BME510/I7700: Microfluidic Devices in Biotechnology

The City College of New York

BME 510: Fundamentals of modern microfluidic devices with applications to biomedical measurements, e.g., electrophoretic systems, flow cytometers, and immunoassays. Review of fundamental properties of microfluidic systems including the effects of fluid mechanics, heat transfer, and electromagnetic phenomena on biological systems. Critical overview of design, manufacture, and operation of micrometer scale systems that use photolithographic and surface treatment techniques for device development.

Lectures:

Mondays	11:00AM-12:15PM	ST-402
Wednesdays	11:00AM- 2:50PM	ST-508/ASRC

Instructor:

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Office Hours: Mondays 2PM-3PM and by appointment as necessary.

Pre/Co-Requisites: All students must have completed an undergraduate fluid mechanics or transport course (e.g. ME356 or ChE341) as well as an undergraduate wet laboratory course (e.g. BME310) NO EXCEPTIONS.

Readings: Assignments uploaded onto blackboard.com must be read prior to lectures.

Lateness: Students are expected to attend every lecture in a prompt fashion. *Please silence electronic devices during each class*. Students who must use a cell phone for emergency purposes are asked to please do so outside of the classroom.

Participation: Class participation in lecture counts! Ask questions and be ready to discuss questions posed in class. Students don't always have to know the right answer, but should be prepared to guess intelligently. Each student should ask and answer multiple questions every lecture.

Lecture Format: Be prepared to brainstorm in small groups during each lecture and to give feedback in a one-minute paper format. Each lecture will generally follow the format shown below:

Administrative Items	5 min
Technical Lecture	40 min
Group Problem Solving	15 min
Discussion	15 min

Exam and HW: One midterm examination will be administered during this course. It will be OPEN BOOK/OPEN NOTES and will consist of problems with multiple parts. No makeup exams will be permitted unless the student can document an emergency. Five homework sets will be assigned throughout the semester. Assignments are due at the beginning of class and will NOT be accepted late.

Laboratories: The course is largely based on micro-manufacturing laboratories required of all students. Labs will be conducted during 10 dedicated class times as shown on the syllabus. One comprehensive laboratory report and device must be submitted as part of the course.

Grade Distribution:

Homework Sets (5 of 5)	**20%**
Midterm Exam	**20%**
Design and Laboratory Report	**25%**
Poster Presentation	**25%**
Class Participation/Effort	**10%**
	100%

Academic Integrity: Students are welcomed and encouraged to discuss homework problems, lecture material, laboratory exercises/reports, and technical analysis with all their classmates, as well as proofread each other's documents. Students Cannot: (1) Use data from another group without explicit instructor permission; (2) Copy (even in part) text from another report (including previous years); (3) Collaborate during examinations. Students who copy OR allow their work to be copied will be de-registered from the course and subject to investigation by the Grove School of Engineering (GSOE).

Course Outcomes: Upon course completion, students will demonstrate abilities to:

1. Successfully analyze a contemporary microfluidic flow problem by considering the underlying transport phenomena and dimensional constraints.
2. Develop and evaluate microscale designs that address bioengineering challenges and spatial constraints including consideration of manufacture, materials, and operation.
3. Fabricate microscale devices used for engineering analysis and/or system throughput.

Lec	Date	Topics Discussed	Due
1	08.28.17(M)	Introduction and Course Overview	Diagnostic
2	08.30.17(W)	Review of Math/ Fluid Mechanics*	***MV OUT**
	09.04.17(M)	**NO CCNY CLASSES**	
3	09.06.17(W)	Review of Heat Transfer/Thermodynamics	
4	09.11.17(M)	Overview of Key Microfabrication processes Photolithography (Technical Lecture)	HW 1 (Transport)
5	09.13.17(**W**)	Overview of Clean Room Spaces and Lab Safety **CCNY LAB 1** (Photolithography)	HW 2 (Pre-Lab 1)
6	09.18.17(M)	Discussion of Results from CCNY LAB 1	
	09.20.17(W)	**NO CCNY CLASSES**	
7	09.25.17(M)	Preview of ASRC LAB 2/ Lab Safety	
8	09.27.17(**W**)	**ASRC LAB 2** (Photolithography)	HW 3 (Pre-Lab 2)
9	10.02.17(M)	Discussion of Results from ASRC LAB 2 Surface Bonding and Micromolding (Technical Lecture)	
10	10.04.17(**W**)	**CCNY LAB 3** (PDMS Stamping)	HW 4 (Pre-Lab 3)
	10.09.17(M)	**NO CCNY CLASSES**	
11	10.11.17(W)	Discussion of Results from CCNY LAB 3*	***MV OUT**
12	10.16.17(M)	Etching (Technical Lecture: Trevino)	
13	10.18.17(**W**)	**ASRC LAB 4** (DRIE and Wet Etch)	HW 5 (Pre-Lab 4)
14	10.23.17(M)	Discussion of Results from ASRC LAB 4 Midterm Review	
15	**10.25.17(W)**	**MIDTERM EXAM**	
16	10.30.17(M)	Vapor Deposition (Technical Lecture: Trevino)	
17	11.01.17(**W**)	Chemical Vapor Deposition (Technical Lecture: Trevino) Metrology (Technical Lecture: Trevino)	
18	11.06.17(M)	Microfluidic Designs (Technical Lecture)	
19	11.08.17(**W**)	**ASRC LAB 5** (DRIE, CVD Demo)	

20	11.13.17(M)	Discussion of Results from ASRC LAB 5	
21	11.15.17(**W**)	Microfluidic Design Projects (Teams)	
22	11.20.17(M)	Open Design Meetings	
23	11.22.17(**W**)	Team Design Revision 1	Design Rev 1
	11.23.17 (TH)	**THANKSGIVING DAY**	
24	11.27.17(M)	Finalized Design	Design Rev 2
25	11.29.17(**W**)	**ASRC LAB 6** (Comprehensive, design microfabrication)	
26	**12.04.17(M)**	**OPEN ASRC LAB 7**	
27	**12.06.17(W)**	**OPEN ASRC LAB 8**	
28	12.11.17(M)	**DESIGN POSTER PRESENTATIONS** (15-min each)	
	12.20.17(W)	**Design Laboratory Reports Due**	