Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NCHD508	Rheology	3	0	0	3

Course Objective

- To impart knowledge on the fundamental concepts of rheology, methods of determination of rheological characteristics and the analysis of various rheological problems, encountered in engineering applications

Learning Outcomes

- Students will have adequate knowledge of rheology of fluids and complex fluids/mixtures, the significance of various rheological parameters and their usage in engineering.

Unit No.	Description of Lectures	Contact Hours	Learning Outcomes
1.	**Introduction to rheology:** Rheology of fluids and complex mixtures- macromolecules solutions, melts, gels etc., multiphase systems- dispersions, emulsions and gels. Microscopic mechanisms: interactions unusual flow phenomena.	6	Students get familiar with the flow behavior of various Non-Newtonian fluid systems
2.	**Mathematical concepts:** Tensors, index notation, operations with tensors, kinematics- deformation measures, balances of mass and momentum, frame invariance.	7	Develop understanding of the basic mathematical framework in rheology
3.	**Rheometry:** Stress, strain, velocity gradient, strain rate, viscometric flows- shear flow, extensional flow, types of rheometers and their operational features, rheometric measurements: material functions: viscosity, creep compliance, relaxation modulus, storage and loss moduli, tan δ, normal stresses and experimental observations.	11	Students get familiar with different rheological measurements for characterizing viscoelastic properties
4.	**Macroscopic continuum Models:** Simplistic Models- Viscous fluids: Newtonian, generalized Newtonian, viscoelastic materials: Maxwell, Jeffreys, governing equations, constitutive relations, linear viscoelastic materials, time-temperature superposition, relaxation time spectrum, non-linear models: convected derivatives non-linear viscoelastic measurements	11	Give basic understanding of different rheological models for developing constitutive relations and continuum equations
5.	**Microscopic models:** Microscopic origin of stress, elastic dumbbell model, overview of other models- Rouse, Zimm, Doi-Edwards (reptation)	7	Students get introduced to different microscopic models for complex fluids
	Total	42	

Textbooks:

1. Bird, R.B., Armstrong, R.C. and Hassager, O.J. (1987). *Dynamics of Polymeric Liquids*. Wiley.

Reference Books:

1. Larson, R.G. (1999). *The Structure and Rheology of Complex Fluids*. Oxford Univ. Press