MATERIALS 1M03
Structure and Properties of Materials

Course Outline 2018

Instructional Team

Prof. André Phillion
Course Coordinator
JHE 213C

Prof. Hatem Zurob
JHE 357/D

Contact Email: prof1m03@mcmaster.ca
All emails to our Avenue account will be forwarded to the above address. All emails to our personal email addresses will not be answered, please use the course email.

The Avenue message board will be used by the instructors to provide you with up-to-date information. This might include corrections, time changes and other updates. It's your responsibility to consult the message board on a regular basis.

Lectures

<table>
<thead>
<tr>
<th>Section</th>
<th>Day</th>
<th>Time</th>
<th>Room</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>C01</td>
<td>Tu We Fr</td>
<td>12:30-13:20</td>
<td>BSB/147</td>
<td>Dr. Phillion</td>
</tr>
<tr>
<td>C02</td>
<td>Tu We Fr</td>
<td>15:30-16:20</td>
<td>BSB/147</td>
<td>Dr. Phillion</td>
</tr>
<tr>
<td>C03</td>
<td>Mo We Th</td>
<td>17:30-18:20</td>
<td>BSB/147</td>
<td>Dr. Zurob</td>
</tr>
</tbody>
</table>

Each section of the class will cover exactly the same content. All course requirements (assignments, tests, exams, etc.) are common to the whole course. On a day-to-day basis however, the sections may not maintain exact synchronization. You should therefore attend the same lecture section continuously.

Daily Help Sessions / Office Hours

Need help on your assignment? Have a question about course content? Drop by the “Materials Orange Lounge” for daily help from TAs. JHE 352, Monday to Thursday, 1:30 to 3:30 (Starting Jan. 8th)

In addition, all of us would be happy to meet with you at any other time. Please email to arrange an appointment: prof1m03@mcmaster.ca

Textbook
**Required text (see also required online content):** *Callister & Rethwisch, Materials Science and Engineering, An Introduction.* Any recent edition will suffice (8th, 9th, or 10th). The e-text can be purchased from the bookstore for ~$64. The ISBN number is 978-1-118-54689-5.

**Method of Assessment**

- Seven assignments (On-line on Avenue) 20%
- Two midterm tests 30%
- Final exam 50%

**Tests and Exams**

There will be two one-hour midterms. The subject area covered by each test will be discussed in class. The term tests will be held on the dates listed below. Please consult Avenue for the test locations.

- **Term test #1:** Monday February 12, 2017 7:00-8:00 pm
- **Term test #2:** Friday March 23, 2017 7:00-8:00 pm

You will need a calculator for both the term tests and the final exam. **The only acceptable calculators are the Casio FX 991 MS or Casio FX 991 MS Plus.** No other calculators are permitted. For both the term tests and the final exam you will be provided with a formula sheet. No other aids are allowed. You must bring your McMaster ID with you and display it on the writing table for inspection during tests and exams.

The final exam will cover all work studied throughout the semester. It will be three hours long. The date and time of the final exam will be scheduled by the Registrar's Office.

**MSAFs**

If you are unable to submit an assignment or quiz, or write a test due to illness, complete the on-line McMaster Student Absence Form (MSAF). More information can be found at the following link [https://www.mcmaster.ca/msaf/index.html](https://www.mcmaster.ca/msaf/index.html).

No follow up email is required. Grading will be as follows: MSAFs for midterms will automatically result in the weight being added to your final exam, MSAFs for Avenue assignments will result in the remaining assignments having additional weight so that the total assignment weight remains 20%. If you do not see your MSAF noted on your Avenue Grade Book two weeks after submission, please follow-up by email to prof1m03@mcmaster.ca.

**Assignments**

There will be 7 assignments in this course. All of them will be done on the Avenue To Learn platform. The assignments and due dates will appear on Avenue and be posted below. Your assignment will be automatically submitted on the due date if you happen to not complete it. It is your responsibility for checking deadlines. No excuses will be accepted for not submitting your assignment on time. Questions will be a variety of true/false, multiple choice and numerical problems.

**Course Objectives**
MATLS 1M03 is an important part of your training as an engineer. It provides an essential Knowledge Base in Natural Sciences.

By the end of this course you should understand:

- The main classes of materials and what distinguishes them
- The most important properties exhibited by materials
  - The range of properties exhibited by materials
  - The basis for materials selection based on properties
  - How materials selection integrates with engineering design

In particular, you should know and understand:

(a) Types of bonding in solids and how they relate to key material properties such as melting point, thermal expansion and elastic constant.
(b) Arrangement of atoms in solids.
(c) The type of defects that exist within crystalline materials and their effect of material properties.
(d) The relation between energy band structure and the electrical properties of materials.
(e) Concept of steady-state and its application to simple diffusion and heat-transfer problems.
(f) Strengthening mechanisms and fracture in solids.
(g) Phase formation and change of state.

As well as be able to:

(a) Read a binary phase diagram.
(b) Distinguish between elastic and plastic deformation
(c) Extract some material properties from experimental data.

To get to this understanding you need these fundamentals:

- The underlying structure of solids from the atomic to the macroscopic scale
- The nature of defects and microstructure in materials
- The functional properties of each class of materials
- The mechanical properties of each class of materials
- How properties depend on materials structure (microstructure / macrostructure)

Ethics

You need to be familiar with the Statement on Academic Ethics and the Senate Resolutions on Academic Dishonesty. These documents are found in the Senate Policy Statements provided when you registered and are also available in the Senate Office. Any student who breaks these resolutions will be treated according to the published policy.

Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3. Posting answers to assignment questions or detailed methods of solution is not acceptable on the Avenue message board, or on other social sites, e.g. Facebook.

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.
Academic Accommodation
Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140, ext. 2865 or e-mail sas@mcmaster.ca. For further information, consult McMaster University’s Policy for Academic Accommodation of Students with Disabilities.

Discrimination Policy
McMaster University is concerned with ensuring an environment that is free of all adverse discrimination. If you encounter a problem that cannot be resolved through discussing it with the people involved, please contact the Department Chair, the Sexual Harassment Office or the Human Rights Consultant, as soon as possible.

Course Modules:

<table>
<thead>
<tr>
<th>MODULE</th>
<th>TEXTBOOK CHAPTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1: Materials Selection</td>
<td>No Textbook</td>
</tr>
<tr>
<td>M2: Mechanical Properties of Materials</td>
<td>6,8</td>
</tr>
<tr>
<td>M3: Atomic Bonding and Structure</td>
<td>2,3,4</td>
</tr>
<tr>
<td>M4: Transport of Heat, Mass, and Electrons</td>
<td>5, 18, 19</td>
</tr>
<tr>
<td>M5: Phase Diagrams</td>
<td>9</td>
</tr>
<tr>
<td>M6: Strengthening Mechanisms</td>
<td>7</td>
</tr>
<tr>
<td>M7: Materials for Silicon Valley</td>
<td>18, 20, 21(?)</td>
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</tbody>
</table>

Advanced Materials
Corrosion, Concrete, Biomaterials, Steels, Electronic Materials

Follow Along Notes
Each Module contains a package of notes that the student can use to assist in following the class lectures
- The notes are to be filled-in during class, and contain definitions, practice problems, exam hints, and other ‘catch-yah’s’
- Many of the practice problems are performed in small working groups using a process of guided inquiry (active learning); After a set time, we have a group discussion

Rough Lecture Schedule:
At certain points in the course it may make good sense to modify the schedule outlined. The instructor reserves the right to modify elements of the course and will notify students accordingly (in class and post any changes to Avenue).

<table>
<thead>
<tr>
<th>LECTURE SCHEDULE</th>
<th>Lecture #1</th>
<th>Lecture #2</th>
<th>Lecture #3</th>
<th>DUE DATES</th>
</tr>
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<tbody>
<tr>
<td>Week 1: Jan 1-5</td>
<td>N/A</td>
<td>N/A</td>
<td>Welcome Lecture</td>
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<tr>
<td>Week 2: Jan 8-12</td>
<td>M1: Materials Selection</td>
<td>M1: Materials Selection</td>
<td>M1: Materials Selection</td>
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<tr>
<td>Week 8: Feb 19-23</td>
<td>Reading Week</td>
<td></td>
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<tr>
<td>Week 9: Feb 26-2</td>
<td>Advanced Materials: Concrete (Bassim)</td>
<td>M5: Phase Diagrams.</td>
<td>M5: Phase Diagrams</td>
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<tr>
<td>Week 10: Mar 5-9</td>
<td>M5: Phase Diagrams</td>
<td>M5: Phase Diagrams</td>
<td>Advanced Materials: Bio (Grandfield)</td>
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<tr>
<td>Week 13: Mar 26-30</td>
<td>M7: Materials for Silicon Valley</td>
<td>M7: Materials for Silicon Valley</td>
<td>Good Friday (Thursday C03 class cancelled)</td>
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<tr>
<td>Week 14: Apr 2-6</td>
<td>M7: Materials for Silicon Valley</td>
<td>Advanced Materials: Electronics (Kitai)</td>
<td>Review Lecture</td>
<td></td>
</tr>
<tr>
<td>Week 15: Apr 9-13</td>
<td>Review</td>
<td>N/A</td>
<td>N/A</td>
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Midterm: Monday, February 12 2018

Midterm: Friday, March 23 2018