



## **CHEM 421/MSE 421 Polymeric Materials** Spring 2018

**Credits:** 3

### **Course Designations and Attributes**

Intermediate level; physical science breadth; counts as L&S credit

### **Meeting Time and Location**

Tu, Th 11.00 AM to 12.15 PM, ECB 1003

### **Instructional Mode**

All face-to-face

### **Specify how Credit Hours are met by the Course**

This class meets each week for two 75-minute lectures. Over the course of the semester, students are expected to do at least 135 hours of learning activities, which includes class attendance, reading, studying, preparation, problem sets, and other learning activities

**Canvas Course URL** <https://canvas.wisc.edu/courses/90591>

## **INSTRUCTORS AND TEACHING ASSISTANTS**

### **Instructor**

Prof. Padma Gopalan, Professor Materials Science and Engineering, Chemistry.  
pgopalan@wisc.edu

### **Instructor Availability**

Optional discussion session: Thursday 5-6 PM EH 2305, Friday 12-1.00PM MSE 221

### **Teaching Assistant**

Wei Wei (wwei39@wisc.edu)

### **TA Office Hours**

Thursday 5-6 PM EH 2305, Friday 12-1.00PM MSE 221

## **OFFICIAL COURSE DESCRIPTION**

### **Course Description**

Polymer chemistry and physics terminologies, structure-property relationship, polymer characterization, polymer synthesis, material requirements for optoelectronics including

conjugated polymers, thin film transistors, light emitting diodes, non-linear optical materials, holographic data storage and liquid crystal polymers.

### Requisites

Chem 341 or equivalent

## LEARNING OUTCOMES

*This course serves as an introduction to essential concepts in polymer science with emphasizes on the structure-property relationship in polymers.*

## GRADING

- There will be two mid-term exams (20%+ 20%) plus a final (20%). Exams will account for approximately 60% of the course grade.
- Final grades will be calculated on a straight scale, 93-100 (A); 88-92 (AB); 83-87 (B); 78-82 (BC); 70-77 (C); 60-69 (D); below 60 (F). Depending upon the final grades, a curve may be applied; however, this will only result in an improved letter grade relative to the straight scale.
- Late assignments / Missed exams: All assignments are expected to be submitted in class on Tuesdays. If for some reason you have excruciating circumstances, you should contact me and exceptions can be made not more than twice during the semester for late submissions.
- Ideally you should never miss an exam. These are very hard to make up for. If you miss an exam, I will need a doctor's note to offer an alternate exam. Since the midterms will be at regular class times there is no excuse to miss the exams.

## EXAMS

- Mid term 1: March 20th, in class.
- Mid term 2: April 19th, in class.
- Finals: May 7th, 12.25 PM to 2.25 PM.

## TOPICS

- **Nature of Polymeric Materials:** Basic definitions, polymer classification, principal uses of thermoplastics, thermosetting resins, crosslinked elastomers.
- **Polymer Characterization:** Molecular weight definitions and branching, determination of molecular weight of polymers.
- **Polymer Synthesis:** Addition, polycondensation, anionic and Ziegler-Natta polymerizations, industrial methods of polymerization.
- **Block Copolymers and Random Copolymers:** Synthesis of block copolymers, thermodynamic principles of self-assembly, principle use of self-assembled nanostructured materials.
- **Glass transition:** the glassy state, theories and experimental determination.
- **Thermodynamics of Polymer Solutions and Blends.**

- **Mechanical Properties**
- **Applications:** of commercial and non-commercial polymers.

<b>MSE 421 (POLYMERIC MATERIALS)</b>	
<b>Lecture contents</b> The lectures are 75 minutes long.	<b># of lectures</b>
<b>Polymer classification</b>	<b>1</b>
<b>polymer characterization and chain dynamics</b>	<b>4</b>
<b>Glass transition: structure property relationship</b>	<b>3</b>
<b>Polymer synthesis: condensation and addition</b>	<b>4</b>
<b>mid term 1 in class</b>	<b>1</b>
<b>Polymer synthesis: copolymerization</b>	<b>2</b>
<b>Zeigler-Natta polymerization</b>	<b>1</b>
<b>Emulsion and Suspension polymerization</b>	<b>1</b>
<b>Spectroscopy and the Characterization of Chain Structure</b>	<b>2</b>
<b>Thermodynamics of Polymer Solutions and Blends</b>	<b>2</b>
<b>Mid term 2 in class</b>	<b>1</b>
<b>Mechanical and Rheological Properties</b>	<b>2</b>
<b>Special topics</b>	<b>3</b>
<b>Application of Polymers</b>	<b>2</b>
<b>Review</b>	<b>1</b>
<b>Final exam</b>	

## **REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS**

- Textbook: "Fundamental of Polymer Science" by Paul Painter, Michael M. Coleman Second edition.
- Other References:
  - "Principles of Polymerization", 3rd edition, George Odian (Wiley Interscience).
  - "Introduction to Polymers," Young, R. A., and Lovell, P. A., Second Edition, Chapman and Hall, 1991.
  - "Polymers: Chemistry and Physics of Modern Materials", 2nd edition, J.M.G.Cowie (Chapman and Hall, 1991).

## **ACADEMIC INTEGRITY**

By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course,

disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to [studentconduct.wiscweb.wisc.edu/academic-integrity/](http://studentconduct.wiscweb.wisc.edu/academic-integrity/).

## **ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

**McBurney Disability Resource Center syllabus statement:** “The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student’s educational record, is confidential and protected under FERPA.” <http://mcburney.wisc.edu/facstaffother/faculty/syllabus.php>

## **DIVERSITY & INCLUSION**

**Institutional statement on diversity:** “Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.” <https://diversity.wisc.edu/>