SYLLABUS
MfgE 531 – Micromanufacturing

Instructor: Professor B.K. Paul
219 Dearborn Hall
(541)737-7320 (OSU)
(541)713-1332 (ATAMI)
brian.paul@oregonstate.edu

Office Hours: 15:30-17:00 TR

Course Structure: This is a 4-credit lecture + laboratory course planned to be offered every fall term.

Lecture: 14:00-15:20 TR, 213 Strand Agricultural Hall

Assistant: Kijoon Lee
Office Hours: By request
leekij@onid.oregonstate.edu

Laboratory: 10:00-11:50; 14:00-15:50 F
MIME Computer Lab (336 Rogers)
Advanced Tech and Mfg Institute (HP Bldg 11)

Course Description: Introduction to microsystem platforms, scaling laws and size effects in micromanufacturing techniques with an emphasis on microchannel arrays, microchannel lamination and micro-scale characterization.

Text: Required readings will be made available on-line over the course of the term.

Website: Canvas

Course Objectives:
The objective of this course is to provide the background and skills for developing manufacturing plans in support of products with micrometer-scale dimensions. Students will be introduced to the concepts, theory and practice surrounding micromanufacturing techniques used at the Advanced Technology and Manufacturing Institute on the Hewlett Packard campus in Corvallis, OR. Throughout the term, microchannel process technology will be used as a means to explore the intricacies of process design in support of research and commercial objectives. Specific learning outcomes include:

1. Distinguish various miniaturization technologies and microsystem platforms.
2. Demonstrate the advantages of microchannel scaling laws through analysis.
3. Document the design of a microchannel array.
4. Describe the geometric attributes of importance at both a lamina and device-level and how to characterize these attributes.
5. Determine appropriate material and processing techniques and conditions needed to reliably manufacture a microchannel device.
6. Describe potential defects for various micromanufacturing processes.
7. Develop a tool design for a micromanufacturing process step.
8. Develop a cost estimate for a device based on cycle time, equipment, utility and material estimates for various processes.

**Grading:** Letter option only (A-F)

Course grades will be based upon a normal curve distribution of scores. Specifically, course grades will be based as follows:

| Laboratory | 25% | Homework | 15% |
| Midterm Exam | 20% | Final Exam | 25% |

Cost Modeling Project: 15%

**Course Outline:**

<table>
<thead>
<tr>
<th>Wk</th>
<th>Date</th>
<th>Lecture Topic</th>
<th>HW due</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>21-Sep</td>
<td>Microsystem Platforms</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>26-Sep</td>
<td>MPT Unit Operations</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>28-Sep</td>
<td>MPT Scaling Law Analysis</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3-Oct</td>
<td>Lasers</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>10-Oct</td>
<td>Laser Welding</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>12-Oct</td>
<td>Photochemical Machining</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>17-Oct</td>
<td>Diffusion Bonding</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>24-Oct</td>
<td>Micromachining</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>31-Oct</td>
<td>Microforming</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>2-Nov</td>
<td>Cost Modeling</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>7-Nov</td>
<td>Geometric Dimensioning &amp; Tolerancing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9-Nov</td>
<td>Shape Variation in Micromanufacturing</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>14-Nov</td>
<td>Metrology and Characterization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16-Nov</td>
<td>Tool Design 1</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>21-Nov</td>
<td>Tool Design 2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>23-Nov</td>
<td>THANKSGIVING</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>28-Nov</td>
<td>Verifying Cost Models</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>30-Nov</td>
<td>Cost Modeling Presentations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Final</td>
<td>TBD FINAL</td>
<td></td>
</tr>
</tbody>
</table>

**Policies:**

**Academic Dishonesty:**
Students are expected to be honest and ethical in their academic work. Academic dishonesty is defined as an intentional act of deception in one of the following areas:

- cheating - use or attempted use of unauthorized materials, information or study aids
- fabrication - falsification or invention of any information
- assisting - helping another commit an act of academic dishonesty
- tampering - altering or interfering with evaluation instruments and documents
- plagiarism - representing the words or ideas of another person as one's own

If academic dishonesty is observed or suspected, students are required to report this to the course instructor. The source will be held in strict confidence. Prosecution of documented cheating will be carried out to the fullest possible extent. This will include assignment of a deferred grade and prosecution through the department and college. Penalties can range from assignment of an “F” grade through permanent expulsion from the University.

**Grade Appeals:**

Appeal of grading of projects or homework must be done neatly in writing on an 8½ x 11 inch white paper with the heading as follows:

From: (Name)
To: Professor B.K. Paul
Date: (date)
Subject: (Example: Midterm grading)

This heading should be followed by a description of the appeal, including problem or question number if appropriate, in a concise business-like memorandum format.

**Absence:**

The making-up of missed laboratories must be appealed using the same format as for Grade Appeals. A valid excuse for your absence (e.g. hospitalization, emergency medical treatment, etc.) must accompany the appeal memo. The appeal must be addressed to Professor Brian K. Paul and delivered to 204 Rogers within one week of the absence. If absence from a laboratory or lecture is anticipated (e.g. interview trip), then the student must notify the instructor beforehand so that suitable arrangements can be made. An interview trip is not a valid excuse after the fact. Laboratory make-up must be handled independently with the laboratory instructor.

**Laboratory and Homework:**

Several laboratories and homework assignments will be made during the course of the term. Some laboratories will be conducted in groups and some will be individual. For laboratories conducted as groups, one laboratory grade will be given to the entire group. Individual laboratory grades may be assigned based on participation or other individual metrics and will be at the discretion of the laboratory instructor. Late submissions for all
assignments are to be submitted to the administrative assistants in 204 Rogers and will have 50% deducted from the maximum points available for each day late.
Laboratory Participation:
The laboratory instructor will supply a laboratory grade at the end of the term. Criteria for this grade may include attendance and participation.

Laboratory Safety:
In the laboratory, students are required to adhere to all safety procedures including appropriate attire. Do not begin to operate equipment of any type if you are not fully familiar with the operating procedures, shut-down procedures, and safety instructions of the equipment. Additional safety requirements specified by the laboratory instructor must be adhered to. **When in doubt, the laboratory instructor has final authority in all safety-related matters.**

Any student not adhering to the established safety instructions will be dismissed from the laboratory for that lab and will not be allowed to make-up the laboratory. The laboratory instructor has authority to dismiss students not adhering to the safety rules.

Expectations for Student Conduct:
Students are expected to be honest and ethical in their academic work. Academic dishonesty is defined as an intentional act of deception in one of the following areas:
- Cheating - use or attempted use of unauthorized materials, information or study aids
- Fabrication - falsification or invention of any information
- Assisting - helping another commit an act of academic dishonesty
- Tampering - altering or interfering with evaluation instruments and documents
- Plagiarism - representing the words or ideas of another person as one's own

If academic dishonesty is observed or suspected, students are required to report this to the course instructor. The source will be held in strict confidence. Prosecution of documented cheating will be carried out to the fullest possible extent. This will include assignment of a deferred grade and prosecution through the department and college. Penalties can range from assignment of an “F” grade through permanent expulsion from the University. For further information, visit [http://studentlife.oregonstate.edu/studentconduct/offenses-0](http://studentlife.oregonstate.edu/studentconduct/offenses-0).

Students with Disabilities:
Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at [http://ds.oregonstate.edu](http://ds.oregonstate.edu). DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.