



### Rheology of Complex Materials

Chemical Engineering

**Instructor Name:** Prof. Abhijit P. Deshpande

**Institute:** IIT Madras

**Department:** Chemical Engineering

**About Instructor:** Abhijit P. Deshpande is a Professor of Chemical Engineering at IIT Madras. His focus is on obtaining the understanding of polymeric systems, more specifically their aggregation and gelation behaviour. Rheology is used as a probing tool to investigate polymer blends, sulfonated polymers, crosslinked hydrogels, supramolecular / living polymers and polymeric composites in his group. His teaching interests include specialized courses in fluid mechanics, rheology and continuum mechanics; and core chemical engineering courses such as mass transfer and thermodynamics.

**Pre Requisites:** : Fluid Mechanics or solid mechanics course at the undergraduate level

**Core/Elective:** : Elective

**UG/PG:** : PG

**Industry Support** : Food products, Personal care products, Plastic processing industries, Paints and emulsions, Adhesives, Inks, Biomaterials, crude oil recovery and transport

**Course Intro:** : Non-Newtonian fluids are encountered in various engineering applications. This course introduces concepts required to analyze the behaviour of such fluids. Since micro-structural features of materials are responsible for non-Newtonian nature, this course describes the most commonly used classes of material systems and their rheological behaviour.

#### COURSE PLAN

SL.NO	Week	Module Name
1	1	Flow phenomena in complex materials and microstructure; Complex materials; Applications of rheology, with some example material systems
2	2	Stress, strain rate, velocity gradient; Kinematics for simple flows
3	3	Rheometric flows; Rheometers – general review
4	4	Tensors and index notation; Viscous fluids; Stress relaxation
5	5	Maxwell model; Oscillatory shear
6	6	Relaxation time spectrum; Generalized Maxwell model; Time temperature superposition; Solidlike materials
7	7	General linear viscoelastic material – linear response; Review of material functions
8	8	Survey – polymers; Survey – glass-rubber transition
9	9	Survey – multiphase systems; Experimental artifacts – fluid mechanics of coneplate geometry



10	10	Strain and convected rate; Normal stress, stress growth
11	11	Yield stress fluids “ Hershel Belkley model, thixotropic fluids “ Structural MODEL
12	12	Terms in nonlinear models; Microscopic origin of stress