



Project Proposal for Ph.D.

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

Project Title	Development of Carbon–Metal Oxide Composite Aerogels for Advanced Gas Adsorption and Sensing Applications
Project Summary (Minimum 500 and maximum 2000 characters)	The increasing demand for efficient and selective gas adsorption and sensing materials is driven by global concerns related to environmental monitoring, industrial safety, and clean energy. Aerogels, with their ultralow density, high surface area, and tunable porosity, offer a unique platform for tailoring multifunctional materials. This research proposes the development of novel carbon–metal oxide composite aerogels that synergistically combine the high conductivity and adsorption affinity of carbon nanostructures with the catalytic and surface-reactive properties of metal oxides. The project aims to (i) design and synthesize hybrid aerogel networks through sol–gel and supercritical/ambient drying strategies, (ii) control textural and chemical properties by varying carbon allotropes (graphene, CNTs, bio-derived carbon) and metal oxides (ZnO, TiO ₂ , Fe ₂ O ₃ , etc.), (iii) investigate adsorption behavior toward environmentally significant gases (CO ₂ , NH ₃ , VOCs), and (iv) evaluate sensing performance under real-world conditions, focusing on sensitivity, selectivity, and response time.

Ph.D. Supervisors*
(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*	Ritu Gupta	Department of Chemistry	ritugupta@chemistry.iitd.ac.in
Supervisor 2	Harun Venkatesan	Textile and Fibre Engineering	harun@iitd.ac.in

Project requirements (Student qualifications, experience required, etc)
*The candidate will be shortlisted based on common shortlisting criteria decided by ScRC (SIRe)

- M.Tech/M.E/ M.Sc. in Materials Science, Chemistry, Chemical Engineering, Nanotechnology, Polymer science, Physics, or relevant disciplines.

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

Candidate with his/her own fellowship is preferred

Role of Faculty Members involved:

Supervisor-1	Gas adsorption and sensing.
Supervisor-2	Aerogel Synthesis and Characterization

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.