

**Department of Materials Science and Engineering**  
University of Maryland, College Park, Maryland

**ENMA 472: Technology and Design of Engineering Materials**

**Course Description:** Relationship between properties of solids and their engineering applications. Criteria for the choice of materials for electronic, mechanical and chemical properties. Particular emphasis on the relationships between the structure of solids and their potential engineering applications.

**Pre-requisites:** ENES 230 or consent of instructor

**Textbook:**

- R.A. Flinn and P.K. Trojan, Engineering Materials and Their Applications, 4<sup>th</sup> ed., John Wiley and Sons, 1995.
- Selected readings from the current literature will also be required.

**Course Goals to meet ABET 2005 Criteria:**

The objective of this course is to explore the relationships between structure, properties and applications and how this can be used in materials and process selection and design. Students satisfactorily completing the class will:

1. Be able to make materials selection decisions based on material properties and process variables for metals, ceramics, polymers, semiconductors and composites.
2. Understand the relationship between property development and manufacturing processes and process variables.

**Topics Covered:**

- I. Introduction and Review: Bonding, crystal structures, planes and directions, non-crystalline and semi-crystalline materials, microstructure and its potential effects on properties, band model of solids, binary phase diagrams
- II. Properties of Materials and Their Relationship to Electronic Structure, Crystal Structure, Microstructure and Processing/Manufacturing:
  - Mechanical Properties
  - Optical Properties
  - Electrical Properties (conductors, superconductors, semiconductors and dielectrics)
  - Thermal Properties
  - Magnetic Properties
  - Environmental Stability
  - Composite Materials – what is a composite?, composites with “scalar” properties and composites with “new” properties
- III. Case Studies- including student presentations

Note: In order to examine the effects of processing on structure, microstructure and property development, we will not necessarily follow the book (or even any given chapter) in the order presented in the textbook.

**Class Schedule:** Tuesday, Thursday 9:30-10:45 a.m. in CHE 2136

**Grading:**

|              |     |                                                                                                                                                 |
|--------------|-----|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Termpaper    | 20% | (due Thurs. <b>April 24, 2003</b> ; topic due <b>Feb. 11</b> , 5 possible references <b>AND</b> outline <b>OR</b> abstract due <b>Feb. 27</b> ) |
| Presentation | 10% | 8 min. + 2 min. questions (May 6, 8 and 13, 2003)                                                                                               |
| Midterm I    | 20% | Tues. March 11, 2003, tentative date                                                                                                            |
| Midterm II   | 20% | Tues. April 28, 2003, tentative date                                                                                                            |
| Final Exam   | 25% | Sat. May 17, 2003 8:00 am – 10:00 am ( <b>Sched.</b>                                                                                            |

**Classes**

Homework 5%

Homework is graded on a  $\square+$ ,  $\square$ ,  $\square-$  basis; it is intended to give students a chance to practice with concepts and critical thinking skills in an environment where mistakes are not "costly". While general concepts may be discussed with classmates, homework is **NOT** to be a team effort unless specified.

**University Code of Ethics:** <http://www.inform.umd.edu/CampusInfo/Departments/JPO/>

**Instructor:** Dr. Isabel Lloyd  
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**2138 CHE (Bldg. 090)**  
**email:** [illoyd@eng.umd.edu](mailto:illoyd@eng.umd.edu)

**Office hours:** TBA – note, you are always welcome to stop by and see if I can answer questions outside office hours or to email me to set up an appointment.

**Termpapers:**

- Your termpaper should focus on the relationship between and the structure and properties of a material and a specific application or set of applications. The use of particular manufacturing techniques or processes to achieve the desired properties is appropriate but it is also acceptable to focus on properties that are not strongly manufacturing or microstructure dependent. Remember that depth as well as breadth is important when you choose your topic and write your paper.
- You may choose a topic related to a job or thesis, but, you may NOT choose a topic central to your job or thesis. If you choose a topic related to a job or thesis you must indicate that you are doing so. Topics must be approved ahead of time (see grading).
- Specifics:
  - The paper should be about 15 pages counting figures.
  - The paper should contain about 5-20 references, at least 2 of which come from current refereed literature ( $\geq 1998$ ). You should not depend entirely on review articles, textbooks, or the internet! If you use "news release" type references (typically found on websites and in trade magazines) you should: 1) indicate that they are unrefereed, 2) analyze the content in the context of publicity information, and 3) severely limit the number of such references.

- **General Format (All papers must include the following)**
- Title page with an abstract or executive summary (your topic and your main "conclusions/results"). (Less than 1 page) **(Being able to succinctly state what you have done- in terms of "process" and results, and why it matters is a critical skill in the "real world".)**
- Table of Contents (Number each page in your paper)
- Introduction (1-2) pages  
What will be discussed in your paper in general terms.  
Why it is important to industry, to science, and/or to the public.  
Where it is used.
- Body (12-14 pages, including figures and tables)  
Survey and analysis of the literature on your topic. Evaluate what you read and "tie" it together. Annotated bibliographies are not acceptable. You should be comparing and contrasting the information from your sources and analyzing what it means.
- Summary ( $\leq 1$  page, your body should support your summary)
- References (Authors, title, and source. I prefer J. Am. Ceram. Soc. style, see a December issue for details.)
  
- **Credit for sources:**
- When you copy a figure, table, graph, etc. include the source in your figure caption or in a table footnote to make sure that it is properly attributed. (Remember you would need permission to use them if you were writing a paper for publication.)
- In the body, make sure you attribute ideas as well as data.  
For example: Lloyd [1] found that tiger snails travel at 10 mm/hr while Liu [2] found that tiger snails travel at 5 mm/hr. The difference is attributable to the different subspecies studied. Both results validate Smith and Jones' theory [3] on snail locomotion. This theory ...
  
- **Note:** Please make sure you understand the information you include and discuss. It is dangerous to include material you don't understand since that is usually where questions are pointed. It also tends to lower your credibility with respect to the rest of the paper.

### **Termpaper presentations**

- **8 minutes with 2 minutes for questions.** Your grade will suffer if your presentation is longer than 9 minutes or shorter than 7 minutes. Practice it ahead of time!!!
- Grades will be based on: 1) technical content (60%) – it should be appropriate, accurate, and understandable (the class is your target audience); 2) organization (20%) – purpose must be clearly stated, sufficient background should be given to make the talk interesting and understandable, and visual aids must be appropriate and readable; and 3) delivery (20%) – confident, audible, understandable, appropriate technical language, effective use of visual aids, within time limits

- You should plan on **no more than 1** transparency per minute- some transparencies may take several minutes to explain.
- Do NOT read your talk.
- Make sure your visual aids are readable (you should use at least 18 point font). If you use a figure or table from the literature make sure that the audience can read the axes, etc. also briefly acknowledge the source verbally – e.g. Jones published the following graph showing the effects of annealing in her 1999 paper OR include the full reference on your transparency).
- **If you wish to do a power point presentation you must bring your own recent laptop or convince a classmate to do so as well as give me enough warning to reserve a computer projector for the class.**