Indian Institute of Technology Delhi

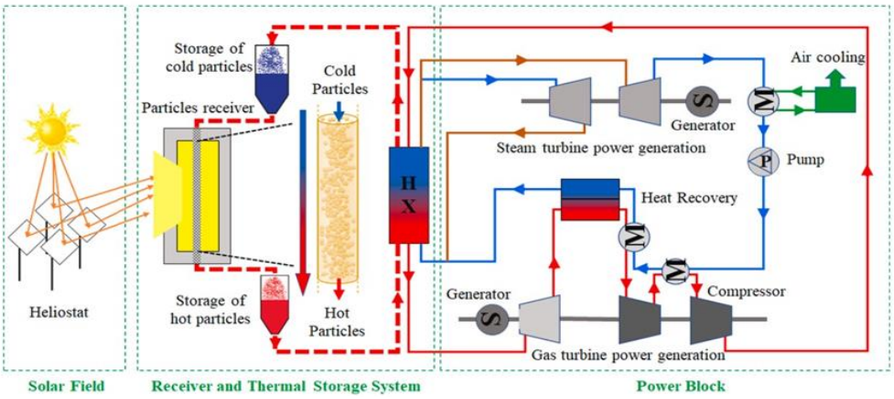
School of Interdisciplinary Research (SIRe)

SIRe Project Number

2025-01-22

(will be assigned by SIRe)

Project Proposal for Ph.D.

Project Details (The research problem must indicate the need for an interdisciplinary approach)	
Project Title	**Design of Solar Collector for High-Temperature Applications**
Project Summary (Minimum 500 and maximum 2000 characters)	Solar energy is a clean, renewable, and abundant resource that is crucial in meeting thermal and electrical power needs. Concentrating Solar Power (CSP) systems, particularly central tower technology, are effective in harnessing solar energy. However, traditional receivers face challenges related to heat transfer fluids (HTFs), such as operational difficulties, pressure-related issues, and temperature limitations. To address these challenges, researchers are exploring solid particles like ceramic and bauxite as heat transfer media in free-falling particle receivers. In a free-falling particle receiver, particles are dropped from the top of a tower and absorb heat from concentrated solar radiation during their descent. However, the short residence time of the particles limits the energy absorbed. This project proposes a porous free-falling particle receiver, which will use a porous structure to slow particle movement, thereby increasing exposure time and enhancing heat absorption. The research will involve numerical and experimental studies to optimize the receiver design. The numerical study will focus on simulating solar flux distribution, modeling heat transfer, and analyzing how the porous structure's tortuosity, pore size and pore-size distribution impact particle movement. The experimental phase will include building a test facility to validate numerical models and assess thermodynamic performance. A techno-economic analysis will evaluate the system's energy efficiency and cost-effectiveness.  Fig: Schematic layout of a concentrating solar power hybrid power plant using the falling-particle receiver

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	Dr. K Ravi Kumar	DESE	krk@dese.iitd.ac.in
Supervisor 2	Dr. Suresh Neelakantan	DMSE	sureshn@mse.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. Mechanical (Thermal) or Materials Science Engineering

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

Role of Faculty Members Involved:	
Supervisor-1	Dr. K Ravi Kumar will provide solar flux modeling, heat transfer, and techno-economic analysis expertise.
Supervisor-2	Dr. Suresh Neelakandan will contribute his expertise in material selection and porous structure design for the receiver and particles.