**MSE 474: Biomaterials and Nanomedicine** Spring Semester, 2025

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TA TBD
Canvas: https://canvas.illinois.edu/courses/56180

**Course Description:** This course will give a brief introduction to the synthesis of biomaterials and their applications in nanomedicine. For the synthesis of biomaterials, we will cover the topics of bioconjugation techniques, functional group protection and deprotection, the design and synthesis of various polymeric biomaterials include polypeptide, polyesters, and other synthetic non-degradable and degradable polymers. Synthesis of hydrogels, bio-inspired materials, self-assembly, and stimuli responsive biomaterials will also be covered. The topics to be discussed on nanomedicines include micelles, nanoparticles, protein conjugates, drug conjugates, nanoencapsulates, polymeric vesicles and gene delivery. We will address the design of nanomedicines, the correlation of the design of nanomedicines with the stability, biocompatibility, toxicity and *in vitro* and *in vivo* efficacy of nanomedicine. Issues related to clinical translation of biomaterials and nanomedicines will also be covered.

**Course Objectives:** The objective of this course is to give an overview of the basic techniques for the conjugation and biomaterials synthesis, and the principles and strategies of designing nanomedicines for disease treatment. After finishing this course, the students are expected to be able to (1) understand and perform basic bioconjugation reaction, (2) prepare polymeric biomaterials via controlled organic/polymer synthesis, (3) design and control the preparation of polymeric nanomedicine and evaluate the nanomedicine in vitro and in vivo. This course will cover several topics at the interface of organic/polymer chemistry, materials science, nanotechnology, pharmaceutical science, and translational and clinical medicine. Students who aim to develop career in biomaterials, drug delivery, bioengineering or medicine, may find this course useful.

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

**Lecture:** T/R 12:30-1:50 p.m., Engineering Hall 106B3

**Office hour:** Every Tuesday 2:00 – 3:00 p.m.
**TA Office hour:** You can email TA with any questions about homework and exams, and schedule with TA for in person meetings.

**Suggested Textbook:** Part-1: Topics on bioconjugation: Bioconjugate Techniques, 2nd Edition by Greg T. Hermanson
Part-2: Topics on polymeric biomaterials and nanomedicine: class notes and papers

**Other Suggested reading:** Biomaterials Science: An introduction to Materials in Medicine (Buddy Ratner, 2004)
Polymer chemistry: An introduction (Malcolm Stevens, 1999)

**Grading:**

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| Attendance and participation in class discussion/activity | 0-2 points (Additional) |
| Test | 60% (25% mid-term; 35% final) |
| Homework[a] | 25% |
| Final presentation[b] | 8% |
| Final paper or project/report[c] | 7% |

Final grade: 20% A/A+, 30% A-, 30% B+, 15% B, 5% B- or below. If your score is less than half of the class average, you will get a final grade of "D". C+ is the lowest score we had in the past

[a] The students will normally be given one week to finish the homework. If the homework is late for less than 24h, 50% points will be deducted. If the homework is late for more than 24h, 100% points will be deducted. We have 5 homework assignments in total. Homework will be turned in in-person before Tuesdays' class.
[b] Each group will have ~4 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.
[c] One final presentation (PowerPoint file) and one final report (MS Word file) per group.
*Attendance will be discussed in the first class (Jan 16)

**Important Dates**

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| March 11: | Mid-term (25 pts) |
| ~April 1: | Requirement for the final project and report will be provided. |
| April 15: | The topic of the final project should be finalized and emailed to Prof. Wang |
| May 1: | Final presentations |
| Early May (Determined by College): | Final exam (35 pts) |
| 3 days after final exam | Final reports due |