



# PHYSICAL AND ELECTROCHEMICAL CHARACTERIZATIONS IN CHEMICAL ENGINEERING

## PROF. TAMAL BANERJEE

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**PRE-REQUISITES :** Elementary Chemistry

**INTENDED AUDIENCE :** Undergraduates and Postgraduates from different disciplines related to Chemical Engineering, Mechanical Engineering, Metallurgical Engineering, Chemistry, and Physics

**INDUSTRIES APPLICABLE TO :** Most of the Industries does utilize these tools to characterize materials whether in Electronic, Chemical or Pharmaceuticals Industries for characterizing and confirming the final product to Specific Standards. Hence, the knowledge of these will be helpful for outgoing undergraduates and postgraduates for better employment opportunities.

## COURSE OUTLINE :

Information on the various properties of materials are the key to unlock and analyze their suitability for various futuristic applications. The course Physical and Electrochemical Characterizations in Chemical Engineering aims to address these aspects fundamentally and practically in the field of Chemical Engineering and allied disciplines. The study span during the course includes the fundamental principles of various instrumentation techniques, which include spectroscopy, surface and electrochemical characterizations, and mechanical stability. Upon successful completion of the course, students are expected to be conversant with various characterization techniques including characterization of bio/nanostructures and nano/bio/smart materials. They are expected to become competent in carrying out analysis on the structural, thermal, chemical and mechanical properties of materials.

## ABOUT INSTRUCTOR :

Prof. Tamal Banerjee earned his Doctorate degree from Indian Institute of Technology Kanpur in the year 2007. Subsequently, he joined the Indian Institute of Technology Guwahati and is currently a Full Professor at the Department of Chemical Engineering since 2017. He has published over 150 papers in reputed peer-reviewed journals. In 2011, he was awarded the Indo-US Fellowship in Engineering Sciences. He has also authored two books each in CRC Press and Elsevier which discusses experiments and molecular modelling aspect of Ionic Liquids as an extractive agent. Prof. Banerjee's research focuses on the use of Ionic Liquids and Deep Eutectic Solvents as green solvents concerning both energy generation and environment mitigation. His group uses both ab-initio methods and Molecular Dynamics methods to predict thermodynamic and transport properties. The properties of interests are primarily in predicting activity coefficients for phase diagrams using Continuum Solvation Model such as COSMO (COnductor like Screening MOdel). His other interests lie in the Reactive Force Field simulations of both renewable (alcohols) and non-renewable (coal and chemical hydrides) energy sources. Recently his group have started evaluating Deep Eutectic Solvents as potential electrolytes and thermal fluids for supercapacitors and solar desalination respectively. He has also initiated thermodynamic pathways using biocompatible gels comprising of Polysaccharide or DES based precursors for drug delivery.

## COURSE PLAN :

**Week 1:** Spectroscopic Techniques

**Week 2:** Spectroscopic Techniques

**Week 3:** Physical and Chemical Absorption Methods

**Week 4:** Rheological and Interfacial Measurements

**Week 5:** Rheological and Interfacial Measurements

**Week 6:** Electron Spectroscopy for Surface Analysis

**Week 7:** Electrochemical Characterization Techniques

**Week 8:** Electrochemical Characterization Techniques