

## MSE 470: Design and Use of Biomaterials Fall Semester, 2025

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Canvas website: <https://canvas.illinois.edu/courses/50122>

**Course Description:** We will cover various materials, in particular soft biomaterials (polymeric biomaterials), that have been designed and developed for biomedical applications. The course is designed for advanced undergraduate and graduate students who have basic background in organic and polymer chemistry, physics, biochemistry and materials science. The course integrates both materials science and biology, and is intended to enable students to understand the fundamental principles and knowledge associated with current biomaterials research, in particular polymeric biomaterials, and the biomedical applications of these materials.

**Course Contents:** The course will have several modules covering polymeric material design, synthesis of polymeric biomaterials, bioconjugation, materials degradation, biomaterial surface interactions, biocompatibility of materials, nano-biomaterials, and biomaterials applications in drug delivery, tissue engineering and diagnosis. Biomaterials devices and bioimplants will be briefly covered. Topics to be covered include:

- Introduction to biomaterials for biomedical applications: a brief overview of biomaterials and their applications
- Polymeric biomaterials: synthesis, design principles and properties
- Bioconjugation techniques (Organic chemistry background required)
- Degradation of biomaterials
- Biomaterial surface interactions and biocompatibility of materials
- Nano-biomaterials
- Biomaterials for drug delivery application (small molecules, gene and protein)
- Biomaterials for imaging and diagnosis
- Biomaterial and tissue engineering and cell-biomaterials interaction
- Biodevices and bioimplants
- Immunomaterials

**Prerequisites:** Organic chemistry or polymer chemistry; basic biochemistry or physiology

**Lecture:** T/R 12:30-1:50 p.m., 4039 Campus Instructional Facility

**Office hour:** Every Tuesday 2:00 – 3:00 p.m.

**Textbook and Course Materials:** (a) PowerPoint slides, lecture notes given in class, research articles, related book chapters. (b) (optional reading) "Biomaterials: The intersection of Biology and Materials Science." By Temenoff and Mikos.

|                 |                                                                                |                               |
|-----------------|--------------------------------------------------------------------------------|-------------------------------|
| <b>Grading:</b> | Attendance and participation in class discussion/activity                      | 0-2 points (Additional)       |
|                 | Exams                                                                          | 60% (20% mid-term; 40% final) |
|                 | Homework <sup>a</sup>                                                          | 25%                           |
|                 | Final presentation <sup>b</sup>                                                | 8%                            |
|                 | Final paper or report <sup>c</sup>                                             | 7%                            |
|                 | Final grade: 20% A (or A+), 27% A-, 28% B+, 15% B, 10% B- or below (Tentative) |                               |

<sup>a</sup> The students will normally be given one week to finish the homework. We have 5 homework assignments in total. Homework will be turned in in-person before Tuesdays' class.

<sup>b</sup> Each group will have ~4-5 students. The final presentation will be graded based on the novelty and the feasibility of the proposed research, the quality of slides and presentation, and the performance.

<sup>c</sup> One final presentation (PowerPoint file) and one final report (MS Word file) per group.

\*Attendance will be discussed in the first class (Aug 26, 2025)

### Important Dates

|                                    |                                                                              |
|------------------------------------|------------------------------------------------------------------------------|
| October 16:                        | Mid-term (20 pts)                                                            |
| ~November 1:                       | Requirement for the final project and report will be provided.               |
| November 15:                       | The topic of the final project should be finalized and emailed to Prof. Wang |
| December 9:                        | Final presentations                                                          |
| TBD:                               | Final exam (40 pts)                                                          |
| TBD (three days after Final exam): | Final reports due                                                            |