Microfluidic Chip Design and Fabrication
BIOEN 5701 & 6701; MEEN 5730 & 6730

Class Time: Tuesday 2:00 – 3:30 PM in WEB L126
Lab sessions to be determined. Will be held in various locations.
Computer lab reserved WEB L224 CADE Lab Windows

Instructor: Dr. Bruce Gale
Office: 3711 SMBB
Telephone: 801-585-5944
E-mail: bruce.gale@utah.edu
Office Hours: 3:30 – 5:00 PM Tuesdays
Other times by appointment

Lab Assistant: Valentin Romanov vromanovaus@gmail.com SMBB 3800
Class Web Page: Canvas access through CIS

Text: No required text. Class notes and handouts will be the basis of the literature for the class.
Articles from research journals and select sections from reference books listed below. I will post
lecture notes in PDF on Canvas. When available, supplementary materials will be posted on the
Canvas as well.

Supplemental Texts:
1. N.-T. Nguyen and S. T. Wereley, Fundamentals and Applications of Microfluidics, Artech House,
   Boston, MA, 2002.
2. G. Karniadakis and A. Beskok, Micro Flows: Fundamentals and Simulations, Springer-Verlag,

Objectives
1. To gain an understanding of microfabrication techniques used in the construction of microfluidic
   systems.
2. To know the major classes, components, and applications of microfluidic systems and to demonstrate
   an understanding of the fundamental principles behind the operation of these systems
3. To understand and be able to use tools for simulating microfluidic systems
4. To understand the unique requirements, environments, and applications of microfluidics in
   biomedical applications.
5. To apply knowledge of microfabrication techniques and applications to the design and simulation of a
   microfluidic system.
6. To make the study of microfluidics enjoyable

Grading
Grades will be based on the standard >90% = A, 80-90% = B, 70-80% = C, 60-70% = D, and <60% = E. In
the event that grades are abnormally low, the required scores will be adjusted accordingly.

Lab and Lab Notebooks 30%
Project Presentations 20%
Project Report 30%
Quizzes and Homework 20%

Quizzes and Homework
Quizzes will be given on Canvas for weekly reading materials. Quizzes will cover the material in
assigned readings and will consist of 5-7 basic questions. Homework will be assigned as needed to
enable practice on specific areas of the class.
Lab Notebooks
During the course, you are required to keep a record of your work (simulations, experiments, designs, results, etc.) in a lab notebook. Lab notebooks will be reviewed during each lab section to review the previous week’s lab to be examined/graded by the course instructors. Lab notebooks will be available for pickup during the week following the finals week.

Project Report
Each individual/group will prepare a final 7-10 page report on their design and findings for their project. The report guidelines will be distributed via Canvas. The report will be due May 3.

Mixer Presentations
Each mixer group will prepare and give three presentations describing their design and findings. The presentations will take place as noted on the schedule. In addition to my evaluations, the presentations will be scored by your classmates.

Schedule
All topics listed in this outline will be covered in class. The schedule is subject to change and changes to the published schedule will be announced in class and on the web page. Note especially that lab topics may change due to equipment availability. Additional assignments may be made if deemed necessary by the instructor.

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<thead>
<tr>
<th>Class</th>
<th>Date</th>
<th>Topic</th>
<th>Weekly Lab</th>
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<tr>
<td>1</td>
<td>10-Jan</td>
<td>Introduction to the Course / What is Microfluidics?</td>
<td>Microfluidics Introduction</td>
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<td>Basic Microfluidic Physics</td>
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<td>2</td>
<td>17-Jan</td>
<td>Micromixing</td>
<td>Laser Lab/laminates</td>
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<td>3</td>
<td>24-Jan</td>
<td>Microscale fluid flow</td>
<td>Modeling I: Introduction to COMSOL</td>
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<td>4</td>
<td>31-Jan</td>
<td>Experimental Flow Characterization</td>
<td>Mixer design/drafting</td>
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<td>Presentations on project concept</td>
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<td>5</td>
<td>7-Feb</td>
<td>Microfluidic Fabrication</td>
<td>Modeling II: Simulation and Analysis in COMSOL</td>
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<td>6</td>
<td>14-Feb</td>
<td>Microfluidic Fabrication/Packaging</td>
<td>Mixer Modeling</td>
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<td>7</td>
<td>21-Feb</td>
<td>Microfluidic Integration</td>
<td>3D Mixer Modeling</td>
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<td>28-Feb</td>
<td>Microvalves</td>
<td>Mask Design</td>
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<td>8</td>
<td>7-Mar</td>
<td>Micropumps</td>
<td>Lab Safety and Facilities Tour</td>
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<td>14-Mar</td>
<td>SPRING BREAK</td>
<td>SPRING BREAK</td>
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<td>10</td>
<td>21-Mar</td>
<td>Inertial Microfluidics</td>
<td>Master Fabrication</td>
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<td>11</td>
<td>28-Mar</td>
<td>Highly Parallel Microfluidics/Digital Microfluidics</td>
<td>Soft Lithography and Packaging</td>
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<td>12</td>
<td>4-Apr</td>
<td>Microfluidic Lab-on-a-Chip</td>
<td>Mixer Characterization</td>
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<tr>
<td>13</td>
<td>11-Apr</td>
<td>Microfluidic Lab-on-a-Chip</td>
<td>Mixer Characterization</td>
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<td>14</td>
<td>18-Apr</td>
<td>Paper Fluidics; Nanofluidics</td>
<td>Revised Mixer Characterization</td>
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<td>15</td>
<td>25-Apr</td>
<td>Presentations on Micromixers</td>
<td>No labs</td>
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<td>16</td>
<td>2-May</td>
<td>Final Presentations: 1:00 – 3:00 PM</td>
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General Class Policies
1. Attendance: Failure to attend more than 50% of presented lectures will result in failure of the class unless extenuating circumstances exist.
2. Cheating and Shared Work: Cheating on in-class assignments and exams will result in a zero on that assignment. Shared work on take home assignments will result in a shared grade.