



# INTRODUCTION TO POLYMER PHYSICS-IITG

## PROF. AMIT KUMAR

Department of Chemical Engineering  
IIT Guwahati

**PRE-REQUISITES :** Thermodynamics, Engineering Mathematics

**INTENDED AUDIENCE :** Undergraduate (preferably final year) and post graduate students; professional practitioners working in the area of polymers

**INDUSTRY SUPPORT :** Companies working on polymers/plastics such as Reliance Industries Limited, GAIL, DuPont, Dow, SABIC.

## COURSE OUTLINE :

Polymer physics is important to understand the structure-property relation in polymers. An understanding of the structural features and interactions responsible for polymer properties can aid in tuning the desirable properties. This introductory course will discuss the models for ideal polymer chains, and thermodynamics of polymer solutions and blends, focusing on miscibility. The course will also cover the different methods to measure polymer molar mass, which has a strong effect on polymer properties. The physics of branching and network formation will be introduced with reference to branched polymers, dendrimers and cross-linked polymers. The course will also discuss mechanical properties of polymers with focus on viscoelasticity and rubber elasticity. Finally, a brief introduction to polymer dynamics will be provided.

## ABOUT INSTRUCTOR :

Prof. Amit Kumar is currently an Associate Professor in the Department of Chemical Engineering at IIT Guwahati. His research interests include molecular modeling and simulation, polymers and polymer nanocomposites, and gas adsorption and transport in porous materials. He completed his BTech from IIT Kharagpur and PhD from University of Delaware, USA in Chemical Engineering. He has been teaching an elective course on Polymer Science and Technology to senior undergraduates, Master's and PhD students at IIT Guwahati for two years.

## COURSE PLAN :

- Week 1:** Introduction To Polymers; Models Of Ideal Polymer Chains; Real Chains And Excluded Volume Effects
- Week 2:** Thermodynamics Of Polymer Solutions; Flory-Huggins Theory; Phase Behavior, Miscibility And Solubility Parameter
- Week 3:** Thermodynamics Of Polymer Blends And Block Copolymers; Determination Of Polymer Molar Mass By Osmometry
- Week 4:** Polymer Molar Mass By Light Scattering; Frictional Properties And Viscometry; Size Exclusion Chromatography
- Week 5:** Branching, Network Formation And Gelation
- Week 6:** Crystalline And Amorphous Polymer Phase; Mechanical Properties
- Week 7:** Viscoelasticity, Maxwell And Voigt Models; Non-Newtonian Behavior And Rheology; Rubber Elasticity
- Week 8:** Unentangled Polymer Dynamics, Rouse And Zimm Models; Entangled Polymer Dynamics, Reptation