EMCH 562 - Micro/nanofluidics and Lab-on-a-Chip

**Credit hours** – 3  **Contact hours** – 75 minutes MW

**Instructor** – Guiren Wang


**Specific Course information:**

a. **EMCH 562** - Micro/nanofluidics and Lab-on-a-Chip (3) Basic fluid mechanics, capillary, drop and micro/nanoparticle, electrokinetics; Micropump, mixer, preconcentrator, electrophoresis, microactuator and particle manipulator; Separation based on electrokinetics; Sensors for pressure, velocity, concentration, temperature in environmental monitoring/biodefence, clinical diagnostics, drug discovery/delivery.

b. **Prerequisites:** Upper division and CHEM 112/L, PHYS 212

c. **Mechanical Engineering Elective**

**Course Goals:**

a. **Outcomes**

1. Student will demonstrate an understanding of some advanced fluid mechanics relevant to micro/nano scale device.
2. Students will demonstrate an ability to design and analyze microfluidic devices
3. Students will demonstrate a basic understanding of principle and processes of microfluidic device testing and characterization
4. Students will demonstrate and understanding of lab-on-a-chip and the impact of microfluidics device for application in life science
5. Students will demonstrate and ability to make reasonable decisions about the microfluidic device, selection, options and performance

b. **Relationship of Course to Program Objectives:** The importance of each course objective to meeting the program outcomes is indicated with the following scale: 3 = major importance; 2 = moderate importance; 1 = minimal importance. Blank if not related

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<thead>
<tr>
<th>Program Outcomes (see list for complete description)</th>
<th>Course Outcomes</th>
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<tr>
<td></td>
<td>CO 1</td>
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<tr>
<td>1.1. analyze, design and realize</td>
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<td>1.2. computation techniques</td>
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<td>1.3. design and interpret experiments</td>
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<td>1.4. apply linear algebra, calculus</td>
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<td>1.5. apply statistical methods</td>
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<td>1.6. understand chemistry and physics</td>
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<td>2.1. engineering economic analyses</td>
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2.2. plan and execute projects 1 1 2 1
2.3. oral and written communications 2 1 1 1
2.4. professional responsibility 1
2.5. multi-disciplinary teams 1
2.6. life-long learning 1 1
3.1. engineering in modern society 2
3.2. literature, arts, humanities.
3.3. foreign language

**Topics:**

The general outline of this course consists of:

1. Introduction of microfluidics and lab-on-a-chip, basic principle of fluid mechanics, boundary conditions 2 weeks
2. Capillary, drop and micro/nanoparticles
   Unidirection flow 2 weeks
3. Hydraulic circuit analysis, passive scalar transport 2 weeks
4. Electrostatics, electroosmosis 2 weeks
5. Electric double layer 1 week
6. Zeta-potential 1 week
7. Nanofluidics and application 1 week
8. Microfluidic components: micro-pump, preconcentrator, electrophoresis and particle manipulator 1 week
9. Experimental measurements: sensors for pressure fluorescence, measurement of flow velocity temperature and concentration 1 week
10. Applications: biosensor in environmental monitoring and biodefence, clinical diagnostics, drug discovery and delivery 1 week

Prepared by Guiren Wang 1/26/10
Steve McNeill formatted for ABET 2011 – 3/9/11
Approved by Guiren Wang 3/14/11