

PTFE 3230 POLYMER & FIBER PROCESSING

Credit: 3-0-3

Course Coordinators: Dr. Dong Yao

Prerequisites: PTFE 3210 and PTFE 4775 or PTFE 4777.

Catalog Description: Understanding of polymer/fiber processing from various fundamental aspects including rheology, mechanics, energetic, diffusion, polymer properties, and structural development. Common techniques used in polymer/fiber processing including extrusion, molding, forming, and melt/solution spinning.

Course Learning Objectives:

1. Learn polymer fluid mechanics pertinent to polymer/fiber processing.
2. Learn different polymer processing methods and the equipment and tools involved.
3. Obtain fundamental understanding of the process dynamics in extrusion, molding, forming, and fiber spinning.

Textbook: No designated textbook. Printed course notes will be provided, based on the following references:

1. Z. Tadmor and C.G. Gogos, Principles of Polymer Processing, Wiley-Interscience, 2006.
2. D.G. Baird and D.T. Collias, Polymer Processing Principles and Design, Wiley, John & Sons, 1998.
3. T. Osswald, Polymer Processing Fundamentals, Hanser/Gardner Publication, Inc., 1998.
4. J.F. Agassant, Polymer Processing: Principles and Modeling, Hanser, New York, 1991.
5. S. Middleman, Fundamentals of Polymer Processing, McGraw-Hill, 1977.
6. M. Lewin, J. Preston, and H. F. Mark (eds.), Handbook of Fiber Science and Technology: High Technology Fibers, Marcel Dekker Publisher, 1996.
7. M. Ward, P. D. Coates, and M. M. Dumoulin (eds.), Solid Phase Processing of Polymers, Hanser Publishers, Munnich, 2000.

Topical Outline of Lectures:

1. Introduction: basics and general background
2. Overview of polymer/fiber processing
3. Thermal, mechanical and rheological properties pertinent to polymer/fiber processing
4. Governing equations in polymer processing
5. Isothermal flow of purely viscous non-Newtonian fluids
6. Non-isothermal aspects in polymer/fiber processing
7. Elementary steps in polymer processing
8. Principle of polymer mixing
9. Characteristics and selection of polymer/fiber processing methods
10. Extruder and extrusion
11. Molding and forming processes
12. Computer aided engineering for polymer processing
13. Post-extrusion processes (fiber melt spinning, film blowing, film casting, wire coating, etc.)
14. Other fiber processing techniques
15. Structural development during polymer/fiber processing

Course Outcomes: Specifically, at the end of the course the students will be able to:

1. Describe common polymer/fiber processing techniques, including molding, extrusion, thermoforming, film blowing, melt/solution spinning, casting, etc. [3]*.
2. Explain general material properties and deformation behaviors of polymeric liquids and solids, which are pertinent to polymer/fiber processing [1,3].
3. Analyze mass and heat transfer problems in simple geometries (e.g. 1-D or axi-symmetric) for polymeric materials during polymer/fiber processing [1].
4. Understand the structural-property relationship and interpret the influence of processing on the structural development during polymer/fiber processing [3].
5. Select suitable polymer/fiber processing techniques and sequences for product realization [3].
6. Apply CAD and CAE for solving polymer/fiber engineering problems [13].

* Numbers in Brackets refer to PFE Program Outcomes to which the Course Outcomes relate.

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