RUTGERS, THE STATE UNIVERSITY OF NEW JERSEY
School of Engineering
Materials Science and Engineering Department
Materials Processing I
14:635:204

Course Instructor:
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Term:
Spring Semester, 2016

Grade:
The grades for this course will be based on:
Exams (2 midterms): 40%
Term Paper: 20%
Final Exam: 20%
Attendance: 5%
Quizzes: 10%
Homework: 5%

Office Hours:
Mondays and Wednesdays ~ 3:00 – 3:30. I have an open door policy – If I am in my office then I will be happy to speak to you.

Grading:
The grading for the course is broken up as described above. The two midterms will be given on the assigned dates. The Final Exam will be cumulative but will comprise of course content not covered in the midterms. The exams will require only pencils. No bathroom breaks will be allowed so plan accordingly. I encourage you to work together for homework problem sets but refrain from outright copying of each other's work. Copied work in any form will be treated as cheating.

Course Description:
The course will provide an introduction to synthesis, properties and processing of technologically important materials such as polymers, ceramics, metals and thin films. The course will provide introduction to fundamental scientific concepts that are important in all material systems. Specific examples will be given to correlate basic concepts with practical systems.

Objective:
The primary aim of this course is to expose students to challenges encountered in synthesis and processing of inorganic and organic materials. The students will develop an understanding of how the materials properties, initial conditions and processing parameters impact the final properties of the product. This course will build on Intro to Materials concepts and prepare students for advanced courses given in the junior and senior years (e.g. polymer processing, microprocessing, and ceramics).

Prerequisites:
There are no major prerequisites for this class. Students will apply basic physics, chemistry and mathematical concepts.

Attendance:
Students are urged to arrive to class on time. I start the lectures promptly at 1:40PM. I usually start the class with important announcements. Attendance is essential for this class in lieu of the fact that there is no required textbook. Attendance will be taken every class and will count towards 5% of your final grade.

Topical Paper:
A term paper is required for the course. The topic of the term paper will be a material that the students will randomly draw from a box. The due date for the term paper is ***April 13th 2015***. Below I provide the details of what is required for a successful term paper.

Length: 1500 – 1800 words (not counting the references or the figure captions).
Font: New Times Roman or Arial (12point).
Spacing: 1.5

The term paper should have a cover page showing the title of the paper, your name, and the date.

The following sections should appear in the term paper:

Introduction: This should put the topic of your paper in context. Why is the material important? What are some of the applications? What makes the material so special for those applications?

Synthesis, Structure and Properties: How is the material made? What is the crystal structure of the material? How do the synthesis conditions and structure influence its properties?

Applications: Briefly describe the applications that the material is used for. Then choose one application to describe in detail. Why is the material suited for that application? What are the advantages using the material for that application? What are the limitations of the material and are there alternatives or ways to improve the material?

Summary: Briefly summarize the key points regarding your material. This section should be no more than 5-6 lines.

Figures: Every term paper should contain at least three figures. The Figures should be placed within the term paper (vs. at the end). For example, one could show the crystal structure, one could show synthesis method schematic, one could show property variation graph (e.g. hardness versus temperature). Each figure should be labeled as Figure 1 then Figure 2 then Figure 3 etc. Each figure must also contain a Figure Caption that describes what the Figure is. For example, for a figure showing hardness versus temperature for boron carbide, the caption would read:

"Figure X: Hardness versus temperature for spark plasma sintered boron carbide. It can be seen that the hardness remains constant up to temperature 1200^{o}C then decreases rapidly."

The Figures must also be explicitly mentioned in the main body of the term paper. That is, use the figures to make up the text of the term paper. For example, you could say something like:

"The structure of boron carbide is shown in Figure X. It can be seen that the structure consists of a 12-atom unit cell consisting of a 9-atom icosahedra cage and a 3-atom chain [1]. This unique structure gives rise to several interesting properties…"

References: Each term paper should contain a minimum of six references (more is OK), three of which must be from a book and/or technical paper and not from a website. The "[1]" above refers to a reference. References should appear chronologically in the term paper. Please make sure to cite all relevant information. References should be listed at the end of term paper and should have the following format:

1. V Domnich, S Reynaud, RA Haber and M Chhowalla, J. Am. Ceram. Soc. **94**, 3605 (2011).

Term Paper Submission: All term papers must be turned in as hard copies. Please note that the deadline for submission is 3PM on April 13th.

Term paper will count for 20% of the grade. The grade will be based on whether the term paper contains all of the sections/items outlined above, whether it follows the format guidelines, appearance, and finally the technical content.

Text Books:
This course consists of content that cannot be found in a single book. I will provide handouts in addition to the lecture notes to supplement the study materials.

1. A. Brent Strong, **Plastics: Materials and Processing**, Pearson Prentice Hall, 2006.
2. Tim A. Oswald and Georg Menges, **Materials Science of Polymers for Engineers**, Hanser/Gardner Publishers, 1995.
3. J. Reed, **Principles of Ceramic Processing**, 2nd Edition, John Wiley and Sons, 1995.

Class Notes: A complete set of notes will be provided.

Please note that the all documents provided on Sakai for this course are copyrighted. Students must respect copyrighted material. The material posted on Sakai is for your own personal use and must not be passed onto others. Providing these materials to others or receiving such materials from others is a *violation of copyright and is illegal*. Since not

all students have access to old exams and assignments, it is *unethical* to receive these documents and therefore will be treated as *cheating*.

Please note that the slides are for your personal use and should not be redistributed or posted without my explicit written permission.

Course Content:
Topics Covered: Application of law of motion in materials systems; waves and oscillations; chemical bonds; interatomic potential; surface energy and surface tension; fracture in brittle and plastic materials; heat transfer; solidification; materials characterization; materials synthesis; materials processing.

Quizzes, In Class Activities and Homework:
Quizzes: Approximately four quizzes will be given. Quizzes will be relatively short, taking 20mins to complete.

Homework/Study Guides: I will post study guide assignments on Sakai with specific due dates. Late submission will count as 0% for that assignment. Homework will count for 5% of the grade.

Exams: There will be two mid-term exams and one final exam. Each exam will count for 20% of the grade.

Exam 1: March 9, 2016
Exam 2: April 11, 2016

Academic Integrity, Etiquette and Modus Operandi in Class:
Fairness and politeness are keys to creation of a fruitful learning environment. I am committed to interacting with all of you in a respectful and polite manner and I expect all of you to do the same with each other and me.

Based on MSE UG students' feedback at the MSE Faculty retreat and SOE surveys, students have communicated that cheating is a major problem. To address your concerns about cheating, specific guidelines during exams will be followed. *These include no bathroom breaks.* Additional instructions on use of calculators etc. will be provided on the exam.

The aim of these guidelines is to protect the vast majority of students who do not cheat but nevertheless are negatively impacted by the few that do cheat. Additional guidelines are found in Policy on Academic Integrity listed within the New Brunswick Undergraduate Catalogue.

Contribution of Course to Meeting the Professional Component of ABET:
This course teaches students basic materials processing through lectures involving theoretical and practical concepts from materials science, chemistry and physics. Students

develop both quantitative and qualitative understanding of various polymers; ceramic and thin film processing topics.

Relationship with Course Program Objectives:
The topics covered in this course are essential for future courses such as Materials Processing II, Polymers Processing and Senior Lab.

ABET A - L Content

A	[Apply math, science, engineering]	30%
F	[Prof/ethical responsibility]	20%
G	[Communications]	10%
H	[Global/economic/environmental]	10%
I	[Lifelong Learning]	20%
J	[Contemporary issues]	10%