

McGill University
Department of Mining and Materials Engineering
MIME262 - Properties of Materials in Electrical Engineering
Fall 2009, Prof. Richard R. Chromik

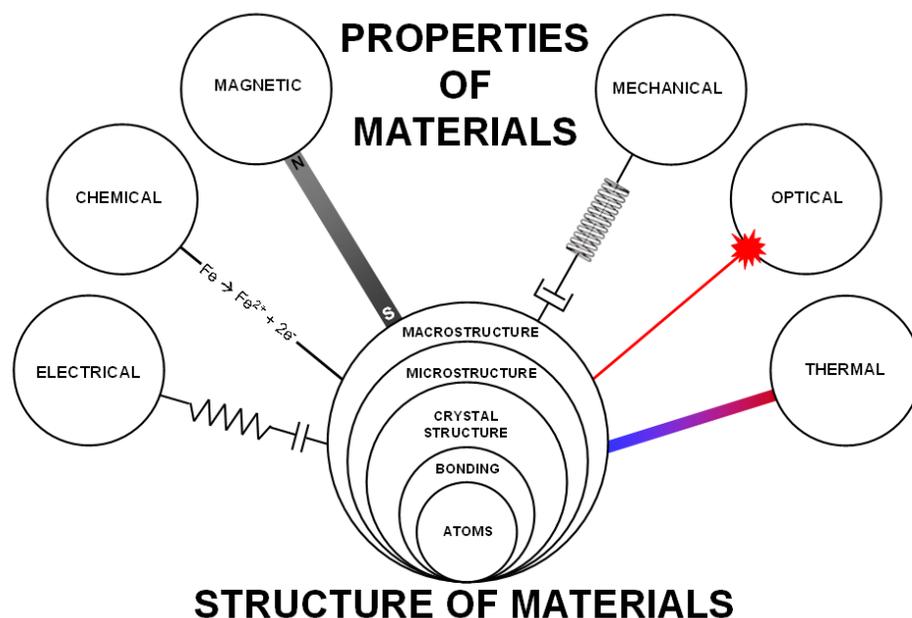
I. Course Objectives

Electrical engineers utilize the electrical, magnetic and optical properties of materials to develop new devices for a wide variety of cutting edge applications. A strong foundation in physics and chemistry helps electrical engineers to understand these properties, but knowledge from these disciplines does not necessarily provide the tools necessary for material selection, fabrication, processing and design. For these tasks, an electrical engineer must have working knowledge of the mechanical, thermal and chemical properties of materials.

This course will link your knowledge of physics and chemistry with your chosen field of electrical engineering. Materials science and engineering provides this link. This field focuses on materials properties, their structure and the links between the two at all length scales. This course is an introduction to materials science and engineering. The course will highlight: 1) structure-property relationships and 2) materials used for electrical engineering applications.

By the end of this course, students will be able to:

- Classify materials based on their properties.
- Explain how properties are measured.
- Explain how structure is characterized at different length scales.
- Recognize links between structure and properties for a variety of materials.
- Illustrate the use of different materials in the field of electrical engineering.
- Apply their knowledge of materials in their chosen field of electrical engineering.



Concept Map for MIME262 - Structure-property relationships govern how and why we use a particular material for an engineering application.

II. Text books and other source material

Required Text – Materials Science and Engineering – An Introduction (7th Edition), W.D. Callister, Jr. (Wiley, New York, 2006). ISBN 978-0-471-73696-7

This text will be used for every aspect of this course: assigned readings, lectures, tutorials, problem sets, and myCourses content.

Companion Text – Materials Science for Electrical and Electronic Engineers, I.P. Jones (Oxford Press, Oxford, 2001). ISBN 0-19-856294-2

This is a recommended text and will be used to supplement the required text for lectures, problem sets and myCourses content.

There are many other good introductory materials science and engineering textbooks available in the Schulich Library.

e-books – Some chapters from e-books available through the Schulich library will be assigned as readings. Note that you must be on a McGill computer or using VPN to access library materials. See this page for more information on VPN: <http://www.mcgill.ca/library-using/connect/>

EB1 *Microsystem engineering of lab-on-a-chip devices*, <http://www3.interscience.wiley.com/cgi-bin/booktoc/107061803> (Weinheim, Wiley, 2004), Ch. 6 and 9.

EB2 *Electroceramics: materials, properties, applications*, <http://www3.interscience.wiley.com/cgi-bin/booktoc/107061803>, (New York, Wiley-Interscience, 2003).

III. Lectures & Tutorials

Lectures – Mondays, Wednesdays and Fridays, 1:35 PM – 2:25 PM, McDonald 279

Tutorials – Monday, 3:35 PM – 4:25 PM, Wong 1020

Tuesday, 8:35 AM – 9:25 AM, Wong 1050

Thursday, 1:05 – 1:55 PM, Trottier 2110

IV. Instructor and teaching assistant office hours, locations and contact information

Professor Richard R. Chromik

Wong Building, Rm. 2100

Ph: 398-5686

Email: Please use myCourses or for an “emergency” use richard.chromik@mcgill.ca

Office hours: TBA and by appt.

Teaching Assistant(s)

Pantcho Stoyanov

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V. Email and myCourses

Please check the course’s myCourses site frequently for announcements. myCourses will be used for all electronic correspondence. In the event you need to email your instructor, use the mail function in myCourses. While I will reply as quickly as possible, expect a potential 24 hour turnaround on weekdays and a 48 hour turnaround on weekends.

VI. Course evaluation

In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.

Breakdown of marks

| | |
|------------------|-----|
| Homework | 10% |
| Tutorial Quizzes | 21% |
| Mid-Term Exam | 19% |
| Final Exam | 50% |

Homework

Recommended homework sets from Callister will be posted on myCourses. These are not formally graded. In addition to these, five homework sets will be assigned and graded (2.5% each). One of these 5 is optional and would count towards bonus points on the mid-term.

Tutorial Quizzes (7% each)

Four tutorial quizzes will be provided; three required and one optional. The optional quiz would replace your lowest quiz grade (does not replace absences). Useful study aides are the assigned homeworks and, in some cases, previous tutorials.

Mid-Term Exam

The mid-term exam will be given during lecture and test all aspects of the course. Thus, you should study assigned readings and homeworks, lecture notes, and the quizzes.

Final Exam

The final exam is comprehensive. Useful study aides include: assigned readings, homeworks, the in-term exams, lecture notes and quizzes.

Curving of Marks

In some instances, points may be "given back" on exams at the instructor's discretion. While this may be interpreted as a policy of curving, it is done based on student performance with respect to the *learning objectives*, not a desire to obtain a specific class average on an exam or for the course.

Contesting of Marks

The course policy is that both the instructor and teaching assistants will strive to provide accurate marks based on a grading scheme that will be applied to all students in the same manner. When you feel that an error has been made on a mark for your work, you may go to myCourses and complete a "Mark Review Request Form." No review of your work will be carried out without the completion of this form, which should be handed in to the instructor with the work in question at the end of lecture. A review may result in raising, lowering or maintaining the mark in question.

Statement of Academic Integrity (All students MUST read this)

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information).

How the statement of academic integrity applies to this course:

- 1) While you may decide to collaborate on homework, your final solution should be written up on your own. Do not provide solutions identical to those published by Callister, copied from a colleague or from some other source.

- 2) When you use library or internet resources to formulate your answers on homework, you should provide these references in some standard reference style, such as: <http://www.mcgill.ca/files/library-assistance/mla.pdf>.
- 3) Tutorial quizzes will be closed note and closed book, and individual work only. They will be monitored by the instructor and/or teaching assistants. Cheating will not be tolerated.
- 4) Mid-term and final exams will be closed note and closed book. They will be monitored by the instructor, teaching assistants and/or invigilators. Cheating will not be tolerated.

VII. Important Policies

- 1) You are expected to attend all exams and tutorial quizzes. If you have a personal emergency, it is your responsibility to alert your instructor. In these cases, you should call immediately, leaving a phone message if necessary, and follow up with an email from your McGill account.
- 2) You take your tutorial quiz in your assigned tutorial. No exceptions without permission from the instructor.
- 3) In the event a student is absent from an *exam*, accommodations will only be made if a medical excuse is obtained.
- 4) Absence from a tutorial quiz will only be permitted if a medical excuse is obtained or in the event of a personal emergency (see policy #1). Tutorial quiz make-ups will be closed book, closed notes and on a topic assigned to the student prior to the make-up date.
- 5) Students are required to use a faculty standard calculator (FSC). Non-programmable calculators that are comparable to FSCs may be pre-approved for term work by specific request to the instructor (***deadline 9Sep***). Non-FSC may be taken away during tutorial quizzes & exams with no replacement provided.
<http://www.mcgill.ca/engineering/student/sao/policies/examinations/calculators/>

VIII. Projected Course Schedule

| Lecture (DD/MM/YY) | Lecture Topic | Readings | Assignments |
|-------------------------------|--|---------------------------------------|---|
| 02-09-09 | Course Description | Ch. 1 | Purchase Callister, Visit myCourses website |
| 04-09-09 | Bonding | Ch. 2 | |
| 07-09-09 | <i>Lecture Cancelled - Holiday</i> | | HW #1 (Ch. 2) Tutorials – Ch. 3 |
| 09-09-09 | Close Packing | Ch. 3.1 – 3.7 | |
| 11-09-09 | Crystal Structures | Ch. 3.1 – 3.7 | |
| 14-09-09 | Points, Planes Directions | Ch. 3.8 – 3.10 | Tutorial Quiz #1 (Ch. 3) |
| 16-09-09 | Defects | Ch. 4.1 – 4.4 | |
| 18-09-09 | Defects | Ch. 4.5 – 4.10 | |
| 21-09-09 | Determining Structure | Ch. 3.13 – 3.17 and Ch. 4.9 – 4.10 | HW #2 (Ch. 4) Tutorials – Ch. 5.4 |
| 22-09-09 | Diffusion | Ch. 5.1 – 5.6 | |
| 25-09-09 | Diffusion | Ch. 5.1 – 5.6 | |
| 28-09-09 | Phase Diagrams | Ch. 9.1 – 9.7 | Tutorial Quiz #2 (Ch. 5) |
| 30-09-09 | Phase Diagrams | Ch. 9.8 – 9.9 | |
| 02-10-09 | Phase Diagrams | Ch. 9.13 – 9.17 | |
| 05-10-09 | Applying Defects, Diffusion, Phase Diagrams | | Tutorials – Ch. 9 |
| 07-10-09 | Review of Defects, Diffusion, Phase Diagrams | Ch. 4, 5 & 9 | |
| 09-10-09 | Phase Transformations | Parts of Ch. 10 & 17 | |
| 12-10-09 | <i>Lecture Cancelled - Holiday</i> | <i>Relax!</i> | <i>Happy Thanksgiving!</i> |
| 14-10-09 | Review of Sample Mid-Term | <i>Study!</i> | HW #3 (Ch. 9) <i>optional</i> |
| 16-10-09 | <i>MID-TERM EXAM</i> | <i>Relief!</i> | <i>No Tutorials</i> |
| 19-10-09 | Classes of Materials | Ch. 1 | Tutorials – Review Mid-Term |
| 21-10-09 | Mechanical Properties | Ch. 6.1 – 6.9 | |
| 23-10-09 | Mechanical Properties | Ch. 6.1 – 6.9 | |
| 26-10-09 | Strengthening Mechanisms | Ch. 7.1 – 7.7 | Tutorials – Ch. 6 |
| 28-10-09 | Strengthening Mechanisms | Ch. 7.8 – 7.10 | |
| 30-10-09 | Failure and Fracture | Ch. 8.1 – 8.5 | |
| 02-11-09 | Fatigue | Ch. 8.7 – 8.11 | Tutorial Quiz #3 (Ch. 6) |
| 04-11-09 | Creep | Ch. 8.12 – 8.14 | |
| 06-11-09 | Review of Mechanical Properties | Ch. 6, 7 & 8 | |
| 09-11-09 | Corrosion | Ch. 17 | HW #4 (Ch. 7 & 8) Tutorials – Ch. 18 |
| 11-11-09 | Electrical Properties – Metals | Ch. 18.1 – 18.9 | |
| 13-11-09 | Electrical Properties – Semiconductors | Ch. 18.11 – 18.13 | |
| 16-11-09 | Electrical Properties – Ceramics, Polymers | Ch. 18.16 – 18.25 | <i>No Tutorials</i> |
| 18-11-09 | Piezoelectricity | | |
| 20-11-09 | Review of Electrical Properties | Ch. 18 | |
| 23-11-09 | Thermal Properties | Ch. 19 | HW #5 (Ch. 18) <i>No Tutorials</i> |
| 25-11-09 | Optical Properties | Ch. 21 | |
| 27-11-09 | Optical Properties | Ch. 21 | |
| 30-11-09 | Magnetic Properties | Ch. 20 | Tutorial Quiz #4 (Ch. 19 & 20) <i>optional quiz</i> |
| 02-12-09 | Magnetic Properties | Ch. 20 | |
| 03-12-09 | Review for Final Exam | | |

XX-12-09 Final Exam