**Department of Materials Science and Engineering**

### University of Maryland, College Park, Maryland

## ENMA 463: Macroprocessing of Materials

# **Course Information**

# **Catalog Description:** Processing of modern, bulk engineering materials: raw materials, forming, firing, finishing and joining. Note: More emphasis will be placed on metals and ceramics than polymers.

**Pre-requisites:** ENMA 300 or consent of instructor

**Class Schedule:** TuTh 9:30-10:45 AM; CHE 2136

**Inclement Weather**: If the University of Maryland is closed or opens after 10am, or if the instructor believes it is unsafe to travel to College Park, there will be a shortened make-up lecture on-line. If the University opens at 10 am, class will begin at 10 am if Prof Lloyd can make it to campus.

**Instructor:** Prof. Isabel Lloyd

**Textbook:**

• J.W. Evans and L.C. DeJonghe, The Production of Inorganic Materials, Macmillan, 1991.

***Other sources:***

• Readings from the literature

• utube videos

• J.S. Reed, Introduction to the Principles of Powder Processing, Wiley, 2nd. Ed., 1995.

• W.D. Callister and DG Rethwisch, Fundamentals of Materials Science and Engineering: An Integrated Approach 4th or 5th Ed., John Wiley and Sons (ENMA 300 text).

**Course Description, Goals, and Expectations**

**Course Objectives:** The objective of this class is to examine the types of processes required to make discrete engineering components, especially polycrystalline ceramic and metallic components and engineering polymers. Processing and manufacturing are evolving areas so emphasis is placed on understanding what happens during process steps and the critical thinking skills necessary to effectively combine process steps in an overall process transferable to manufacturing.

**Learning Objectives: (Materials Science and Engineering Measurable Skills (MSEMS))**

1. Students apply experimental design to optimize a process or develop a new material.

2. Students understand the similarities between processing different classes of materials (metals, ceramics and polymers) as well as the differences.

3. Students will be able to identify the relationships between a processing method and resultant properties and microstructure.

4. Students will prepare a written paper on an issue in modern materials processing and a team oral presentation on the manufacturing

**Topics (see the course schedule on ELMS for details):**

I. Introduction

II. Experimental Design and Robust Design: How can we design experiments and processes to maximize the ratio of information gained/resources expended? How do we design materials and processes so that they are reproducible, reliable and meet specifications and customer needs? **Posted references and youtube videos**

III. Raw materials: What kinds of raw materials are used to produce metals, ceramics, polymers and composites? How can desirable components of raw materials be separated from undesirable components? **Chapters 1; 7.3; 8.4-8.6; 9.2-9.3; Callister**

IV. Powder processing **Chapters 4; 5; 6; 11; 12; 13; 14; 15; other sources**

a) Powder preparation

b) Shaping: pressing and slurry-based approaches

c) Densification: solid state and liquid phase sintering

V. Processing from the melt **Chapters 8.7, 8.8, 10, 12.6, 12.7, 16.2, 16.4, Callister; other sources**

VI. Deformation Processing **Chapter 10.3, Callister; other sources**

VII. Composites: How do you process mixed systems where the materials have different properties (bonding, density, size, shape, hydrophobic vs. hydrophilic etc.)? **Callister Chapter 15; other sources**

VIII. Characterization: chemical, physical, microstructural – integrated throughout the class in conjunction with processes as they are covered

**Course Procedures and Policies**

**Grading:**

Literature Project 12% Individual assignment – see posted rubric; Topic and potential references due 2/5/19 (1%); Detailed outline and 5 references (including 3 archival 2015 or later) due 2/19/19, (2%); Final paper due 3/14/19 (9%)

Manufacturing Pres. 10% Group Assignment – see posted details including rubric; includes self and peer evaluations; 4/11/19 and 4/18/19

Homework 12% About 6-7, see schedule

Midterm 22% Tentative Date: Thursday, 4/28/19

Final Exam 44% Friday, 5/17/19 from 8-10 am **(Office of Registrar)**

**Homework** 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.

**Participation:** Attendance is important since the text doesn’t cover everything many topics

## Exams: Exams will focus on concepts and students will be allowed to use self-generated study sheets.

**Literature Project:** Exploration of a current topic of current interest; must emphasize the **solid state** or **liquid phase** processing of a **bulk** (e.g. not thin film) material; consequences/results of the processing in terms of properties and applications **should** be included, but processing **MUST** be the main focus; topics must be approved; about 4-6 pages in length and include **analysis of multiple sources** including at least 3 current (2015 or later) archival articles. Details will be available on ELMS.

**Manufacturing Presentation:** Groups of 4-5; intended to provide a link between the more fundamental aspects of processing and the manufacturing where processes are combined to make products. More details will be available on ELMS.

**University Policies and Resources**

UMD policies for undergraduate classes and syllabi are provided on the university’s page of policies and resources [http://www.ugst.umd.edu/courserelatedpolicies.html.](http://www.ugst.umd.edu/courserelatedpolicies.html) This page includes links to resources related to each policy. Students should familiarize themselves with these pages, particularly the excused absence policy and the academic integrity policy.

**Attendance:** Regular attendance and participation in this class is the best way to grasp the concepts and principles being discussed. However, in the event a class must be missed, the University policy is available at:

<https://www.faculty.umd.edu/teach/#expectations> It is important to notify your instructors if you will need to miss a class as soon as possible, generally before the class unless you are so ill you can’t send an email.

**Academic Accommodations**: If you have a documented disability, contact Accessibility and Disability Support Services (0126 Shoemaker Hall). Students must provide a current ADS form for accommodations and discuss appropriate accommodations with instructor. The rules for eligibility and the types of accommodations a student may request can be reviewed on the DSS web site at <https://www.counseling.umd.edu/ads/>

**Academic Integrity:** It your responsibility to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit <http://www.shc.umd.edu/SHC/Default.aspx>

**CourseEvalUM Spring 2019**: Participation in the evaluation of courses through CourseEvalUM is a responsibility you hold as a student member of your academic community. Your feedback is confidential and important to the improvement of teaching and learning at the University as well as the tenure and promotion process. CourseEvalUM will be open for you to complete your evaluations for semester courses sometime in May 2019.

**Instructor:** Prof. Isabel Lloyd, Room 2309 CHE (Bldg. 090), [illoyd@umd.edu](mailto:illoyd@umd.edu), 301-405-5221

**Office Hours:** Wednesdays 1-2 pm, Thursdays 5:30-6:30 and by appointment (tentative)