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Spring 2020

CHE 702-102: Special Topic - Biomaterials

Xiaoyang Xu

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CHE 702 Biomaterials- recent advances in drug delivery and tissue engineering

Instructor: Professor Xiaoyang Xu
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Departments of Biomedical Engineering
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Class hours:

Type	Time	Days	Where	Date Range	Schedule Type	Instructors
Class	6:00 am - 8:50 pm	Monday	FMH 209	Jan 21, 2020 - May 16, 2020	Lecture	Xiaoyang Xu (P)

Date to be offered: Spring, 2020

Prerequisite: Graduate standing

Course description:

Biomaterials have gained increasing interest during the past decade, particularly for biomedical use in tissue engineering, drug delivery and regenerative medicine. Such materials include synthetic polymers, metals, natural polymers, micro-/nano- composite, proteins, nucleic acids, and biologically oriented synthetic polymers, as well as colloids, surfactants, and liquid crystals. The course will focus on the most recently developed biomaterials and their medical applications including gene editing/cell therapy/cancer immunotherapy. The course will provide students with a solid foundation in biomaterial design, synthesis, characterization, processing, and their biomedical applications. The topics include theory of polymer chemistry and physics, biomaterial design, metals, nanomaterials, liquid crystals, characterization of biomaterials, and the biomedical applications of biomaterials. This course is open to students from all departments in college of engineering and college of science. The class format will be lectures and critiques of recent literature.

By the end of the course, students will be able to:

- Be able to classify biomaterials based on their method of preparation, chemical structure, macromolecular architecture, and physicochemical properties.
- Describe and calculate the structural parameters of polymeric materials including monomer units, molecular weight, tacticity, coil dimension, crystallinity, and morphology, etc.

- Describe the structure property relationship between the structural parameters and the mechanical and thermal properties of biomaterials and apply the acquired knowledge to develop new biomaterials with designed properties.
- Design, synthesize, fabricate and characterize biomaterials will specific biomedical functions.
- Assess the pros and cons of various biomaterial systems.
- Effectively work as a team to accomplish an assigned project.
- Develop knowledge of biomaterials and the structure, properties, and applications of those materials.
- Propose methods and relevant experiments to validate biomedical applications of certain biomaterials.
- Familiar with the most recent advances in biomaterials and their applications in drug delivery and tissue engineering.

Tentative schedule:

Date	Topic	Assignment
	Introduction of biomaterials	
	Polymer chemistry: Polymer types, polymerization, molecular weight, common polymers	
	Polymer physics: Gelation and crosslinking, glass transition, crystalline polymers, amorphous polymers, chain dimensions, rubber elasticity, viscoelasticity	
	Biomacromolecules, proteins, nucleic acids, etc.	
	Metal based biomaterials	
	Micro- and Nanomaterials	
	Biomaterials fabrication, biomaterial-based devices, etc.	
	Application of biomaterials in drug delivery	
	Application of biomaterials in tissue engineering	
	Recent progresses of biomaterial-based therapies in clinical	
	Evaluation of biomaterials	
	Challenges and perspectives	

Texts and supplemental materials: Relevant articles will be sent to the class prior to lectures.

Evaluation: Grades will be determined based on class participation and assigned homework (25%), midterm exam (25%), and project report/presentation (50%) given by the students. Homework assignments (literature summaries and short lecture) for this course are considered individual assignments. Students may discuss the questions with other students in the course, but each student should prepare their solutions to the assignment individually.