



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                                                                                           | AI-Integrated Biosensing and Cyber-Physical Systems for Infectious Disease Diagnostics and Wound Management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Project Summary<br><br>(Minimum 500 and maximum 2000 characters)                                        | <p>Infectious diseases and chronic wounds, particularly in diabetic patients, represent a significant healthcare burden in India. Current diagnostic and management approaches are often siloed, relying either on laboratory-based pathogen detection or on clinical wound assessment, with limited integration of real-time physiological monitoring and intelligent decision support.</p> <p>This interdisciplinary project brings together expertise in cyber-physical systems (CPS) and artificial intelligence (AI) with molecular biology and advanced biosensing to develop an integrated platform for infectious disease diagnostics and wound management. The research will bridge computational intelligence and biological sciences by combining AI-driven data analytics with biosensor-based pathogen and biomarker detection.</p> <p>Supervisor 1 contributes expertise in cyber-physical systems, wearable sensor integration, edge AI, and machine learning for multi-modal health data analysis. Supervisor 2 brings expertise in molecular virology, biosensing platforms including SERS-based nanowire chips, and ML-enabled spectral classification for rapid pathogen identification and antimicrobial resistance profiling.</p> <p>The integration of these two distinct disciplines - computational engineering and biological sciences - is essential because neither alone can address rapid, intelligent, point-of-care diagnostics combined with continuous patient monitoring. The CPS/AI component provides the computational backbone for real-time data fusion and predictive analytics, while the biosensing component provides biological assays, pathogen characterization, and biomarker discovery.</p> <p>The PhD scholar will work at the intersection of these disciplines, developing AI/ML algorithms for biosensor data interpretation, integrating spectral classification models with CPS frameworks, and validating the platform using clinically relevant infectious disease and wound models.</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. Santhosh Sivasubramani | Centre for SeNSE, IIT Delhi                            | <a href="mailto:ssivasub@sense.iitd.ac.in">ssivasub@sense.iitd.ac.in</a>         |
| Supervisor 2                                                                                     | Prof. Vivekanandan Perumal   | Kusuma School of Biological Sciences (KSBS), IIT Delhi | <a href="mailto:vperumal@bioschool.iitd.ac.in">vperumal@bioschool.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.

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| <b>Project requirements (Student qualifications, experience required, etc)</b><br><b>*The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)</b> |                                                                                                                                                                                                                                                                                                                      |
| Essential                                                                                                                                                                                | Qualifications:<br>- M.Tech./M.E. in Computer Science, Electrical/Electronics Engineering, Biomedical Engineering, Bioinformatics, or related discipline;<br>OR<br>- M.Sc. in Computational Biology, Bioinformatics, Biotechnology, Physics, or related discipline with strong computational background.             |
| Desirable                                                                                                                                                                                | Skills:<br>- Experience with machine learning / deep learning frameworks (Python, TensorFlow/PyTorch)<br>- Familiarity with sensor data processing or biomedical signal analysis<br>- Exposure to molecular biology techniques or biosensing platforms is an advantage<br>- Strong analytical and programming skills |
| Valid GATE/NET/JRF qualification is preferred.<br>•<br>•                                                                                                                                 |                                                                                                                                                                                                                                                                                                                      |

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| <b>Source of fellowship/funding and project number</b><br>(CSIR/UGC/DBT/ICMR/ICAR/NEET-PG/DST-INSPIRE/IRD/FITT Project details, if any) |
| Full-time Institute Assistantship (FIA)                                                                                                 |

| Role of Faculty Members involved: |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Supervisor-1                      | Prof. Santhosh Sivasubramani (Supervisor 1) will guide the PhD scholar on:<br>- Design and development of AI/ML algorithms for multi-modal health data analytics<br>- Cyber-physical systems architecture for wearable sensor integration and edge computing<br>- Machine learning model development for biosensor data interpretation and predictive analytics<br>- Overall project coordination, computational infrastructure, and research methodology |
| Supervisor-2                      | Prof. Vivekanandan Perumal (Supervisor 2) will guide the PhD scholar on:<br>- Biosensing platform design including SERS-based nanowire chips for pathogen detection<br>- Molecular biology and microbiological characterization of clinical samples<br>- Antimicrobial resistance profiling and biomarker identification<br>- Experimental validation of biosensor assays and clinical sample analysis                                                    |

- Note :-**
- 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.**
  - 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.**
  - 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.**
  - 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.**
  - 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.**
  - 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.**
  - If Institute fellowship is being sought, then DRC approval of the parent department of Supervisor 1 is required at the time of selection.**