000.00	26,000.00
C. Deposits (Refundable) to be paid at the time of Admission			
1.	Institute Security Deposit	1,000.00	1,000.00
2.	Library Security Deposit	1,000.00	1,000.00
3.	Mess Security Deposit	1,000.00	1,000.00
Sub-Total (C)		3,000.00	3,000.00
GRAND TOTAL FEE (A + B + C+ Mess Advance)		78,650.00	53,650.00

Note:

- a. All the SC/ST/Divyangjan students are exempted from payment of Tuition fee.
- b. *Students not staying in the campus or not provided married accommodation are not required to pay fee at sl. no. 7, 8, 9, 10 & 11.
- c. ^IIT Dharwad reserves the right to revise the Tuition Fee-Statutory Fee (in future).

F DEPARTMENT OF BIOLOGICAL SCIENCES AND BIOENGINEERING

F.1 ELIGIBILITY FOR ADMISSION

F.1.1 Qualifying Degree

M.Tech/MSc. or equivalent in Bioinformatics/

Chemistry/Biotechnology/Microbiology/Computer Science or other allied biology subjects.

- Must have qualified GATE/NET or **Junior Research Fellowship** (JRF) from CSIR/UGC/DST INSPIRE/DBT/MHRD/ICMR or any other relevant funding agencies for TA category
- **Junior Research Fellowship** (JRF) of CSIR/UGC/DST INSPIRE/DBT/MHRD/ICMR or any other relevant funding agencies for TA category.

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 (M.Tech./MSc.):

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

For SC/ST category candidates and differently abled candidates (PwD), a relaxation of 5% (or CPI/CGPA of 0.5 on the scale of 0-10) in the qualifying degree is applicable.

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

Students who are in the final phase of receiving above mentioned qualifying degree and who are likely to graduate before commencement of Spring 2022-23 semester of IIT Dharwad are also eligible to apply. However, if offered, the admission to those candidates would be provisional. To join academic program at IIT Dharwad, such candidates need to furnish necessary documents regarding completion of the degree on the date of joining mentioned in the Section A above. They need to meet the criteria specified in 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 two stages of online interviews. All the eligible candidates will be called for Round 1 interview. From this round, the top 10 candidates will be selected for the second round of interview. Final selection will be made based on performance in Round 2 interview. The Round 1 interview (~10-15 min in duration) will test the basic understanding of the biology concepts and will be conducted for all in the eligibility

shortlist. For the syllabus, please refer to the Ph.D. brochure. The Round 2 interview (~30 min in duration) will be specific to the candidate's preferred research area.

F.3 SYLLABUS

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

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

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

F.4 RESEARCH TOPICS

Project title 1: Identifying novel Genes involve in cancer development.

Project title 2: Role of Mitochondrial genes in cancer development.

Project title 3: Understanding of surfacosome in cancer development.

Project title 4: Label free metabolomics for bioprocess monitoring.

F.5 Focus area of research

Cancer biology and Raman Spectroscopy

F.5.1 Position 1

Code – SP22-23_PhD_BSBE_T1

Broad domain of research – Cancer Biology

Eligible social category to apply – OBC-NCL

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA **Duration of funding** - 5 years **Details** (if any) -

Topic – Identifying novel Genes involve in cancer development.

Most, if not all, cancers are caused by two types of genes: proto-oncogenes and tumor-suppressor genes. We will use bioinformatics, biostatistics, and molecular biology methods in this project to identify novel cancer-associated genes and their functions.

F.5.1 Position 2

Code - SP22-23_PhD_BSBE_FA

Broad domain of research – Cancer Biology

Eligible social category to apply – Not applicable

Fee – refer section [FEES, DEPOSITS & HOSTEL RENT](#)

Type of funding support – FA **Duration of funding** - 5 years **Details** (if any) -

Topic – Role of Mitochondrial genes in cancer development.

Mitochondria plays a critical role in cell physiology. The project aims to understand the role of mitochondrial genes in cancer development.

F.5.1 Position 3

Code - SP 22-23_PhD_BSBE_PA

Broad domain of research – Cancer Biology

Eligible social category to apply – Not applicable

Fee – refer section [FEES, DEPOSITS & HOSTEL RENT](#)

Type of funding support – PA **Duration of funding** - 5 years **Details** (if any) -

Topic – Understanding of surfacosome in cancer development.

Cell membrane proteins play a critical role in cell physiology. The project aims to understand the role of surface proteins in cancer development.

F.5.1 Position 4

Code - SP22-23_PhD_BSBE_T3

Broad domain of research – Biophysics

Eligible social category to apply – SC

Fee – refer section [FEES, DEPOSITS & HOSTEL RENT](#)

Type of funding support – TA **Duration of funding** - 5 years **Details** (if any) -

Topic – Label free metabolomics for bioprocess monitoring

Large scale production of proteins and biopharmaceuticals within bioreactor systems requires continuous monitoring of product formation and microbial growth. Three different types of monitoring methods are inline, online, and at line. These are often real time but involve destructive approaches. Main objective of this work will be to assess the potential of different optical sensing methods for their prospective application in monitoring production of different biochemical.

G. DEPARTMENT OF CHEMISTRY

G.1 Eligibility for Admission

G.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**)

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

G.2 Modality of the Selection Process

Only the eligible applicants are permitted to participate in the selection process.

- The selection process consists of **two rounds** of online interview.

G.3 Syllabus

- Fundamental principles of organic and inorganic chemistry
Recommended textbooks: J. Clayden, L. G. Wade, J. D. Lee and P. Atkins
- Spectroscopy: NMR spectroscopy and mass spectrometry
Recommended textbooks: C. N. Banwell, D. L. Pavia, Silverstein and H. Gunther
- Organic name reactions: Reactions and their mechanisms
Recommended textbooks: W. Carruthers and J. Clayden

G.4 Focus area of research

The broad areas of research will include organic chemistry, biochemistry, and chemical biology. Students will have exposure to different interdisciplinary areas of chemistry and protein biochemistry. 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 focused areas given below.

Position 1

Code - SP22-23_PhD_CY_OMS

Broad domain of research – Organic chemistry, Inorganic chemistry and Material science **Fee** – refer section **FEES, DEPOSITS & HOSTEL RENT**
Type of funding support – TA (as per the institute guidelines) or FA

Duration of funding - 5 years for TA. For FA as per the funding agency guidelines

Details: Brief outline of the topic is given below:

1. Development of organic polymer based sensors for volatile organic 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 application 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 explore their applications in organic materials with a particular interest in fluorescent sensing and photocatalytic applications for organic transformations and hydrogen evolution.

Generally, the plants emit different volatile organic compounds (VOCs) and under stress (biotic and abiotic) the concentration of these VOCs will significantly vary. By sensing these VOCs and estimating their concentrations one can predict the plant infestation at the early stages. It will greatly add to the crop health monitoring. Thus, in this project, we develop the aggregation-induced emission (AIE) promoting (tetraphenyl ethane, pyrene, polyphenylene etc.) polymer networks for sensing variety of VOCs that are emitted by the plants. We utilize the unique structural strategies to detect the targeted VOC exclusively and minimizes the interference created by the other VOCs present in the mixture.

H. DEPARTMENT OF CIVIL ENGINEERING

H.1 Qualifying Degree

M.Tech. or equivalent degree in Civil Engineering with the specialization of Geotechnical Engineering, Transportation Engineering and Environmental Engineering (or any other equivalent PG specialization in Civil Engineering)

H.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 (M.Tech./M.E.):

1. a minimum of 60% marks (without round off) in aggregate, OR,
2. a minimum Cumulative Grade Point Average (CGPA) or Cumulative Performance Index (CPI) of 6.0 on the scale of 0-10; with corresponding proportional requirements when the scales are other than on 0-10, (for example, 4.8 on a scale of 0-8).
3. 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.

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.

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

Students who are in the final phase of receiving the above-mentioned qualifying degree and who are likely to graduate before commencement of Spring 2023 semester of IIT Dharwad are also eligible to apply. However, if offered, the admission to those candidates would be provisional. To join an academic program at IIT Dharwad, such candidates need to furnish necessary documents regarding completion of the degree on the date of joining mentioned in the Section A above. They need to meet the criteria specified in 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.

H.2. Modality of selection process

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

Round 1: Candidates must make a presentation of their own research work for 10 min 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 candidates will be called for a technical interview based on the Civil Engineering GATE equivalent syllabus

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

H.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.

Pavement Engineering: Pavement Materials, Hot Mix Asphalt, Warm Mix Asphalt, Asphalt Binder Rheology, Pavement Evaluation, Pavement Management System.

Environmental Engineering: Water, industrial, and wastewater treatment, solid waste management, composting, life cycle assessment (LCA), Environmental impact assessment (EIA), Affordable electrochemical reactors development, electrochemical, and advanced oxidation techniques, nonthermal plasma techniques.

In this call, applications are invited under TA category only.

Number of openings: 4

H.3.1. Position 1

Code – SP23_Civil_PhD_TA1

Broad domain of research – Geotechnical Engineering

Eligible social category to apply for TA position: - GEN, OBC, SC and PwD

H.3.2. Position 2

Code – SP23_Civil_PhD_TA2

Broad domain of research – Pavement Engineering

Eligible social category to apply for TA position: - GEN, OBC, SC and PwD

H.3.3. Position 3

Code – SP23_Civil_PhD_TA3

Broad domain of research – Environmental Engineering

Eligible social category to apply for TA position: - GEN, OBC, SC and PwD

H.3.4. Position 4

Code – SP23_Civil_PhD_TA4

Broad domain of research – Environmental Engineering

Eligible social category to apply for TA position: - GEN, OBC, SC and PwD

I. DEPARTMENT OF COMPUTER SCIENCE AND ENGG.

I.1. Qualifying Degree

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

I.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.):

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

For SC/ST category candidates and differently abled candidates (PwD), a relaxation of 5% (or CPI/CGPA of 0.5 on the scale of 0-10) in the qualifying degree is applicable.

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

Students who are in the final phase of receiving the above-mentioned qualifying degree and who are likely to graduate before commencement of Spring 2022 semester of IIT Dharwad are also eligible to apply. However, if offered, the admission to those candidates would be provisional. To join an academic program at IIT Dharwad, such candidates need to furnish necessary documents regarding completion of the degree on the date of joining mentioned in the Section A above. They need to meet the criteria specified in 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.

I.2. Modality of selection process

Only the 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/academics_phd.php from time to time. Selection committee decisions are final in all matters including any disciplinary matters/malpractice.

I.3. Focus area of research

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

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

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

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):** Application of neural networks on Edge devices, 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, and Graph Theory.
5. **High Performance Computing and Programming Languages (HPCPL):** Parallel Computing, Compilers and Translation Systems, Programming models and runtime systems.

I.4. Teaching Assistantship (TA)

In this call, applications are invited under TA category only for research areas (1)-(4). The applicant may be asked to indicate the choice of the research topics in the order of preference.

Position Code: SP22_CSE_PhD_TA

I.5. Externally Sponsored (EX)

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

I.6 Project Assistantship (PA)

In this call, applications are **not** invited under the PA category.

I.7. Syllabus

- **Discrete Mathematics:** Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Groups. Graphs: connectivity, matching, coloring. Combinatorics: counting, recurrence relations, generating functions, Linear Algebra: Matrices, determinants, system of linear equations, eigenvalues and Eigenvectors, LU decomposition. Calculus: Limits, continuity and differentiability. Maxima and minima. Mean value theorem. Integration. Probability: Random variables. Uniform, normal, exponential, poisson and binomial distributions. Mean, median, mode and standard deviation. Conditional probability and Bayes theorem.
- **Computer Organization and Architecture:** Machine instructions and addressing modes. ALU, data-path and control unit. Instruction pipelining. Memory hierarchy: cache, main memory and secondary storage; I/O interface (interrupt and DMA mode).
- **Programming and Data Structures:** Programming in C. Recursion. Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs.
- **Algorithms:** Searching, sorting, hashing. Asymptotic worst case time and space complexity. Algorithm design techniques: greedy, dynamic programming and divide-and-conquer. Graph search, minimum spanning trees, shortest paths.
- **Theory of Computation:** Regular expressions and finite automata. Context-free grammars and push-down automata. Regular and context-free languages, pumping lemma. Turing machines and undecidability.
- **Compiler Design:** Lexical analysis, parsing, syntax-directed translation. Runtime environments. Intermediate code generation.
- **Operating System:** Processes, threads, inter-process communication, concurrency and synchronization. Deadlock. CPU scheduling. Memory management and virtual memory. File systems.

Computer Networks: Concept of layering. LAN technologies (Ethernet). Flow and error control techniques, switching. IPv4/IPv6, routers and routing algorithms (distance vector, link state). TCP/UDP and sockets, congestion control. Application layer protocols (DNS, SMTP, POP, FTP, HTTP). Basics of Wi-Fi. Network security: authentication, basics of public key and private key cryptography, digital signatures and certificates, firewalls.

J. DEPARTMENT OF ELECTRICAL ENGINEERING

J.1. Eligibility Criterion

J.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.

J.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):

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

For SC/ST category candidates and differently abled candidates (PwD), a relaxation of 5% (or CPI/CGPA of 0.5 on the scale of 0-10) in the qualifying degree is applicable.

J.1.3. 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 Spring 2022 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.

J.1.4. Application Categories and Financial Support

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

Note: In TA category, the vacancies available in different social categories are mentioned along with the research areas in Section J.3. **The PA, EX, and FA category vacancies are unreserved.**

J.2. Guidelines for Shortlisted Candidates

J.2.1. Modality of 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 via video conferencing. Syllabus for the interview is given in Section J.4 of this document.

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

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

J.3. Research Areas

J.3.1. For TA, FA, and EX categories

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

Eligible social category to apply for TA position: - GEN, OBC, EWS, SC, ST and PwD

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

Eligible social category to apply for TA position: - GEN, OBC, EWS, SC, ST and PwD

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

Eligible social category to apply for TA position: - GEN, OBC, EWS, SC, ST and PwD

4. **Power & Energy Systems:** Power system stability and control; cyber security in smart grid, synchrophasor applications to power systems protection, monitoring and control; microgrid; game theory based incentives for ancillary services, Impact of renewables, battery energy storage and Electric Vehicles on Grid; Smart Grid; Power Electronics and converters for Electric Vehicle; Power Electronics and converters for Renewable Energy; Medium voltage hybrid DC circuit breakers; Grid connected multilevel inverters; high voltage power electronics and control; Electrical drives for Electrical Vehicles.

Eligible social category to apply for TA position: - GEN, OBC, EWS, SC, ST and PwD

J.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.

J.5. For PA category (Project Funded Positions)

No reservation is applicable for PA category

Position 1

Code - Sp22_PhD_MS_EE_PowerSystem

Project Title: UNIFY (solutions for clean energy integration in power grids with Improved Flexibility)

Description: This project involves the development of situational awareness algorithms to maximize renewable energy integration.

Broad domain of research: Power System/Smart Grid.

Requirement: The candidate should have exposure to the basics of power systems, electrical machines, and network theory.

Type of funding support – PA (Rs. 35000/-; additional HRA applicable if staying outside the campus; it may vary as per the policy applicable from time to time)

Duration of funding - 3 years

Number of openings: 1

Position 2

Code – Sp23_MS_EE_Comm

Project Title: A Spatial Scale-up to 6G: Developing Physical Layer Technologies for 6G IoT Non-Terrestrial Networks (NTNs)

Description: This project involves designing mechanisms for UAV based and LEO satellite wireless networks.

Broad domain of research: Wireless communications/networks, 5G and beyond.

Requirement: The candidate should be interested in working on theoretical and experimental problems. He/She should have a good understanding of basic communication systems and probability theory. Good knowledge in programming (preferable MATLAB) is an added advantage.

Type of funding support – PA (Rs. 35000/-; additional HRA applicable if staying outside the campus; it may vary as per the policy applicable from time to time)

Duration of funding – 3 years

Number of openings: 1.

K. DEPARTMENT OF MECHANICAL MATERIALS AND AEROSPACE ENGINEERING

K.1 Eligibility for Admission

K.1.1. Qualifying Degree

M.Tech./M.E./M.Sc.(Engg.) or equivalent degree in Mechanical Engineering or Materials and Metallurgical Engineering or Aerospace Engineering or equivalent 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.):

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.

K.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 Spring 2022-23 semester of IIT Dharwad are also eligible to apply. However, if offered, the admission to those candidates would be provisional. To join an academic program at IIT Dharwad, such candidates need to furnish necessary documents regarding completion of the degree on the date of joining mentioned in the Section A above. They need to meet the criteria specified in 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.

K.1.4 Institute Staff

The existing employees of IIT Dharwad can apply for the PhD if they fulfil the eligibility criteria. It is mandatory to follow the institute's guidelines while applying.

K.2. Modality of selection process

First round: An online interview based on prior experience/MTech Project will be conducted to assess the basic understanding related to project and overall Mechanical Engineering. The duration of this will be 20-30 min. You will be given a time-slot window (about 1–3 hours) during which we may connect with 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 Interview: Each applicant short-listed in 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 time-slot will be communicated to you.

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

K.3. Dos and Don'ts

Dos:

- Please participate in a mock call session before the actual interview to ensure the audio-video set up is ready. Example, a pre-lunch slot mock call starts at 9:00 am.
- 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 1.5Mbps) 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.
- Best Practices while in online meetings:
 - Sign in to the online client (Google Meet App/Desktop) 10-15 minutes ahead of scheduled meeting time and stay signed in
 - Turn your camera on and have your camera at the eye level
 - Stay muted unless you're talking to reduce background noise
 - Make sure you sit in a well-lit and quiet place
 - Be mindful of what's going on behind you. Think about having a solid wall/nice curtain behind you or turning on the virtual background (if available).

Don'ts:

- Avoid windy noisy surroundings during interview
- 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 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.

K.4. Focus area of research

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

K.4.1. Position 1

Code – Sp22_PhD_MMAE_D1

Broad domain of research – Computational Solid Mechanics

Eligible social category to apply – GEN (EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/- ; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Details - PG in Machine Design specialization or allied areas with exposure to programming languages

Topic: Machine learning applications in Computational Solid Mechanics

Brief Description: Computational Solid Mechanics has evolved as an essential tool for analysis in CAE. With development of Machine Learning, Computational tools are evolving to explore the benefits of Machine Learning. In this regard, the proposed research area attempts to address this gap.

K.4.2. Position 2

Code – Sp22_PhD_MMAE_D2

Broad domain of research – Computational Mechanics, Computational Dynamics

Eligible social category to apply – GEN(EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/-; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Details - Exposure to programming, Good analytical and mathematical skills, Numerical methods.

Topic: Model order reduction of dynamical systems.

Brief Description: The numerical simulations play important role in design and development of new product/ technology and realization of new technical ideas/complex phenomenon. The more detailed and large-scale simulations require powerful computational resources/efforts. Despite the recent advancements in computational bandwidth and accessibility, simulating the complete dynamics of a complex system continues to be a time-inefficient task. In order to limit the upper bound on such simulation runtimes, Model Order Reduction (MOR) techniques have been developed. This research work focuses on developing new algorithms to solve nonlinear and coupled dynamical systems. (Note: This work is purely numerical and mathematical).

K.4.3. Position 3

Code – Sp22_PhD_MMAE_D3

Broad domain of research – Fluid Mechanics, Computational Mechanics

Eligible social category to apply – GEN(EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/-; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Details - Exposure to programming, Good analytical and mathematical skills, Numerical methods.

Topic: Stability and Dynamics of Thin Liquid Film Flows

Brief Description: Thin liquid film flowing down vertical string or cylindrical fiber undergoes complex dynamics and gives rise to wavy film profiles, traveling waves, formation of droplets, dewetting, fingering instabilities, rupture, etc. These complex dynamics of thin film flows can be found in many industrial applications and therefore it is an important class of problems in the area of fluid-mechanics. The major objective of this research work is to conduct a study on dynamics and stability of thin liquid film flowing on the vertical cylinder or inclined substrate.

(Note: The work involves advanced mathematics and writing computer program to get the solutions of the system under consideration.)

K.4.4. Position 4

Code – Sp22_PhD_MMAE_D4

Broad domain of research – Design and 3D modeling

Eligible social category to apply – GEN (EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/- ; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Details - Inclination to mathematical modeling and programming is desirable. Prior knowledge of Data structures and algorithms will be an added advantage.

Topic: 3D Bio-modeling and Biomechanics.

Brief Description:

Techniques leveraging the artificial intelligence (AI) methods especially in using computer vision to create high fidelity 3D geometrical models of the complex anatomical shapes and design of biomedical devices will be explored. This work may use the sophisticated nonlinear computational mechanics simulations to optimize design and performance of biomedical devices as well the interesting and intriguing mysteries of tissue growth and homeostasis. The research work will broadly have the core theme of developing physics-informed AI techniques to model the life sciences. The research work is expected to be based on Non-linear solid mechanics foundations and simultaneously it will blend the algorithmic aspects typically relevant in the computational geometry and computer graphics, especially to ensure geometrical accuracy in the models.

K.4.5. Position 5

Code – Sp22_PhD_MMAE_M1

Broad domain of research – Material Science and Solid Mechanics

Eligible social category to apply – GEN (EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/- ; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Details - Basics knowledge of materials science and mechanics of materials, experience with any programming language are desirable. Prior knowledge of (any one or more) material modeling, metal plasticity, experimental mechanics, and data analysis will be an added advantage.

Topic: Design and Development of multi-phase advanced high strength steels (AHSS) for automotive application.

Brief Description:

This project aims to develop a lightweight and crash-worthy multi-phase structural steel using microstructure-property relationship. Experimental activities involve specific heat treatments for adjusting the volume of different phases and grain size, cold rolling or annealing to alter the dislocation density, different mechanical testing and material characterization. Crystal plasticity constitutive model development specific to different phases such as ferrite, austenite and martensite will be complemented by the experimental inputs. For now, the plan is to work on Dual Phase (DP) steels, Martensitic steels, Transformation-Induced Plasticity (TRIP) Steels, and Twinning-Induced Plasticity (TWIP) steels. Past research experience of the group with crystal plasticity modeling of different phases in steels and characterization will be instrumental for the success of this project.

K.4.6. Position 6

Code – Sp22_PhD_MMAE_M2

Broad domain of research – Material Science and Solid Mechanics

Eligible social category to apply – GEN (EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/- ; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Details - Basics knowledge of materials science and mechanics of materials, experience with any programming language are desirable. Prior knowledge of (any one or more) material modeling, metal plasticity, experimental mechanics, and data analysis will be an added advantage.

Topic: Development of experimentally informed field dislocation mechanics (FDM) aided crystal plasticity model for Al-Cu-Li aerospace alloys..

Brief Description:

Under the scope of this project, we have planned to model the influence of dislocation-solute (better known as PLC effect) and dislocation-precipitate interactions on the micro and macroscopic deformation behavior of Al-Cu-Li aerospace alloys with the support of experimental inputs. Core simulation activities under this project includes capturing the yield anisotropy, effect of different aging treatments, and effect of precipitation on dislocation-solute interactions using mesoscopic field dislocation mechanics model. Experimental inputs for the micromechanical model will be obtained by mechanical testing, material characterization and in-situ digital image correlation (DIC) strain mapping of Al-Li alloys.

K.4.7. Position 7

Code – Sp22_PhD_MMAE_T1

Broad domain of research – Fluid and Thermal Engineering, Rheology

Eligible candidates to apply – GEN(EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/- ; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Details - Good mathematical/analytical skill is desirable. Prior knowledge of computational fluid dynamics and programming skill in C & Bash will be an added advantage.

Topic: Drop impact dynamics of yield stress fluids

Brief Description:

Drop impact process has importance in several industrial applications such as spray coating and painting, ink-jet printing, surface cleaning, cooling, and atomization in internal combustion engines. Rigorous investigation on yield-stress fluid drop impacts has been lacking although such flow conditions and impact configurations are common in industrial processes. Indeed, no comprehensive literature exists that seeks to model, or at least heuristically predict, the outcomes of drop impact of yield-stress fluids on dry and wet surfaces. With the increasing use of 3D printing and additive manufacturing technology, the drop impact and deposition process has become crucial in the fabrication processes. Understanding the role of each fluid property in a decoupled way is very important for the optimization of the flow in industrial applications. Although such decoupling is relatively difficult in experiments, numerical and theoretical studies facilitate such decoupling. In this research, we will perform the direct numerical simulation (DNS) on the impact of viscoplastic drops on dry and wet surfaces using the Basilisk solver (<http://www.basilisk.fr>). One of the main objectives of this research will be to disentangle the effect of yield stress on the drop impact dynamics. The prime focus will be on the drop impact dynamics on wet surfaces; a part of the research will also be allocated to the drop impact on dry surfaces to understand the effect of surface wettability.

K.4.8. Position 8

Code – Sp22_PhD_MMAE_T2

Broad domain of research – Fluid and Thermal Engineering, Multiphase Flow

Eligible social category to apply – GEN(EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/- ; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Details - Good mathematical/analytical skill is desirable. Prior knowledge of computational fluid dynamics and programming skill in C & Bash will be an added advantage.

Topic: Fluid dynamics of disease transmission

Brief Description:

The micro-drops can float in the air for a long time and can carry pathogens with them to a long distance. For example, saliva microdroplets generated by coughing and sneezing were one of the main carriers of coronavirus (COVID-19) from the infected host to the susceptible one. The aerosols formed during the impact of raindrops on contaminated plant leaves can carry the pathogens to thousands of kilometers and is the reason for foliar outbreaks after rainfall. It is extremely important to understand and control the outbreaks from a health as well as economic point of view. However, we continue to struggle to control the outbreaks because of a limited understanding of the flow physics. In this research, we plan to study this complex disease transmission process. Both experimental and numerical simulation tools will

be deployed to understand the disease transmission process.

K.4.9. Position 9

Code – Sp22_PhD_MMAE_T3

Broad domain of research – Fluid and Thermal Engineering, Multiphase Flow

Eligible social category to apply – GEN (EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/- ; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Topic: Pinch-off dynamics of surfactant laden drops (Multiphase flow: Experiments and CFD)

Brief Description:

Drop formation is essential in many industrial applications, for example, emulsification, spraying and inkjet printing, to name a few. In most of the natural and industrial processes applications, contaminants or surfactants are present along with fluid flow. However, most of the investigations on drop pinch-off have been performed with pure liquids having constant surface tension coefficient. The presence of the surfactants can change the dynamics entirely because the concentration gradient of the surfactants generates Marangoni stress. This doctoral research work will investigate the pinch-off dynamics of surfactant-laden aqueous drops. Experiments will be performed by mixing nanoparticles with water. The computational fluid dynamics (CFD) analysis will also be performed by incorporating the Marangoni effect. Theoretical models will also be built using long-wave theory for better physical understanding. Special attention will be given to understand the effect of nanoparticles on the satellite formation during dripping and on the transition from dripping to jetting regimes.

K.4.10. Position 10

Code – Sp22_PhD_MMAE_T4

Broad domain of research – Aerodynamics

Eligible social category to apply – GEN (EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/- ; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Topic: Performance improvement of turbomachines using flow control

Details: Sound knowledge of fluid mechanics, engineering mathematics and an aptitude for conducting experiments and scientific programming.

Brief Description:

Turbomachines such as centrifugal compressors are ubiquitous in several industries. Their performance improvement will lead to significant savings in terms of power consumed and operation hours. Use of flow control in existing systems allows for a wider range of operation, including operation under poor inflow conditions. The study aims to investigate the effect of inflow conditions on the aerodynamic performance of a turbomachine and the effect of flow control using experimental techniques supplanted by numerical studies.

K.4.11. Position 11

Code - Sp22_PhD_MMAE_T5

Broad domain of research – Thermal and Fluid Sciences

Eligible social category to apply – GEN(EWS), SC, ST, PWD

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/- ; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Details - Exposure to experimental techniques

Topic: Fire Research

Brief Description:

The study involves fabrication and performing experiments, numerical simulations to understand the physics of fire dynamics. It includes several contact and non-contact measuring techniques. Fire numerical simulations are to be performed to validate the code. Further simulations are to be performed to understand the large scale fires. Proposal of semi-empirical or analytical models that would assimilate all the learning is part of the study.

K.4.12. Position 12

Code - Sp22_PhD_MMAE_T6

Broad domain of research – Thermo Fluids, Combustion, Instabilities

Eligible social category to apply – GEN (EWS)

Fee – refer section **FEES, DEPOSITS & HOSTEL RENT**

Type of funding support – TA (*presently Stipend Rs. 31000/-; additional HRA applicable if staying outside campus; it may vary as per the policy applicable from time to time)

Duration of funding - 5 years

Topic: Fluid mechanics and combustion dynamics of laminar/turbulent combustion systems

Brief Description:

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

K.5. Syllabus – Common for all streams

K.5.1. 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.

K.5.2. 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.

K.6. Syllabus – Specific to the selected stream

K.6.1. 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.

K.6.2. 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.

K.6.3. 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 castings, solidification and cooling, Pattern materials, allowances, types of pattern, 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.

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

(To be typed on letterhead of the Sponsoring Organization)

Name of the applicant:

Name of the sponsoring organization:

Address:

Present Designation of the applicant:

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

Division where research work is proposed to be done:

Name of supervisor from the sponsoring organization:

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

Details of facilities relevant to the research problem which will be made available to the candidate by the organization.

Statement of proposed Co-supervisor (external)

If Shri / Kum. / Smt. _____

is registered for the doctorate degree, I, _____

, agree to act as his/ her research Co-supervisor along with the research Supervisor from IIT Dharwad.

Date:

Signature of proposed Co-supervisor (external)

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

Statement of sponsoring authority

If Shri. /Kum. / Smt. _____

is admitted to the Ph.D. programme, we shall allow him/ her to undergo the programme of studies at IIT Dharwad.

Further, we shall fully relieve him/her from normal duties to complete the course work requirement (and qualifier examination, if applicable) at IIT Dharwad.

During the period of Doctoral programme, the candidate will be permitted to carry out his / her research work at our laboratories / organization and will be given the required facilities.

We also give our consent to Shri. /Kum. / Smt./Dr. _____

of our organization to be the Co-supervisor (external) of the Ph.D. thesis, along with a faculty member of IIT Dharwad as the Supervisor.

Date:

Signature and Seal of the Sponsoring Authority

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