

Advanced Rheology

Graduate 3 credit course in Polymer Engineering curriculum

Amirkabir University of Technology

Chapter 1: Introduction to Rheology (What Rheology is, why it is important and how we will learn it. Deviation from Newtonian behavior, Polymer behavior in flow and Rheology as Spectroscopy.)

Chapter 2: Tensors & Vectors (Definition and operation and their importance in fluid mechanics and rheology calculations.)

Chapter 3: Review of Newtonian fluid mechanics (Conservation of mass and momentum, Newtonian constitutive equation, Derivation of Navier-Stokes equation, discussion on boundary conditions and problem solving strategy with solving example problems)

Chapter 4: Standard flows for rheological studies (Definition and importance of standard flows, simple shear and shear-free flows, Stress tensor in standard flows.)

Chapter 5: Material functions (Definition and application of material functions, Material functions based on shear and elongational flow, steady and unsteady flow.)

Chapter 6: Review of experimental data and polymer behavior (Polymer solution and melt behavior in shear and elongational flow, steady and unsteady flow.)

Chapter 7: Generalized Newtonian Fluid (No memory fluids, constitutive constraints, the GNF constitutive equations, material functions predictions and GNF limitations, Example flow problem of power law fluid.)

Chapter 8: Generalized Linear Viscoelastic Fluid (Memory effects and Maxwell models, the GLVE constitutive equation and its limitations, Example flow problem of the GLVE fluid.)

Chapter 9: Advanced Constitutive Modeling (Finite strain measures, Lodge equation, convected derivatives, other constitutive approaches)

References:

1. Faith, A. Morrison, "Understanding Rheology" Oxford University Press, January 2001.
2. R. Byron Bird, Robert C. Armstrong, Ole Hassager, "Dynamics of Polymeric Liquids, Volume 1: Fluid Mechanics", 2nd Edition, Wiley, May 1987.
3. Thomas G. Mezger, "The Rheology Handbook", 4th Edition, Vincentz Network; July 2014).