

MSE 483/583

Nanomedicine

(Credits: 3, Spring quarter 2023, Tuesday and Thursday 2:30-3:50 pm, MEB242)

Instructor: Miqin Zhang

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Professor of Neurological Surgery

Adjunct Professor in Bioengineering, Radiology, and Orthopaedics & Sports Medicine

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Course Description

The foundational research in nanosciences and the rapid development in nanotechnology have provided a new set of research tools and medical devices that will change our ways to practice medicine in the near future. The objective of this course is to provide students a broad understanding of cutting-edge development of nanomaterials and nanodevices in medicine. This course covers the methods of synthesis and characterization of nano-sized materials and specific considerations of their use within biological systems. The use of those structures, devices, and agents will then be discussed in the context of their clinical applications.

Course outline

1. Introduction : (1.5 week)
 - Introduction to nanomaterials
 - Nanoscale effect
 - Physical characterization of nanomaterials
 - Biological characterization of nanomaterials
2. Nanoparticle diagnostics: biosensors (2.5 weeks)
 - Types of biosensors
 - Transducers: nanocomponents and nanotechnologies
 - Nanoelectromechanical systems
 - Applications: nanoarrays, point of care diagnostics, and implantable systems
3. Nanoparticle diagnostics: imaging contrast agents (3 weeks)
 - Nanoparticle variants and synthesis
 - Nanoparticle conjugates
 - Applications of nanoparticles in cell trafficking, magnetic imaging, optical imaging, computed tomography, positron emission tomography, and ultrasound imaging.
4. Nanoparticle therapeutics (3 weeks)
 - Synthesis of nanoparticles
 - Nanoparticles for chemo drug delivery
 - Nanoparticles for gene delivery

Nanoparticles for cancer therapies: solid tumors, blood type tumors, and metastasis
Nanoparticles for biotechnology therapy: stem cell therapy, immunotherapy phototherapy, radiosensitization, and hyperthermia

Textbooks and lecture materials

No text book is required. Lecture notes, review articles and reading materials will be distributed by the instructor.

Reference books and materials

- 1) Drug Delivery - Engineering Principles for Drug Therapy by Mark Saltzman, 2001.
- 2) Nanofuture: what's next for Nanotechnology by J. Storrs Hall, 2005.
- 3) Nanoparticles in Biomedical Imaging by Jeff W. M. Bulte, Michel Modo, 2010.
- 4) Essential Biomaterials Science by David Williams, 2014

Homework and exams

Homework: Homeworks will be submitted as pdfs through the Canvas assignments page. Homeworks will be released two weeks before they are due and will be due Fridays by 11:00 pm. The due dates are visible through Canvas.

Exams: There will be no makeup exams. If there is a valid reason for your absence, your absence must be approved by Instructor.

Cheating and plagiarism: <http://www.engr.washington.edu/mycoe/am/ampolicy.html>
Coll. of Eng. policy for academic misconduct.

Homework assignments: Four assignments

Midterm in class: multiple-choice questions (open book and lecture notes)

Final: Term paper

Grading

Students enrolled in MSE583 are required to carry out additional literature review, include additional Discussion/Future direction in the term paper, and give an oral presentation at the end of the course. This is not required for those enrolled in MSE483.

	MSE483	MSE583
Homework	40%	35%
Midterm	20%	20%
Final term paper	40%	35%
Final oral presentation	N/A	10%

Schedule

First day of class: Tues, March 27, 2023

May 25: No class

Midterm: 5/18/2023

Final exam (Term paper): 10pm 5/31/2023

Presentation: The whole class (both MSE483 and MSE583) will meet the last two days of the class (June 1st and June 6th) to hear and question the oral presentations from students in MSE 583.