



Project Proposal for Ph.D.

Project Details (The research problem must clearly indicate the need for an interdisciplinary approach)

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| Project Title                                                    | Continuum Modelling of non-Newtonian Blood Flow in Deformable Microchannels and Its Validation through Microfluidic Experiments                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Project Summary<br><br>(Minimum 500 and maximum 2000 characters) | <p>Among biological fluids, blood is one of the most prominent examples of a non-Newtonian fluid, responsible for transporting dissolved gases and nutrients to various organs in the human body. Understanding blood flow dynamics within vessels requires comprehensive knowledge of non-Newtonian and viscoelastic fluid models. In recent years, interest in non-Newtonian fluid dynamics has grown significantly, leading to the development of numerous mathematical models describing the rheological behaviour of blood.</p> <p>This project aims to investigate the viscoelastic behaviour of blood at the cellular level by integrating experimental, theoretical, and simulation-based approaches. In particular, the effects of wall deformation on blood flow, arising from the dynamic behaviour of elastic vessel walls and variations in vascular geometry, under external pressure pulses have not been thoroughly explored and require detailed investigation. Such studies are essential for understanding underlying mechanisms associated with biomechanical and biochemical signalling.</p> <p>The complex interplay between deformable elastic walls, the viscoelastic nature of blood cells, and the non-Newtonian behaviour of blood makes this system highly intricate, necessitating a systematic investigation using biomimetic PDMS-based microchannels. The stress–deformation relationships of the PDMS channels and cellular components, along with the resulting apparent blood viscosity, will be modeled and validated through a combination of controlled microfluidic experiments, theoretical analysis, and simulations.</p> |

| Ph.D. Supervisors*<br>(Supervisor 1 and Supervisor 2 cannot be from the same department of IITD) |                          |                                                         |                                                                          |
|--------------------------------------------------------------------------------------------------|--------------------------|---------------------------------------------------------|--------------------------------------------------------------------------|
| Role                                                                                             | Name of Faculty          | Academic Unit in IITD/Institute/University              | Email ID (Official)                                                      |
| Supervisor 1*                                                                                    | Prof. Debabrata Dasgupta | Mechanical Engineering                                  | <a href="mailto:debabrata@mech.iitd.ac.in">debabrata@mech.iitd.ac.in</a> |
| Supervisor 2                                                                                     | Prof. Priti Sinha        | Department of Biochemical Engineering and Biotechnology | <a href="mailto:sinhapriti@iitd.ac.in">sinhapriti@iitd.ac.in</a>         |

\*Supervisor 1 must be from IIT, Delhi.

+All cells in this table are mandatory fields that need to be filled by faculty for consideration of proposal.

§The date of superannuation of supervisors should be at least three years from the date of registration of selected candidates.

Project requirements (Student qualifications, experience required, etc)

\*The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)

- Students must hold both **BTech and MTech degrees in Mechanical Engineering**. Candidates from any other discipline will not be considered for this position.

Source of fellowship/funding and project number  
(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any)

Institute fellowship

| Role of Faculty Members involved: |                                                                                           |
|-----------------------------------|-------------------------------------------------------------------------------------------|
| Supervisor-1                      | Simulation and theoretical analysis of blood flow in flexible microchannels               |
| Supervisor-2                      | Theoretical analysis and microfluidic experiments on blood flow in flexible microchannels |

**Note :-**

1. Approval from the respective DRC/CRC/ScRC of your Department/Centre/School will be required for using the "Full-time Institute Assistantship (Category-wise) (FIA)" for selecting the students in SIRe.
2. Declaration:- Faculty members, please ensure that you have at least 3 years of service left before superannuation along with adequate sitting space & lab facilities for the SIRe student.
3. PI/s are also encouraged to submit joint proposals with AIIMS, NII, JNU and institutes with which IITD has an existing MoU. If the Co-PI (Supervisor 2) is from outside IITD, kindly share his/her detailed CV.
4. If a research scholar is to be considered for selection under the project fellowship, then the project should have a minimum of two-year duration remaining.
5. A candidate applying with a valid JRF/INSPIRE/any national level fellowship should have at least two-year validity from the date of joining the Ph.D. program.
6. The third supervisor’s name (if required) can be added only after the formation of Student Research Committee (SRC) subject to a strong recommendation of SRC and subsequent approval from the competent authority.
7. If Institute fellowship is being sought, then DRC approval of the parent department of Supervisor 1 is required at the time of selection.