MSE 482/582

Biomaterials/Nanomaterials in Tissue Engineering

(Credits: 3, Spring quarter 2022, Tues and Thurs 2:30-3:50pm, Low 205)

Instructor: Miqin Zhang
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Course Description

The objective of this course is to provide students a fundamental understanding of biomaterials, their implant applications and design consideration. This course covers the fundamentals of the synthesis, properties, and biocompatibility of metallic, ceramic, polymeric, composite, and biological materials, and their applications for both hard and soft tissue replacement, and controlled drug delivery. This course will also provide students a broad understanding of cutting-edge development in nanomaterials and their potential applications in tissue engineering.

Course outline

1. Introduction : (1.5 week)
   - Introduction to biomaterials
   - The structures of materials
   - Characterization of materials
2. Classes of biomaterials (1.5 weeks)
   - Metals
   - Ceramics
   - Polymers
   - Composites
   - Biological materials
3. Tissue response to materials (1 week)
   - Host response to biomaterials
   - Material response to host
   - Biocompatibility of materials
4. Biomaterials (2 weeks)
   - Soft tissue replacement I: sutures, skin, maxillofacial implants
   - Soft tissue replacement II: Blood interfacing implants
   - Hard tissue replacement I: long bone repair
   - Hard tissue replacement II: joints and teeth
   - Transplants
   - Biomaterials in tissue engineering
5. Nanomaterials in tissue engineering (4 weeks)
   - Nanomaterial-cell interactions
   - Electrospinning technology for nanofibrous scaffolds

Nanomaterials for skeletal, muscle, nerve, and heart tissue engineering
Nanomaterials for stem cell tissue engineering
Nanomaterials for drug delivery
Magnetic nanoparticles for tissue engineering
Nanoparticles/nanotubes/nanowires for cellular engineering

Textbooks

Biomaterials: An Introduction, Joon B. Park and Roderic S. Lakes, 3nd Edition, Plenum Press 2007.

Reference books

- Materials Science and Engineering an Introduction, William D Callister, Jr., 6th, or 7th or 8th Edition
- Biomaterials Science: An Introduction to Materials in Medicine, 2nd Edition. Buddy Ratner, Allan S. Hoffman, Frederick J. Schoen, and Jack E. Lemons, Academic Press, 2004 or 2013.
- Essential Biomaterials Science, David William, Cambridge University Press, 2014
- Frontiers in Tissue Engineering, Edited by Charles W. Patrick Jr, Antonios G. Mikos, and Larry V. McIntire, Pergamon, 2011.

Homework and exams

Homework: Five assignments
Midterm: multiple-choice questions
Final: Term paper

Grading

Students enrolled in MSE582 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 MSE482.

	MSE482	MSE582
Homework	40%	35%
Midterm	20%	20%
Final term paper	40%	35%
Final oral presentation		10%

The whole class will meet at the last day of the class to hear and question the oral presentations by the students in MSE 582.

Schedule

First day of class: Tues, March 29
Midterm: Thurs, May 12
Final exam (Term paper): May 31
Presentations: The whole class (both MSE482 and MSE582) will meet at the last two days of the class (June 2 and June 4) to hear and question the oral presentations from students in MSE 582.