



**SCHOOL OF CHEMISTRY
UNIVERSITY OF HYDERABAD**



SEMINAR

Name of the Speaker	Dr. Shubhadeep Chandra Postdoctoral Researcher Ruhr University Bochum, Germany
Title of the Talk	Steering Electrons and Protons: Molecular and Hybrid Electrocatalysts for Sustainable Energy Conversion and Chemical Synthesis
Date & Time	17.11.2026 (Tuesday) 4 PM
Venue	PhD Classroom, SoC

ALL ARE INVITED

Date: 22/10/2026

Dr. Sujoy Rana
Faculty In-charge

Abstract:

Developing sustainable approaches to energy conversion and chemical synthesis requires catalysts that precisely regulate electron and proton transfer and direct reactive intermediates towards desired products. Nature offers remarkable examples of such control through metalloenzymes, which exploit cooperative metal centres and finely tuned coordination environments to achieve high catalytic efficiency and selectivity. Inspired by these principles, I will discuss how molecular design, metal-metal interactions, and hybrid catalytic architectures can be exploited to understand and control electrochemical reaction pathways. By harnessing renewable electricity and integrating complementary catalytic processes, these strategies offer sustainable routes for converting abundant feedstocks into fuels and high-value chemicals. Drawing inspiration from metalloenzymes, we designed triply fused bimetallic porphyrin dimers and used in situ spectroelectrochemistry to investigate how metal-metal interactions influence electronic structure and promote electrocatalytic hydrogen evolution. Extending catalytic control from the molecular active site to the reaction environment, we established cascade strategies that couple electrocatalysts with heterogeneous catalysts, integrating anodic in situ H_2O_2 generation with propylene epoxidation and cyclohexanone ammoximation. By tuning electrolyte composition and interfacial pH, we regulate local reaction environments and proton availability to enhance cascade selectivity. In a complementary approach, we integrated inorganic electrocatalysts with enzymes in tailored redox polymers to create hybrid bioelectrocatalytic cascades that convert CO_2 to methanol through sequential catalytic steps. Together, these studies establish design principles linking molecular-level control with selective chemical transformations and sustainable energy conversion.