



UNIVERSITY OF  
ALBERTA

<b>Section A1 (57344)</b> MWF: 10:00-10:50AM ETLE 1-003	Instructor:	<b>Dr. W. Chen</b> CME 716 780-492-7706 weixing.chen@ualberta.ca	Office Hours: W 1-3pm
<b>Section A2 (57354)</b> MWF: 10:00-10:50AM NREF 2-001	Instructor:	<b>Dr. J.A. Nychka</b> CME 532 780-492-4796 jnychka@ualberta.ca	Office Hours: M 1-3pm
<b>Section A3 (57355)</b> MWF: 1:00-1:50PM NREF 2-001	Instructor:	<b>Dr. H. Zhang</b> CME 710B 780-492-8340 hao.zhang@ualberta.ca	Office Hours: M 2-4pm
<p><b>MAT E 202 MATERIALS SCIENCE II</b> 3.00 Units (3-0-3/2). An introduction to the science of materials relating their mechanical, thermal, electronic and chemical properties to atomic, molecular and crystal structure. Ceramic and metallic crystals, glasses, polymers and composite materials. Multi-phase materials, strengthening processes. Laboratories include mechanical properties of metals and polymers, microstructure, heat treatment of steel, corrosion. Credit may not be obtained in this course if previous credit has been obtained in MAT E 252. Prerequisite: CHEM 105 or consent of Department.</p> <p><b>STUDENT OUTCOMES FOR MAT E 202:</b> <i>At the conclusion of the course, the student shall:</i></p> <ol style="list-style-type: none"> <li>1. understand how different arrangements of atoms and different types of bonding lead to distinctly different materials' properties and materials behaviour.</li> <li>2. be familiar with fundamental engineering properties and their relation to materials structure and morphology.</li> <li>3. understand and be able to explain/interpret phase diagrams.</li> <li>4. have a broad appreciation for the various processing methods used to engineer materials into useful forms.</li> <li>5. demonstrate ability in applying math, science, and engineering skills to solve materials problems.</li> <li>6. be able to find and interpret materials property data, and use it in engineering solutions.</li> <li>7. understand the properties influencing materials selection and design and processing.</li> <li>8. be able to function and contribute to a team.</li> <li>9. understand ethical, economic, global, societal, political, and professional issues associated with materials.</li> <li>10. be able to communicate effectively through writing.</li> <li>11. be aware of contemporary materials engineering issues.</li> </ol>			

**Office Hours:** According to schedule or by appointment (24 hours advanced notice by email or phone).  
In general, don't count on instructors responding to emails on the weekend.  
If necessary, feel free to visit any of the instructors' office hours.

**Helpdesk Teaching Assistant:** Anand Nataraja ([nataraja@ualberta.ca](mailto:nataraja@ualberta.ca))  
Office hours: TBA  
Location: CME 672

Textbook: “Materials Science and Engineering, An Introduction”, 7<sup>th</sup> Ed., by W.D. Callister Jr., John Wiley & Sons, 2007.

**Warning:** Don’t always believe the answers in the back of any book, and don’t let them guide you.

Labs: **Head lab TA:** Ali Hooshlar ([hooshlar@ualberta.ca](mailto:hooshlar@ualberta.ca)), CME 311, 492-3064

**Lab Manual:** must be purchased at bookstore for a nominal fee.

Lab Schedule: see schedule on the website.

Lab attendance is mandatory, and you must attend your section. Each lab session will consist of multiple experiments so be sure to **do the pre-lab portion of each experiment, and hand it in at the beginning!**

Labs must be completed and handed in at the end of each lab period so bring your lab manual to the lab.

All [AM] labs start at **8:00 AM** and all [PM] labs begin at **2:00 PM**.

**Safety Glasses** and closed-toe shoes (no sandals) **must** be brought to each lab (student responsibility).

Website: WebCT (Vista 4) Mat E 202-Materials Science II (LEC AX Fa08)

Includes: contact information, homework assignments, links, and solutions.

Format: Homework will be posted for download from the website one week in advance of the due date. Downloadable homework solutions will be posted on the website on the due date.

Grading: The final grade will be calculated based on the students raw score weighted according to the following formula, and a letter grade assigned at the end of the course. Scaling may or may not be applicable depending on the class performance.

Homework (10; + one bonus worth 0.25% of final grade)	10%
Laboratories (13 experiments)	13%
Midterm Exam (Saturday October 18 <sup>th</sup> 9-11am, location TBA)	25%
Comprehensive Final Exam (Saturday, December 6 <sup>th</sup> 9am-12pm)	52%

For grades falling on borderlines, consideration will be given to attendance, participation, and performance trends.

Attendance: Attendance to class is highly encouraged. Anything presented in class will be considered testable material (in addition to text readings, handouts, etc.). Participation will only help you learn the material, and questions are encouraged. Punctuality is expected, and tardiness will not be tolerated.

Absences: If for any reason you are unable to be present for an exam or hand in a written assignment on time, you need to contact your instructor. If the absence can be predicted in advance, you are expected to notify your instructor in advance (24 hours minimum, but preferably as soon as you know). If the absence is not planned, you must contact your instructor within one week and supply evidence of an excusable absence. Until you are excused of your absence a grade of zero will be assigned for that assignment or exam. If sick, a note from your doctor is required. If your instructor is unavailable, you must try to contact the TA. Do not rely on e-mail as a confirmation that your message has gotten through. Please take the effort to confirm your message is received. For legitimate absences, students will be expected to make time in their schedules to make up the exam as soon as possible within 1 week. Failure to follow these guidelines will result in a failing grade for the exam. Excusable absences can be found in the University Calendar.

Homework: While homework only counts for 10% of your course grade, the importance of doing the homework cannot be overemphasized, as it will help you learn the material. Homework assignment due dates are listed in the attached schedule. Examine the schedule and inform your instructor of any known conflicts as soon as possible *before* the due dates.

Homework assignments will be posted and performed on WebCT and are due by 11:59pm on the specified due date. The length of time for completion will be 3 hours with 2 attempts. Homework solutions will be posted on the website on the due date. **THERE IS NO SUCH THING AS LATE HOMEWORK!** Always use SI units and an appropriate number of significant figures in your answer.

#### Exams:

One **midterm** exam (120 minutes) is scheduled for **Saturday, October 18<sup>th</sup>, from 9-11am**. The midterm will include all material in Units 1-7 inclusive, and Labs 1 and 2.

The **final** exam is comprehensive (all material covered in the course, including the labs) and will be held at **9am-12pm on Saturday, December 6<sup>th</sup>, 2008**.

All exams will be cumulative, and closed book. You are allowed a university approved non-programmable calculator and writing utensils. No other items will be allowed on your desk – no drinks, food, papers, phones, etc.

Data and equations absolutely necessary to solve problems will be provided as needed, but be forewarned...more data than you need may also be incorporated.

**Exams will be based on the homework and the labs, but will not be the same problems to be regurgitated. Integration and application of knowledge will be tested. There will be theory and worked problems.**

#### Referencing and Citing:

Plagiarism is a serious and punishable offense, both in the classroom setting and in real life. Any work submitted for credit or to a publication house must be the student's own work. This includes any material found on-line, or in books, which should be referenced properly. Verbatim copying is not permitted.

Any cheating offense will be reported, and in real life who knows what could happen – you could have your degree revoked, you could be fired from your job, or be publicly shamed.

Please visit "Code of Conduct" for Instructors. This site will give you an idea what the instructors responsibilities are. <http://www.quasar.ualberta.ca/edit537/conduct.htm>

#### Civility

The classroom is a community for learning. Please respect each other and do not speak while others are speaking. You will find that you can learn a great deal from your peers, so pay close attention and pay respect when they are asking questions. There will be no attacks of a personal nature or statements denigrating another on the basis of race, sex, religion, sexual orientation, age, ethnicity, or other such irrelevant factors. This will help to create an interactive class, and participation will enhance your learning experience!

#### Learning Accommodations

Students who require accommodations in this course due to a disability affecting mobility, vision, hearing, learning, or mental or physical health are advised to discuss their needs with Specialized Support and Disability Services, 2-800 SUB, 492-3381 (phone) or 492-7269 (TTY).

Other student services can be found at Student Services www site

<http://www.uofaweb.ualberta.ca/student-services/>

If you are having academic difficulties there are resources available at

<http://www.uofaweb.ualberta.ca/academicsupport/nav02.cfm?nav02=50367&nav01=5>

Information on student ombudsmen services is available at:

<http://www.uofaweb.ualberta.ca/OmbudService/>

Information on important university deadlines can be found at

<http://www.registrar.ualberta.ca/calendar/Academic/Schedule/11.html>

Course Outline: For the detailed course outline see website

**Units**

1. Introduction
2. Mechanical Properties of Materials
3. Failure of Materials
4. Structure of Materials
5. Atom Movements in Materials
6. Plastic Deformation
7. Annealing

(**Midterm** – Units 1-7 and Labs 1-2)

8. Phase Diagrams
9. Transformations
10. Polymers
11. Ceramics
12. Corrosion

(**Final** – all units and all labs)

Course Survival Skills:

The **students** should be respected, and be registered in the University of Alberta to take this course. The **students** are responsible for learning the content of the course and for demonstrating the knowledge that they have acquired.

The **instructors** should be respected and should be allowed to teach the course in their own style. The **instructors** are responsible for enabling the students in learning the content of the course, for testing the knowledge of the students in the subject, supplying feedback, and for reporting the results of the testing.

**Guidelines for the student to fulfill his/her responsibility in a course (the rule of “5 times”):**

Read the textbook the day before a lecture,  
Attend the lecture,  
Review the material in the textbook and notes within a day of the lecture,  
Do the homework on time, and  
Review the material and study for the test.

**Guidelines for the instructor to fulfill his/her responsibility in a course:**

Prepare and present lectures,  
Prepare and assign homework,  
Be accessible to answer questions,  
Prepare and administer test(s), and  
Grade and report outcomes from test(s).

**CODE OF STUDENT BEHAVIOUR**

The complete Code of Student Behavior is contained in the General Faculties Council Policy Manual Section 30, and in the University Calendar. Any amendments made during the year are published in the Gateway.

**EXTRACTS FROM THE CODE OF STUDENT BEHAVIOR -- TO BE REVIEWED WITH EACH CLASS AS EARLY AS POSSIBLE EACH TERM .**

The Code of Student Behavior (Section 30A, the section relating to Individual Students) defines Plagiarism and Cheating as follows:

## 1. Plagiarism

No student shall submit the words, ideas, images or data of another person as the student's own in any academic writing, essay, thesis, research project or assignment in a course or program of study.

## 2. Cheating

No-student shall:

- a. in-the course of an examination, obtain or attempt to obtain information from another student or other unauthorized source or give or attempt to give information to another student, or knowingly possess, use or attempt to use any unauthorized material;
- b. represent or attempt to represent oneself as another or have-or attempt to have oneself represented by another in the taking of an examination, preparation of a paper or other similar activity;
- c. submit in any course or program of study, without the written approval of the course instructor, all or a substantial portion of any academic writing, essay, thesis, research report, project or assignment for which credit has previously been obtained by the student or which has been or is being submitted by the student in another course or program of study in the University or elsewhere;
- d. submit in any course or program of study any academic writing, essay, thesis, research report, project or assignment containing a statement of fact known by the student to be false or a reference to a source which reference or source has been fabricated.

The Code of Student Behavior provides for the following penalties for plagiarism, cheating, and other academic offences:

## Section 30A.5.1.b

- i. Expulsion,
- ii. Suspension,
- iii. Mark reduction on the assignment or examination,
- iv. A grade of F in a credit/no credit course and 1F for a graded course,
- v. Conduct probation,
- vi. Written reprimand,
- vii. Suspend any degree already awarded,
- viii. Rescind any degree already awarded.

Section 30A.8.2 sets out the procedures to be followed by an instructor or supervisor in the event of an alleged academic offence. The following is excerpted from the full listing of procedures:

- c. The instructor must discuss the alleged offence with the student. In the event that the alleged offender refuses to meet with the instructor to discuss the matter the instructor shall proceed as outlined below (Section 30A.8.2.d).
- d. Where the instructor has reason to believe that an offence has been committed, the instructor shall report the incident to the Dean and shall file with the Dean a statement in writing setting out:
  - i. a brief summary of the conduct alleged to constitute the offence, and
  - ii. a statement that the instructor has complied with Section 30A.8.2.c, and

iii. a brief statement of any action taken by the instructor as a result of the incident.

e. Where the instructor feels a discipline penalty should be considered the instructor may make that recommendation to the Dean, and may refer to one or more of the penalties listed in Section 30A.5.1.b.

Section 30A.9. 1 outlines the steps a student follows should he or she decide to appeal the imposition of a penalty. The following is excerpted from the full listing of procedures:

a. A student may appeal the decision of the Discipline Officer or the Dean by submitting a notice of appeal in writing to the Appeals Coordinator. Such notice must be received by the Coordinator no later than fifteen (15) calendar days after notification of the written decision of the Discipline Officer.

As an aside, think about it this way: 77% of the course grade will be determined on individual performance in exams, so it is not to your benefit to cheat on homework only worth only 10%.

A Bachelor of Engineering is a professional degree. As such, it is regulated and has very high ethical and professional standards, just as law and medicine. According to this tradition, cheating and plagiarism will not be tolerated in MAT E 202. Ponder this: when you are sick, would you choose a doctor that cheated on the homework that covered your symptoms? Moreover, how would you know?

Units	Date	# of Lectures	Reading (7 <sup>th</sup> edition Callister)	Assignments (A: available D: due)	Laboratory
<b>1. Introduction</b> - types of materials	Sept 3	0.5	Chapt 1		
<b>2. Mechanical Properties</b> - tension testing : elastic and plastic deformation - hardness testing - variability of material properties	Sept 3-10	3.5	6.1-6.3, 6.5-6.6, 6.8 6.10(Rockwell), 6.11	<b># 1</b> A Sept 10 D Sept 17	
<b>3. Failure</b> - fundamentals of fracture : ductile and brittle - impact testing : Charpy, DBTT - fatigue : S-N curve, crack initiation/propagation - creep : steady state creep, stress and T effects	Sept 12-17	3	8.1-8.4 8.6 8.7-8.11 8.12-8.13, 8.15	<b># 2</b> A Sept 17 D Sept 24	<b>Lab 1</b> <b>Impact Transition</b> <b>Tension Test</b> <b>The Microscope</b>
<b>4. Structure of Materials</b> - interatomic bonds : covalent, ionic, metallic - crystalline solids: systems, unit cells atomic packing , density, polymorphism, - crystallographic features : directions, planes, linear and planar density - crystalline vs. noncrystalline - imperfections : vacancies, solid solutions, dislocations, grain boundaries	Sept 19-29	5	2.5, 2.6 3.1-3.4, 3.7 3.5, 3.6 3.8-3.10 3.11, 3.12 3.13-3.14, 3.17 4.1-4.6	<b># 3</b> A Sept 24 D Oct 1	<b>Lab 2</b> <b>Creep of Metals</b> <b>Crystal Structures</b>

<b>5. Atom Movements in Materials</b> - diffusion : interstitial, vacancy - Arrhenius equation	Oct 1-3	2	5.1-5.3 5.5	# 4 A Oct 1 D Oct 8	
<b>6. Plastic Deformation</b> - mechanism: dislocation motion - grain boundary strengthening - solution hardening - strain hardening: cold working - precipitation hardening	Oct 6-10	2.5	7.1-7.2 7.8 7.9 7.10 11.9	# 5 A Oct 8 D Oct 15	
<b>7. Annealing</b> - recovery, recrystallization and grain growth - hot working	Oct 10-15	1.5	7.11- 7.13 11.4	# 6 A Oct 22 D Oct 29	<b>Lab 3</b> <b>Strain Hardening</b> <b>Annealing and</b> <b>Recrystallization</b> <b>Eutectic µstre</b>
<b>Thanksgiving: No class on Monday October 13<sup>th</sup></b>					
<b>Midterm Exam: Saturday, October 18<sup>th</sup>, 9-11am (Units 1-7 inclusive + Labs 1-2 inclusive)</b>					
<b>8. Phase Diagrams</b> - basic concepts and definitions - binary phase diagram : isomorphous, lever rule - binary phase diagram : eutectic - iron carbon phase diagram	Oct 17-27	5	9.1-9.5 9.6-9.10  9.11- 9.12 9.14, 9.18- 9.19	# 7 A Oct 29 D Nov 5	



<b>9. Transformations</b> <ul style="list-style-type: none"> <li>- kinetics : time dependence, Avrami equation</li> <li>- TTT diagram steel : phases, properties of phases</li> <li>- CCT diagram steel</li> <li>- tempering of martensite</li> <li>- Hardenability : Jominy End Quench</li> <li>- Precipitation heat treatment of aluminum</li> </ul>	Oct 29-Nov 12	6	10.1-10.4 10.5,10.7  10.6 10.8 11.8 11.9	<b># 8</b> A Nov 5 D Nov 12  <b># 9</b> A Nov 12 D Nov 19	<b>Lab 4</b> <b>Steel Microstructures</b> <b>Tempering</b> <b>Heat Treatment of Steels</b>
<b>Fall Term Break: No class on Monday November 10<sup>th</sup></b>					
<b>10. Polymers</b> <ul style="list-style-type: none"> <li>- types of engineering polymers</li> <li>- polymer microstructure : monomer, chain length, degree of polymerization, crystallinity</li> <li>- mechanical behaviour : linear, crosslinked, crystallinity, alignment of chains</li> <li>- glass transition temperature</li> <li>- degradation</li> </ul>	Nov. 14-21	4	14.9,15.15 14.1-14.7, 14.11, 14.12  15.2-15.4  15.12-15.14 17.11-17.13	<b># 10</b> A Nov 19 D Nov 26	<b>Lab 5</b> <b>Viscoelastic Deformation</b> <b>Galvanic Series</b>
<b>11. Ceramics</b> <ul style="list-style-type: none"> <li>- structures</li> <li>- properties,</li> <li>- processing : powder methods</li> </ul>	Nov. 24-26	2	12.1-12.3 12.8-12.9 13.9-13.12		
<b>12. Corrosion</b> <ul style="list-style-type: none"> <li>- fundamentals : corrosion cells, EMF, Nernst equation, galvanic series</li> <li>- types of corrosion</li> <li>- corrosion control : material selection, coatings, cathodic protection</li> </ul>	Nov. 28- Dec 1	1.5	17.1-17.3  17.7 17.8, 17.9	<b># 11</b> A Nov 26 D Dec 3	
<b>Course review: December 3<sup>rd</sup></b>					
<b>Final Exam: Saturday, December 6<sup>th</sup>, 9am-12pm (Comprehensive = all units and all labs)</b>					