

**Department of Materials Science Engineering  
University of Maryland  
College Park, MD**

**ENMA 423: Manufacturing With Polymers  
Course website: [www.ajconline.umd.edu](http://www.ajconline.umd.edu)**

**Course Description:** This course introduces students to the broad spectrum of issues associated with the use, manufacturing and processing of polymers, which includes addressing issues of blending of materials, design and production of a polymer formulation and the characterization of material properties. The participants of the course will be organized into teams to work for a semester on an open ended design problem of producing and characterizing a polymer formulation for advanced materials use.

**Prerequisites:** ENES 230 or permission of Department

**Textbook:** no required text, class notes and research projects will be the focus of the course

**Course Objectives:** The goal of this course is to introduce engineering students to the process of engineering design and development of polymer formulations. The students will gain experience in working on interdisciplinary teams with a focus on both the engineering design issues and the economics involved with process development in polymers. After satisfactory completion of this course the student should attained the following skills:

- 1.) General knowledge of commodity polymers and their physical properties. This includes the fundamentals of structure-property relations in polymers.
- 2.) The ability to design an extrusion process, including machine selection, screw design and operating conditions.
- 3.) Develop economics of the manufacturing process of a polymer formulation.
- 4.) Have a working knowledge of basic characterization techniques for determination of physical and mechanical properties of polymers.
- 5.) Gain significant experience with the preparation and presentation of progress reports. Oral and written communication skills are emphasized.

**Course Goals to meet ABET 2005 Criteria:**

1. Material/System/Process design to meet desired properties/performance
2. Characterization - techniques and interpretation
3. Communication - written and oral
4. Team work

## **Topics Covered**

### **Introduction to Polymers**

- Types of polymers
  - Synthetic vs. Biopolymers
  - Chain architecture and copolymers
  - Commodity polymer and specialty polymers
  - Basic physical properties of commodity polymers
  - Recycling issues with polymers
- Fillers used with polymers
  - Types of fillers
  - Economics of fillers
- Blending of polymers
  - Multicomponent polymer systems
  - Block copolymers
  - Thermodynamics of polymer blending
- Introduction to crystallization of polymers

### **Polymer Manufacturing**

- Types of polymer processing equipment
- Introduction to polymer extrusion
- Types of extruders
- Types of extruder screw elements
- Design of extruder screws for processing
- Design and selection of extruder operating conditions for an extrusion process

### **Injection Molding**

- Principles of injection molding
- Injection molding cycle and process design

### **Introduction of Polymer Flow Behavior**

- Properties of viscoelastic fluids
- Mixing of fluids and solids
- Dispersive versus distributive mixing

### **Polymer Characterization**

- Mechanical properties of polymers
- Modulus, failure stress and strain, toughness, impact properties
- Morphological characterization
  - Optical microscopy
  - Scanning electron microscopy

## **Grading:**

- |                                 |     |
|---------------------------------|-----|
| Individual homework assignments | 20% |
| Group assignments               |     |

homework	25%
final report and presentation (includes 10% for overall class presen.)	40%
Group evaluation and participation	15%
<b>Total</b>	<b><u>100%</u></b>

The instructor and the student teams will evaluate the individual student's group participation and 15% of the final grade depends on this evaluation.

**Contribution of course to meeting professional component:**

This course emphasizes participation in interdisciplinary teams of engineers with aspects of design, economics and production present in the semester project. The broad based nature of the course project provides an opportunity for students experience the breadth of the design process present in an professional setting. The course also places importance on developing both written and oral communication skills which are critical for professional success.

**Relationship of the course to program objectives:**

This course satisfies part of the design experience for the undergraduate engineering curriculum.

**Instructor:**           **Dr. R.M. Briber**  
 Department of Materials Science and Engineering  
 2144 Chemical and Nuclear Engineer Building  
 (301) 405-7313,  
[rbriber@umd.edu](mailto:rbriber@umd.edu)  
**To be posted and by appointment**

**TA:**           **To be announced**

**Other Participants:** Engineers from Adell Plastics, Inc. and others to be announced.

Prepared by Prof. Briber, modified 4/28/2004