EMAT 354 – Materials and Physical Metallurgy Lab
Spring 2012

Course Outline

Lecture: Mon. 2-2:50 –ELC 106
Lab: Mon. 3-5:00 –ELC 101

Instructors: Dr. Alan Meier Dr. Sudhakar KV
ELC 212 ELC 218
X4305 X4267
ameier@mtech.edu kvsudhakar@mtech.edu

Office Hours: Al Meier KV Sudhakar
Tu/Th: 11:00-12:00 M-F 1:00 -2:00
Wed: 2:00-3:00 or by appointment
or by appointment

Text: None -Lab Handouts will be provided along with suggested reading

Credits: 1 credit (lecture and lab).

Prerequisites: EMAT 351 and EMAT 352 or equivalent introductory physical metallurgy courses and labs, graduate standing, or instructor permission.

Goals: This course is a continuation of EMAT 352 and it is a required course in Metallurgical and Materials Engineering. The objectives of this course are the same as for EMAT 352:

1. To gain practical experience with the processing, microstructure and performance of materials.
2. To gain practical experience with the relationships between them.

While EMAT352 examined ferrous alloys, the labs in this course will focus on non-ferrous alloys and non-metallic materials. Good lab practice, lab safety, data analysis, and technical writing will again be emphasized.

Laboratories:

1. Aluminum Casting 2 weeks 50 points
2. Precipitation Strengthening of Aluminum 1 week 30 points
3. Cold Work and Annealing of Copper 3 weeks 80 points
4. Grain Growth/Strengthening of Brass 2 weeks 60 points
5. Corrosion 1 week 30 points
6. Creep 1 week 25 points
7. TBD (Possibly Ti or Ceramic) 1 week 25 points
**Grading:** The grade in this course will be based on 7 lab reports and class participation. Additional points may be given for an exceptional lab write-up.

<table>
<thead>
<tr>
<th>Lab Write-ups (~90%)</th>
<th>300 pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Participation/Attendance (~10%)</td>
<td>30 pts</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>330 pts</strong></td>
</tr>
</tbody>
</table>

**Safety:** This semester, we will be working with chemical etchants, hot furnaces, and rotating equipment. For all labs, long pants or full-length lab coats are required. No sandals or open-toed shoes are allowed. Safety glasses are required at all times.

For chemical etching, latex gloves are required and chemical safety goggles are required when working with strong acids. Contact lenses should not be worn when working with chemicals.

For furnace testing, the appropriate thermal gloves and silver suits/face shields should be worn depending on the temperature. The lab instructor or TA will specify the

When working with the rolling mill or other rotating equipment, no ties or scarves should be worn and your sleeves should be rolled up to avoid getting anything caught in the machinery.

**Special Accommodations:** If you have a documented learning disability and need extra test time or other accommodations, please see me and I will make my best to accommodate your needs.

**Academic Dishonesty:** In general, academic dishonesty will not be tolerated. You will be practicing engineers in a few years. Integrity and competence are critical to your professional success. Developing bad habits in college will hinder your professional development and will weaken the prestige of your degree. You can discuss your labs with your fellow students but you need to generate your own reports. The use of lab reports from previous years (“files”) or copying from other class members is not acceptable and will result in a failing grade for that lab.
Lab Outline:

Tentative Schedule: This schedule may shift slightly during the semester.

<table>
<thead>
<tr>
<th>Week of</th>
<th>Experiment</th>
<th>(Points)</th>
<th>Data Due</th>
<th>Lab Due</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/23-1/27</td>
<td>Exp #1: Aluminum Casting (50)</td>
<td></td>
<td>2/3</td>
<td>2/13</td>
</tr>
<tr>
<td>1/30-2/3</td>
<td>Exp #1 (Continued)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/6-2/10</td>
<td>Exp #2: Precipitation Strengthening of Aluminum (30)</td>
<td>2/10</td>
<td>2/220</td>
<td></td>
</tr>
<tr>
<td>2/20-2/24</td>
<td>No Lab (President's Day)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/27-3/2</td>
<td>Exp #3: (Continued)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/5-3/9</td>
<td>Exp #3 (Continued)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/12-3/16</td>
<td>No Lab (Spring Break)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/19-3/23</td>
<td>No Lab (Finish up copper lab)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/26-3/30</td>
<td>Exp #4: Grain Growth/Strengthening of Brass (60)</td>
<td>4/5</td>
<td>4/13</td>
<td></td>
</tr>
<tr>
<td>4/2-4/6</td>
<td>Exp #4 (Continued)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/9-4/13</td>
<td>Exp #5: Corrosion (30)</td>
<td>4/16</td>
<td>4/26</td>
<td></td>
</tr>
<tr>
<td>4/30-5/4</td>
<td>No Lab: Make-up if needed</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Shared group data are due by 5:00 on the dates specified. The lab format is described in the next section. Labs are due at the start of class (2:00) or at 5:00 if no class is scheduled on the due date.

EMAT 354 Lab Reports

The goal of the laboratory is to provide applied demonstrations of several important materials engineering concepts including concepts presented in the EMAT 251/351 lectures. This may require reviewing material from EMAT 251/351; and research utilizing handbooks and testing standards.

The lab write-ups should focus on the presentation and analysis of the test data and the sample microstructures/macrostructures.
The following lab format is recommended (you may use another format if it is neat and clearly presents your results):

1. Title Page:  
   EMAT 354 
   Experiment #X- Title 
   Your Name 
   Date 

   Executive Summary: What did you do and what were your most significant results? 
   (One short paragraph.)

Skip the Introduction section and only describe deviations from the lab manual for the Experimental Procedure.

2. Results: Figures and Tables. Figure and table captions should clearly describe the data presented (e.g. type of test, temperature, strain rate, gage length, magnification). Examples:

   Figure 1: Engineering stress versus engineering strain curve for a 6061 aluminum rod tested in tension at room temperature. The rod had an initial diameter of 20 mm and a 15-mm-gage-length. The rod was water quenched from 600°C followed by 3600 s (60 min.) at 180°C.

   Figure 3: Pearlite/ferrite microstructure of a 1045 steel, air cooled from 1000°C. Light micrograph (500X). Sample was polished to 6 µm with diamond compound and etched with 2% Nital solution.

   All figures and table should be referenced in the text prior to presenting.

   Fit graphs with approximate curves. Do not connect the dots.

   Include scale (micron markers) on all photomicrographs.

3. Discussion: Discuss results and answer any questions from the lab handout or class discussion. Did the data behave as predicted from theory? Why not? What are sources of error?

4. Conclusions: Most significant results and observations. (Similar to executive summary.)

5. References (If applicable).