ENMA 150: The Materials of Civilization - Fall 2018

A University of Maryland I-Series Course in Science and Technology

Course schedule:
Lecture: Tu/Th 3:30 – 4:45pm CHE 2108 (Chemical and Nuclear Eng. Bldg.)
Discussion section 0101: Wed 2:00pm –2:50pm CHE 2136 (Chem/Nucl. Bldg.)
Discussion section 0102: Thursday 11:00 –11:50 KEB 2111 (Kim Eng. Bldg.)

Course website: https://elms.umd.edu
Most course materials will be posted on the website and not handed out in class.

Instructor
R.M. Briber, Professor and Associate Dean
Department of Materials Science and Engineering
(301) 405-7313 rbriber@umd.edu
Office Location: Room 1109 Chemical & Nuclear Engineering Building (Bldg 090)
Office hours for Prof. Briber: Wednesday 1:00 – 2:00 PM
Thursday 12:00 – 1:00 PM

Appointments can be scheduled via e-mail. Appointments are not required but strongly encouraged!

Discussion Sections/Teaching Assistants
Discussion section 0101: Wed 2:00pm – 2:50pm Chem/Nucl Bldg, (CHE) Room 2136
TA: Justin Pearson jpearson7046@gmail.com
Office: Chem/Nuclear Eng. Bldg 1312A
Office Hours: Fridays 2:30-3:30 and by appointment

Discussion section 0102: Thursday 11:00am –11:50am Kim Eng. Bldg (KEB) Room 2111
TA: Austin Thomas athoma5@umd.edu
Office: Chem/Nuclear Eng. Bldg 2132
Office Hours: Thursdays 12 noon - 1pm and by appointment

Course Description
This course is a University of Maryland General Education (GenEd) I-Series Course and also meets the GenEd requirement in natural sciences. The course is a general introductory course to the field of materials science at the 100 level designed primarily for non-science or non-engineering majors.

The discovery of new materials has shaped history and built civilizations. Materials have played such an important role that scholars have named periods of history including the Stone Age, the Bronze Age and the Iron Age.

The study of world history generally focuses on wars, the rulers who governed and the formation and (subsequent) downfall of empires. Little if anything is said about the materials that have often lead to the success (and sometimes failure) of these empires. This trend continues in modern civilization with the advances in materials preceding many of the leaps in technology that we have come to take for granted as part of our society. For example: plastics are so common in every day living and every consumer good that it would be difficult to imagine the modern world with only the more “traditional” materials of wood, stone, ceramic and metal, yet modern plastics have been in wide use for less than
75 years. The computer and electronic revolution is completely built upon silicon and our ability to change the electrical properties of this most unusual material. Rapid, reliable, modern air transportation is completely dependent on the use of aluminum and other lightweight and strong materials. What are the future changes in materials that will lead to revolutions in our society? Advances in health care, the promise of nanotechnology, energy sustainability and the colonization of space are all exciting ideas with tremendous potential that will be predicated in some part on advances in the materials that may make these things possible.

This course will trace the utilization, properties and production techniques of materials from the Bronze Age up through modern times and into the future. We will start with a description of properties of the first materials utilized by man such as stone, fiber and copper. These materials, are explained by considering their atomic structure, the binding forces between atoms and their arrangement. The properties of iron and steel are explained along with the history of iron and steel making. The electronic properties of materials are also covered from a historical as well as from a scientific point of view.

Course Goals
I-Series Course Goals
- Look at complex questions and identify the science in the question and how it impacts and is impacted by political, social, economic, and ethical dimensions
- Understand the limits of scientific knowledge
- Critically assess and formulate basic science arguments
- Find information using various sources and evaluate the veracity of the information
- Communicate scientific ideas effectively
- Relate science to a personal situation

Additional Course Goals Specific to ENMA150
- A general understanding of different classes of materials and their structure
- A general understanding of the role of materials on advances in technology, society and civilizations, including the current (modern) age.
- Basic familiarity with technical writing through the 3 take-home materials projects and the final poster group research project. Also, basic familiarity with simple data analysis using Microsoft Excel (or other spreadsheet)

Text:

Additional Background reading:

There will be 4-5 guest and special lectures during the semester on different topics of modern materials. Materials from Guest Lectures will be covered on the exams.
Other Readings and Videos:
The 4 “Making Stuff” produced by PBS NOVA will be shown in Discussion Section. These are also available for viewing on ELMS in the Course Video -> Video Catalog section. A 2-3 page study guide for each video will be posted emphasizing the important points of the videos. Content from these videos is considered part of the course and may be on exams.

There will be other short readings posted on ELMS throughout the semester. These include:
“A Short History of Metals” by Alan Cramb

“SHARPER - Bob Kramer and the secret lives of knives” by Todd Oppenheimer (from The New Yorker 11/24/2008)
+ other readings as assigned.

Guest and Special Lectures
IMPORTANT Note: Attendance at guest lectures during class time is mandatory and attendance may be taken. Material from in-class guest lectures may appear on exams.


Tu 9/18 Dr. Timothy Foecke, National Institute of Standards and Technology
“How Did World Trade Center Twin Towers Come Down?”

Tu 10/2 Dr. Matthew Trexler, Under Armour
“Under Armour Materials and Innovation: Philosophy, Organization, and Select Examples”

Thu 11/1 Prof. Ichiro Takeuchi, Materials Science and Engineering Department
4:00 PM The Forum (room 1101), Clark Hall
“Robot Materials Science: Can Watson Beat Edison?”
Note the start time and location

Tues 11/6 Last name starts with the letters A-L; Project on Mechanical Properties; Class held in 1135 Kim Engineering Building (Last name starts with M-Z have no class on 11/6)

Thurs 11/8 Last name starts with the letters M-Z; Project on Mechanical Properties; Class held in 1135 Kim Engineering Building (Last name starts with A-L have no class on 11/8)

Tues 12/4 Poster Session – all groups will present their research poster on an advanced material during class time. The poster session will be held in: Chemistry Atrium (this is on the first floor outside the large Chemistry Lecture Rooms - room 1402).
# Grading

<table>
<thead>
<tr>
<th>Midterm</th>
<th>Thursday 10/25/2018 in class</th>
<th>100 points (20%)</th>
<th>The midterm closed book and is based on materials presented up to and including the lecture before the midterm. Material from guest lectures and videos may be on the exam. <strong>The midterm will be on Thursday 10/25/18.</strong></th>
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<tr>
<td>Review Sessions:</td>
<td>Mon 10/22 5-6pm Room TBD and Tues 10/23 5-6pm in TBD</td>
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<td>Reports for 3 take home Projects</td>
<td>Project 1 handed out Th 9/13; due T 9/25 Project 2 handed out Tu 10/2; due Th 10/11 Project 3 handed out 10/30; due: Tu 11/20 Data collection for Project 3: 11/6, 11/8 in Kim Eng. Bldg rm 1135</td>
<td>100 points each (10% each)</td>
<td>Project reports must be computer generated (typed) and follow the format that will be discussed in class, additional instructions are at the end of the handout for each project. Graphs must be done using a computer.</td>
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<td>Team Based Poster Project</td>
<td>on the characteristics of an advanced material. Possible subjects will be provided. Teams will be formed early to mid-semester by the instructor. Poster presentations (all groups) will be Tues 12/4 3:30–4:45pm Location: Chemistry Atrium – this is on the first floor outside the large Chemistry Lecture Rooms (room 1402).</td>
<td>100 points (15%)</td>
<td>There will be a poster session during class time at end of the semester (Tu 12/4) in the Chemistry Atrium where all posters will be presented. <strong>The final posters are due as a stapled collection of PowerPoint slides in class on 12/6/2018 (last class of the semester).</strong></td>
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<td>Final Exam</td>
<td>TBD: Tuesday, Dec. 18, 2018 from 10:30am-12:30pm in Room CHE2108 (normal lecture room) <strong>Note: I realize this is the last day of final exams and campus graduation is that evening(!), the final exam date/time for the course is set by the University and not open to negotiation</strong></td>
<td>100 points (15%)</td>
<td>Final exam will be cumulative on all course materials. The time and date for the final exam is scheduled by the University and cannot be changed see: <a href="http://www.registrar.umd.edu/current/registration/exam%20tables%20fall.html">http://www.registrar.umd.edu/current/registration/exam%20tables%20fall.html</a> Tues. 12/18/18 10:30am-12:30pm TBD: Room CHE2108 (normal lecture room). Material from guest lectures and videos may be on the exam.</td>
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<td>4 Homework sets and short papers</td>
<td>Note: Attendance at the invited lectures is mandatory (except were indicated). Attendance will be taken.</td>
<td>50 points each (5% each)</td>
<td>All written assignments must be computer generated (typed). Calculations can be done by hand.</td>
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<td>Total Points</td>
<td>Note: Some assignments will be graded for a different number of points than listed above and then scaled to the number of points in this list and then entered into ELMS.</td>
<td>$100 + 3*(100) + 100 + 100 + 4*(50) = 800$ points</td>
<td>The total points for the semester may deviate from 800 depending on the number of assignments, etc. In all cases an individual’s final grade will be based on a percentage calculated from # points/total # points.</td>
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Grading (cont.)

Some assignments may have extra credit parts to them. *There will be no extra credit assignments for individuals who want to bring their grade up.*

Generally the course grades follow the standard grading curve by default, though the instructor reserves the right to change the overall curve depending on the grade distribution. The final curve will be posted on ELMS when final grades are submitted.

The total points for the semester may deviate from 1000 depending on the number of assignments, etc. In all cases an individual’s final grade will be based on a percentage calculated from (individual’s # points)/(total # points in the course).

Typically in previous years the grading curve has been:

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<tr>
<th>ENMA150 Grading curve</th>
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Grades shown on ELMS are rounded to the nearest integer value to determine the letter grade.
Course Outline

I. Classification of Materials
   Metals, Ceramics, Polymers, Electronic Materials  Course Notes

II. Historical Development of Materials
    The first materials: Stone and Clay  Chapter 1 in Sass
    The first metals: Copper and Bronze  Chapters 2 and 3 in Sass
    Gold and Silver and the basis of wealth  Chapter 4 in Sass
    Mechanisms and Properties of Metals  Course notes
       The basics of structure
       The basics of mechanical properties
    The Discovery of Iron  Chapter 5 in Sass
    A New Material: Glass  Chapters 6 - 8 in Sass
    Steel: The Modern Metal  Chapters 9 - 11 in Sass

III. Polymers: A Modern Class of Materials  Chapters 12 in Sass and Course notes
    The Discovery of Polymerization
    Mechanisms and Properties:
       What are Polymers?
       The Unique Properties of Polymers
    The Growth of a Science and an Industry
    Modern Lifecycle of Plastics: Synthesis, Use and Recycling

IV. The Electronic Properties Materials  Chapter 15 in Sass
    The Age of Electronic Materials
    Mechanisms and Properties
    Basics of Electronic and Magnetic Properties
    The Semiconductor Revolution
    The Information Age

V. Other Modern Materials  Chapter 13 and 14 in Sass and Course Notes

Take-Home Materials Projects
There will be 3 project reports for the course, based on take home samples and a demonstration done in the materials teaching lab (room 1135 Kim Engineering Building) with the data posted on Blackboard.

   Project 1: **Shape Memory Alloys**  Handed out: Th 9/13  Due: Tues 9/25
   Project 2: **Superabsorbent Polymer**  Handed out: Tues 10/2  Due: Thurs 10/11
   Project 3: **Mechanical Properties**  Handed out: Tues 10/30  Due: Tues 11/20
      Data collection: Tu 11/6 & Th 11/8
Project Reports, Papers and Homework
In general, all assignments turned in for this course need to be prepared on a computer. There are numerous computer labs around campus and you can learn more about access from the campus office of information technology: http://www.oit.umd.edu

All sources in reports and papers must be referenced. It does not matter whether the source is a book, magazine, journal article or the web. All sources must be referenced.

In addition, any figures used in any papers or reports that are not created by you need to be referenced as to the source.

Reports, papers and homework will be due in class, in hard copy form with all pages stapled together. There will be a penalty for late work. It is not the instructor’s responsibility to keep unstapled pages together.

Collaboration and Working together on Homework and Other Individual Assignments
Working together on homework is encouraged but the document that is turned in must represent your own work in solving the homework problem. If it appears that any homework assignments have been copied directly from each other, all will receive a grade of zero for the assignment.

Additional Information
Access to ELMS http://elms.umd.edu/
Since the ELMS website is used extensively for distribution of course materials and announcements, it is important that you check it regularly. If you can’t login, you should follow the help instructions on the website home page. Neither the instructor or the T.A. can give you access to the website.

Copyright
Lectures and course materials, including power point presentations, tests, outlines, and similar materials, are protected by copyright. The instructors are the exclusive owner of copyright in those materials they create. Students may take notes and make copies of course materials for their own use. They may not, and may not allow others, to reproduce or distribute lecture notes and course materials publicly without the instructor's express written consent.

Email and other written communications
In general all written assignments will be collected as hard copy in class. Emailed documents will be accepted only by permission for special circumstances.

All email correspondence with the instructors and TAs should be written as a formal business communication with a salutation, complete sentences, capitalization and punctuation, no texting abbreviations and a closing with your full name and email address. All attachments should include a description of the nature of the document and your name as part of the file name. For example: ENMA150_HW3_JohnDoe.doc

A complete list of campus policies related to courses is here: http://www.ugst.umd.edu/courserelatedpolicies.html
**Academic Accommodations**
If you have a documented disability, you should contact Disability Support Services 0126 Shoemaker Hall. Each semester students with documented disabilities should apply to DSS for accommodation request forms which you can provide to your professors as proof of your eligibility for accommodations. The rules for eligibility and the types of accommodations a student may request can be reviewed on the DSS web site at [http://www.counseling.umd.edu/dss/start/eligibility/](http://www.counseling.umd.edu/dss/start/eligibility/)

**Religious Observances**
The University System of Maryland policy provides that students should not be penalized because of observances of their religious beliefs, students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences for religious observances in advance. Notice should be provided as soon as possible but no later that the end of the schedule adjustment period. Faculty should further remind students that prior notification is especially important in connection with final exams, since failure to reschedule a final exam before the conclusion of the final examination period may result in loss of credits during the semester. The problem is especially likely to arise when final exams are scheduled on Saturdays.

**Academic Integrity**
The University of Maryland has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student you are responsible for upholding these standards for this course. It is very important for you 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://shc.umd.edu/SHC/Default.aspx](http://shc.umd.edu/SHC/Default.aspx)

The University of Maryland is one of a small number of universities with a student-administered Honors Code and an Honors Pledge, available on the web at [http://shc.umd.edu/SHC/HonorPledgeInformation.aspx](http://shc.umd.edu/SHC/HonorPledgeInformation.aspx). The code prohibits students from cheating on exams, plagiarizing papers, submitting the same paper for credit in two courses without authorization, buying papers, submitting fraudulent documents, and forging signatures. The University Senate encourages instructors to ask students to write the following signed statement on each examination or assignment: “I pledge on my honor that I have not given or received any unauthorized assistance on this assignment/examination.”

**Attendance**
Regular attendance and participation in this class is the best way to grasp the concepts and principles being discussed. However, in the event that a class must be missed due to an illness, the policy in this class is as follows: For every medically necessary absence from class (lecture, recitation, or lab), a reasonable effort should be made to notify the instructor in advance of the class. When returning to class, students must bring a note identifying the date of and reason for the absence, and acknowledging that the information in the note is accurate. If a student is absent on days when tests are scheduled he or she is required to notify the instructor in advance, and upon returning to class, bring documentation of the illness, signed by a health care professional.