SYLLABUS
MSE 453 Plastics Engineering
SPRING 2019

Catalog Description and Prerequisites
An introductory course to plastics engineering. Examines components of plastics and data banks; viscoelasticity, yield, and fracture; reinforced polymers; and forming, design (project), and current advances. *Prerequisite:* MATSE 450. *3 hours*. 3 lecture-discussion hours/week

Face-to-face class meeting time: Friday 2:00 to 3:50 PM Room 119 MATSE Building.
One-hour distance education class meetings held in MSE computer lab, Ceramics Bldg, Room 322.
Section AD1 Tuesday from 1:00 to 1:50 PM, and
Section AD2 meets Wednesday from Noon to 12:50 PM.
During these sessions the instructor reviews lecture notes on the assigned topics and students can ask questions. There will be a Compass-based quiz on the Collaborate content that will be due by Thursday 11 PM that week.

Instructor: Dr. Louis Reifschneider
Contact: phone: (309) 438-2621; NOTE ILSTU email: lgreifs@ilstu.edu
Office hour: Friday 4:00 to 4:50 PM in adjunct office 205A MSBE **by prior scheduled appointment**.

No Textbook but class notes (handouts and Compass postings) that students should compile.

Suggested supplemental reading

1. **Osswald and Menges, *Materials Science of Polymers for Engineers*, Hanser (1995) (introductory material science)**
2. Pötsch and Michaeli, *Injection Molding an Introduction*, Hanser (1995) (practical and theory based reference)
3. Osswald, *Polymer Processing Fundamentals*, Hanser (1998) (introductory processing overview)
4. Avery, *Injection Molding Alternatives*, Hanser (1998) (comprehensive treatment of alternatives to molding)
5. Progelhof and Throne, *Polymer Engineering Principles*, Hanser (1993) (deep, theoretical treatment of processing/design)
6. **Ehrenstein, *Polymeric Materials,* Hanser (2001) (excellent foundational treatment of polymeric materials)**
7. Course notes on materials, processing, and design topics available through Compass

Course Topics:

1. Overview of the Plastics Industry
    a. Major processes and products
    b. Classification methods of commercial resins
    c. Net-shaped manufacturing
2. Process Selection (alternatives) (class discussion and activities, laboratory demonstrations)
    a. Extrusion
    b. Injection Molding (and variations) – with in-depth analysis of process physics
    c. Thermoforming
    d. Blow Molding (Injection and Extrusion)
    e. Rotational Molding
    f. Compression Molding and Filament Winding (reinforced thermosets)
    g. Tooling requirements for each process
3. Cost Modeling
    a. Injection molding
    b. Thermoforming
    c. Switch-over Analysis
4. Select Product Design Topics
    a. Prototyping Technology (FDM, SLS, CAE stress and moldflow simulation)
    b. Creep Analysis of Plastics during beam bending
    c. Data sheets and Corporate Design References

5. Plastics Material Selection (selected examples cited in lecture)
    a. Classification based on cost, resistance to chemicals, performance under loads and heat
    b. Commodities: HDPE, LDPE, PP, PS, and PVC (low cost thermoplastics)
    c. *Roll of additives in modifying resin performance*.
        Plastics = Polymers + Additives (for performance, protection, esthetics)
    d. Engineering: PC, PMMA, PA, POM (higher cost and performance thermoplastics)
    e. High temperature: PTFE, PEI, PSU , PPS (very high temperature thermoplastics)
    f. Elastomers (partial cross-linking): PUR and SI
    g. Thermosets: PF, MF, UP, and EP (much cross-linking)
    h. Bio-based: PLA; renewable feedstock vs. compostable products
6. Life Cycle Analysis and Recycling
    a. Role of plastics in sustainable living
    b. End of life options for commercial resins

Course Objectives:

1. To evaluate the properties, processing methods, and relative costs of commercial plastic materials.
2. To teach best practice for summarizing laboratory data from plastic processing machines.
3. To evaluate the different methods of processing plastics in terms of their fundamental advantages and disadvantages from a product design perspective.
4. To evaluate the effect various additives have on changing the performance of a commercial resins.
5. To teach students various methods of cost analysis.
6. To describe engineering design methods for plastic products including stress analysis, moldflow simulation, and engineering data-based creep analysis.
7. To provide an appreciation of the environmental, life cycle and recycling issues related to the use of plastics.

Course Outcomes:

1. Knowledge of variety of methods used to process commercial plastic resins, including limitations.
2. Knowledge of the basic tooling requirements for various plastic processing methods.
3. Ability to write professionally formatted summaries of plastic processing experiments.
4. Ability to "cost" plastics products.
5. Ability to critique the design of a product made with commercial plastic resins and recommend a preferred process for production.
6. Ability to perform basic creep analysis of plastic parts.
7. Articulate the roll of additives in changing the performance of commercial resin systems.

Course Assessments and Point Values, subject to minor changes with instructor notice.

Assessment Activities for MSE 453 Spring 2019			
Quizzes based on	10	QUIZ: Intro and Overview of Plastics	
Friday Lecture content	10	QUIZ: Injection Molding	
DUE MONDAY by 11 PM	10	QUIZ: Molded Part Design, Variations	
	15	QUIZ: Thermoforming	
	10	QUIZ: Extrusion	
	10	QUIZ: Blow Molding & Rotational Molding	
	10	QUIZ: Recycling & Bioplastics	
	20	QUIZ: Creep analysis (uses data sheet)	
	10	QUIZ: Thermoset Processes	
	10	QUIZ: Prototyping	
	30	QUIZ: Presentation Take-Aways	12%
Quizzes	10	Polymerization & Commodity Plastics	
based on	20	Unit Cost for Molded Parts & Blue Prints	
Collaborate	10	Thermal Properties of Plastics	
Sessions	10	Additives for Commercial Plastics	
DUE	15	Forming Cost & Switch-Over Analysis	
THURSDAY by 11 PM	10	Engineering and High Temp Plastics	
	10	Thermoset and Elastomers	
	10	Assembly and Decorating of Plastics	8%
Class Participation	110	Friday Q&A session pop quiz	9%
Assignments	40	Extrusion Report	
Presentation of Plastics	60	Presentation outline and ppt	
application & team talk	40	Presentation delivery and Q/A	12%
Exams	220	Exam 1	
	220	Exam 2	
	40	Part ID Practical part of Exam 2	
	220	Exam 3 (Final)	59%
	1,190	Total points for course	

Grading Scale (Percent of 100 Points)

A+ (97-100) ; A (93-96); A- (90-92)	B+ (87-89); B (83-86); B- (80-82)	F < 60
C+ (77-79); C (73-76); C- (70-72)	D+ (67-69); D (65-66); D- (60-64)	