BME/EE 547: BioMEMS (BioMicroelectromechanical Systems)

Semester: Fall 2012.
Class Time: Mon. Wed. 3:00pm – 4:15pm.
Classroom: Mandeville Hall, Room 218.
Instructor: Xingguo Xiong (Associate Professor)
Office: Tech 140.
Office Hours: Tue. 3:00pm-4:00pm, Mon. Wed. 4:30pm-5:30pm.
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Course Website: UB Blackboard, URL: http://blackboard.bridgeport.edu/webapps/login/

Description: BioMEMS is the application of MEMS (Microelectromechanical Systems) technology in the fields of biomedical and health sciences. Due to their small size (1μm~1mm), BioMEMS have the advantages of low weight, low cost, quick response, high throughput, high efficiency, requiring much less sample/reagent, and easy system integration. BioMEMS found broad applications in disease diagnosis, prevention and treatment. Various bio-MEMS products have been developed, such as microfluidic devices, neural interface devices, μTAS (micro total analysis systems), lab-on-a-chip, DNA chips, micro drug delivery system, microsurgical tools, bio-sensors. This course introduces to students about the fundamentals of bio-MEMS technology, typical bioMEMS devices and their applications.

Credit: 3.0.

Textbook: Steven S. Saliterman, *Fundamentals of BioMEMS and Medical Microdevices*, SPIE Publications, Jan. 19, 2006, ISBN: 0819459771.

References: Mauro Ferrari (editor), *BioMEMS and Biomedical Nanotechnology: I: Prospectus, Biological and Biomedical Nanotechnology (A. Lee, L. Lee); II: Micro and Nano-Technologies for Genomics and Proteomics (M. Ozkan and M. Heller); III: Therapeutic Micro/Nanotechnology (T. Desai and S. Bhatia); IV: Biomolecular Sensing, Processing and Analysis (R. Bashid and S. Wereley),* Springer, 1st edition, Nov. 30, 2006, ISBN: 0387255613

Gerald Urban, *BioMEMS (Microsystems)*, Springer, 1st edition, May 5, 2006, ISBN: 0387287310.

Wanjun Wang, Steven A. Soper, *Bio-MEMS: Technologies and Applications*, CRC Press, 1st edition, Dec. 15, 2006, ISBN: 0849335329.

Ville Kaajakari, *Practical MEMS: Design of microsystems, accelerometers, gyroscopes, RF MEMS, optical MEMS, and microfluidic systems*, Small Gear Publishing, Mar. 17, 2009, ISBN: 0982299109.

Marc J. Madou, *From MEMS to Bio-MEMS and Bio-NEMS: Manufacturing Techniques and Applications*, CRC Press, 1st edition, Jun. 16, 2010, ISBN: 142005516X.

Ellis Meng, *Biomedical Microsystems*, CRC Press, 1st edition, ISBN: 1420051229, Sept. 17, 2010.

Goals: This course is designed to introduce to students about the fundamentals of bioMEMS technology and their applications in biomedical and health sciences fields. The micromachining techniques for bioMEMS fabrication are introduced. The working principle analysis, design, simulation and testing of various bioMEMS devices (e.g. microfluidic devices, biosensors, lab-on-a-chip, DNA chip) will be discussed. Upon completing this course, students will have a good understanding about the fundamentals of bioMEMS, and accumulate hands-on experience in the design and simulation of various bioMEMS devices.

Prerequisites: Undergraduate and graduate students with engineering or physics background.

Topics: The following topics are covered in this course:

1. Introduction to bio-MEMS.
2. Materials for bio-MEMS.
3. BioMEMS fabrication: bulk/surface micromachining, LIGA.
4. Soft fabrication and polymers (soft-lithography, micromolding, micro-stereolithography, thick-film deposition, SAMs.
5. Microfluidic principles.
6. Microfluidic devices: microchannels, microvalves, micropumps, micro-needles, microreserviors, micro-reactors.
7. MEMS biosensors.
8. Microactuators and micro drug delivery system.
9. Micro total analysis system (μTAS), lab-on-a-chip.
10. Microarrays: polymerase chain reactor (PCR), DNA chip, functional genomics, bioinformatics.
11. BioMEMS for tissue engineering.
12. Packaging, power, data and RF safety of bioMEMS.

Grading: The final grade will be 15% on homework, 15% on projects, 31% on mid-term exam, 35% on final exam and 4% on attendance. There will be four random attendance, each will count 1 point in your final grade.

Exams There will be two exams: the mid-term exam and the final exam.
Computer Usage: PC (ANSYS software).

Lab Project: Several lab projects on bioMEMS devices design and simulation will be assigned. The goal of the projects is to help student accumulate skills and experience in bioMEMS CAD design and simulation.

Cheating Policy: It is the student's responsibility to familiarize himself or herself with and adhere to the standards set forth in the policies on cheating and plagiarism as defined in Chapters 2 and 5 of the Key to UB (http://www.bridgeport.edu/pages/2623.asp) or the appropriate graduate program handbook.