

COURSE OUTLINE

Department of Electrical Engineering, University at Buffalo

EE 528 BioMEMS & NanoBioSensors

Time and Fall 2006

Location: M/W/F, 9:00 AM - 9:50 AM, 115 BALDY

Instructor: Kwang W. Oh, Ph.D., SMALLab (nanobioSensors and MicroActuators Learning Lab), Department of Electrical Engineering
215E Bonner Hall, kwangoh@buffalo.edu
Office Hours: Wed 10:00 AM – 12:00 AM or by appointment

Prerequisites: Graduate students in engineering and natural sciences or senior undergraduate students (with permission from the instructor)

Objectives: The field of BioMEMS and Nanobiosensors has seen tremendous growth in the past several years. The lab-on-a-chip (LOC) concept and its applications will be introduced. Various micro/nanofabrication techniques that are commonly used in BioMEMS and Nanobiosensors will be taught. Microfluidics, which is the foundation for most of the applications, will be covered followed by the various chemical and biomedical applications such as separation, implantable devices, drug delivery, and microsystems for cellular studies and tissue engineering. Recent and future trends in BioMEMS and nanobiosensors will be discussed too. Students will gain a broad perspective in the area of micro/nano systems for biomedical and chemical applications.

Textbooks: Class notes and Handouts. Course website will be announced when it is ready.

References:

- Reyes D R, Iossifidis D, Auroux P–A and Manz A 2002 Micro total analysis systems: 1. Introduction, theory, and technology *Anal. Chem.* **74** 2623–36
- Auroux P–A, Iossifidis D, Reyes D R and Manz A 2002 Micro total analysis systems: 2. Analytical standard operations and applications *Anal. Chem.* **74** 2637–52
- Vilkner T, Janasek D and Manz A 2004 Micro total analysis systems: recent developments *Anal. Chem.* **76** 3373–86
- Oh K W and Ahn C H 2006 A review of microvalves *J. Micromech. Microeng.* **16** R13–R39

(textbooks)

- A. Manz, H. Becker, *Microsystem Technology in Chemistry and Life Sciences*, Springer, 1999

- O. Geschke, H. Klank, and P. Telleman, *Microsystem Engineering of Lab-on-a-chip Devices*, John Wiley & Sons, 2nd Edition, 2004
- G. T. A. Kovacs, *Micromachined Transducers Source Book*, MacGraw-Hill, 1998
- N. –T. Nguyen, S. Wereley, *Fundamentals and Applications of Microfluidics*, Artech House Publishers, 2002

Grading: Combination of Homework and Attendance (HA) / Project (Paper and/or Presentation) / Midterm Exam (ME) / Final Exam (FE)
 1. **Graduates:** HA 20%, Paper 20%, Presentation 20%, ME 20%, FE 20%
 2. **Undergraduates:** HA 25%, Presentation 25%, ME 25%, FE 25%

Projects:

1. **Paper:** Choose a BioMEMS/Nanobiosensor system/device/application and write a short review paper. Paper will be due toward the end of the term (12/06).
2. **Presentation:** Come up with a design of a device/system that you might think works better than existing designs. Presentation will occur during the second half of the term, approximately 15 minutes long.

Schedule: The schedule is subject to change and changes to the published schedule will be announced in class.

<u>Wk 01</u>	08/28, 08/30, 09/01	Introduction to BioMEMS and Nanobiosensors
<u>Wk 02</u>	09/04	No Class. Labor Day Observed
	09/06, 09/08	Micro/nanofabrication techniques for BioMEMS
<u>Wk 03</u>	09/11, 09/13, 09/15	Principles of Microfluidics
<u>Wk 04</u>	09/18, 09/20, 09/22	Surface chemistry, Microfluidic components
<u>Wk 05</u>	09/25, 09/27, 09/29	Microfluidic actuators
<u>Wk 06</u>	10/02	No Class. Yom Kippur
	10/04, 10/06	Lab-on-a-chip (LOC), chemical analysis systems
<u>Wk 07</u>	10/09, 10/11, 10/13	Drug delivery devices, Implantable devices
<u>Wk 08</u>	10/16	Midterm Exam
	10/18, 10/20	BioMEMS for cellular studies/tissue engineering
<u>Wk 09</u>	10/23, 10/25, 10/27	BioMEMS for DNA/protein analysis
<u>Wk 10</u>	10/30, 11/01, 11/03	Nanobiosensors I
<u>Wk 11</u>	11/06, 11/08, 11/10	No Class. Out-of-campus for a MicroTAS 2006 Conference
<u>Wk 12</u>	11/13, 11/15, 11/17	Nanobiosensors II
<u>Wk 13</u>	11/20	World-to-Chip Interfacing and Packaging
	11/22, 11/24	No Class. Fall Recess & Thanksgiving
<u>Wk 14</u>	11/27, 11/29, 12/01	Class Presentation
<u>Wk 15</u>	12/04, 12/06	Recent and future trends in BioMEMS and Nanobiosensors
	12/08	Final Exam