ENGG*2120 Material Science

Fall 2018
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - September 05, 2018

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1 Course Details

1.1 Calendar Description

Study of the mechanical, electrical, magnetic, optical and thermal properties of solids. Atomic order and disorder in solids, single-phase metals, and multiphase materials (their equilibria and micro-structure) are examined as a basis for understanding the causes of material properties. Interwoven throughout the course is an introduction to materials selection and design considerations.

Pre-Requisite(s): CHEM*1040, PHYS*1130

1.2 Timetable

Lectures:

Tuesday & Thursday	8:30AM – 9:50 AM	MCLN Room 102

Laboratory: Materials Science Lab (Thrn 1008)

Sec1	Monday	2:30 PM - 4:20PM	THRN 1008
Sec 2	Friday	2:30 PM - 4:20PM	THRN 1008
sec 3	Wednesday	2:30 PM - 4:20PM	THRN 1008
sec 4	Monday	12:30 PM - 2:20 PM	THRN 1008
sec 5	Tuesday	12:30 PM - 2:20 PM	THRN 1008
sec 6	Wednesday	12:30 PM - 2:20 PM	THRN 1008
sec 7	Thursday	12:30 PM - 2:20 PM	THRN 1008
sec 8	Friday	12:30 PM - 2:20 PM	THRN 1008

sec 9	Tuesday	2:30 PM - 4:20 PM	THRN 1008

1.3 Final Exam

Tuesday December 4th 2018 11:30 AM - 1:30 PM

Final exam date, time and location is set by the University registrar

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2 Instructional Support

2.1 Instructor(s)

Dr. Ibrahim Deiab Ph.D P.Eng
Email: ideiab@uoguelph.ca
Telephone: +1-519-824-4120 x58391
Office: 2521 Richards
Office Hours: Tuesday and Thursday 10:00 – 11:00, Wednesday 13:00 -14:00, via email or by appointment

2.2 Instructional Support Team

Lab Technician: Barry Verspagen
Email: baverspa@uoguelph.ca
Telephone: +1-519-824-4120 x58821
Office: THRN 1138

2.3 Teaching Assistant(s)

Teaching Assistant: Abdelkrem Eltaggaz
Email: aeltagga@uoguelph.ca
Office Hours: By appointment

Teaching Assistant: Fatima Haque
Email: fhaque@uoguelph.ca
Office Hours: By appointment

Teaching Assistant: Amro Elhelaly
Email: amro@uoguelph.ca
Office Hours: By appointment

Teaching Assistant: Richard (Han) Chen
Email: hchen01@uoguelph.ca
Office Hours: By appointment

Teaching Assistant: Arku Precious
Email: parku@uoguelph.ca
Telephone: +1-519-824-4120 x58047
Office: THRN 3106
Office Hours: By appointment

Teaching Assistant: Mawath Qahtani

Email:	mqahtani@uoguelph.ca
Office Hours:	By appointment
Teaching Assistant:	Matija Bosnic
Email:	bosnicm@uoguelph.ca
Office Hours:	By appointments

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3 Learning Resources

3.1 Required Resource(s)

D.R. Askeland, and W.J. Wright, The Science and Engineering of Materials, 7th Edition, SI, Cengage Learning, 2015. (Textbook)

3.2 Recommended Resource(s)

W.D. Callister and D.G. Rethwisch, Materials Science and Engineering: An Introduction, 9th Edition, John Wiley & Sons, Inc., 2014. (Textbook)

3.3 Additional Resources

Lecture Information: All the lecture notes will be posted on the web page.

Please note that power point presentations are not comprehensive of all materials covered. During lecture, additional notes and examples will be provided.

Lab Information: The lab manual and schedule for the laboratory exercises are posted on Courselink.

Be sure to read the appropriate lab instructions prior to attending the lab.

Assignments: Study assignments will be posted at the end of a chapter or a group of chapters, with the solutions to follow about one week later. Assignments will not be marked. It is strongly recommended that you work through these assignments as they are valuable study aids and similar to the types of questions that may be asked on an exam.

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4 Learning Outcomes

This course is an introductory course in materials science. The student will be introduced to the atomic or molecular structure of metals, polymers, ceramics, and composite materials and learn how these different structures influence their mechanical, electrical and thermal behaviour. Many of the differences between properties of classes of materials are related to the atomic structure of the material.

There are two main aspects to design: physical structure and material selection. Each material has its own unique properties and characteristics. Understanding how the material properties can change with the environment and how the properties can be manipulated will provide more informed material selection choices. A properly selected material can enhance a design through

structural changes and greater performance while an improperly selected material can lead to complete design failure.

The mechanical properties of a material are influenced by the atomic arrangement and presence of crystallographic defects. In addition, methods of controlling the atomic arrangement of a material such as heat treating and strain hardening will be investigated. Finally, common service failures due to creep, fatigue, or fast fracture will be examined in light of the atomic structure of the different materials.

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Describe the general properties of key engineering materials
2. Recognize Structure-properties relationship
3. Recognize the concepts of stress, strain and how they are related, and determine the elastic modulus, the yield strength, the tensile strength and the ductility for a given engineering stress-strain curve
4. Calculate the weight percent and atom percent for each element in a metal alloy.
5. Draw unit cells and derive the relationships between unit cell edge length and atomic radius for FCC, BCC and HCP crystal structures. And determine the directional and planar (Miller) indices within a unit cell.
6. Determine the phases present, the compositions of the phases and the mass fractions of the phases and for some given phase diagrams.
7. Present, analyze, and discuss experimental data.

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome Set Name	Course Learning Outcome
1	Knowledge Base	2, 3, 4, 5, 6
1.2	Recall, describe and apply fundamental principles and concepts in natural science	5
1.3	Recall, describe and apply fundamental engineering principles and concepts	3
1.4	Recall, describe and apply program-specific engineering principles and concepts	2, 3, 4, 5, 6
2	Problem Analysis	1
2.2	Identify, organize and justify appropriate information, including assumptions	1
7	Communication Skills	7
7.5	Demonstrate ability to process oral and written communication by following instructions, actively listening, incorporating feedback, and formulating	7

#	Outcome Set Name	Course Learning Outcome
	meaningful questions	

5 Teaching and Learning Activities

Please not that topics oder is tentative, the instructor at his description may alter schedule..

5.1 Lecture

Topic(s): Introduction
Reference(s): Chapter 1

Topic(s): Atomic Structure
Reference(s): Chapter 2

Topic(s): Mechanical Properties
Reference(s): Chapter 6

Topic(s): Failure Mechanisms
Reference(s): Chapter 7

Topic(s): Ferrous & Non-Ferrous Alloys
Reference(s): Chapter 13, 14

Topic(s): Ceramics
Reference(s): Chapter 15

Topic(s): Polymers
Reference(s): Chapter 16

Topic(s): Composites
Reference(s): Chapter 17

Topic(s): Atomic Arrangement
Reference(s): Chapter 3

Topic(s): Imperfections in Atomic Arrangement
Reference(s): Chapter 4

Topic(s): Semiconductors
Reference(s): Chapter 19

Topic(s): Solid Solutions
Reference(s): Chapter 10

Topic(s): Dispersion Strengthening - Phase Diagrams
Reference(s): Chapter 11

Topic(s): Dispersion Strengthening - Phase Transformations
Reference(s): Chapter 12

Topic(s): Heat Treating of Steel
Reference(s): Chapter 13

Topic(s): Strain Hardening

Reference(s): Chapter 8

5.2 Lab Schedule

A detailed lab schedule is posted on Courselink. The schedule provides information on groups, experiments and project. All lab reports must be submitted electronically in the dropbox on Courselink for marking by 4:00 PM **two weeks** after the laboratory is performed (unless indicated otherwise). For the weeks students are not in the lab, they are expected to be writing their lab report, or preparing for their next lab exercise. GTAs will be available during the lab time to answer questions.

Y***ou must attend the lab section you are registered in.***

5.3 Other Important Dates

- Thursday, September 6, 2018: First day of class
- Monday, October 8, 2018 Holiday: No classes scheduled
- Tuesday, October 9, 2018: Fall Study Break Day – No classes scheduled
- Friday, November 2, 2018: 40th class day, last day to drop
- Thursday, Novmber 29 2018: Make up for Study Day (Tuesday schedule in effect)
- Friday Nobmber 30 2018: Make up day (Monday Schedule in effect)
- Friday, November 30 , 2018: Last day of class

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6 Assessments

Passing grade: Students must achieve at least 50% of the marks assigned to the midterm and final exams in order for the labs and quizzes to be counted in the final grade. If you do not achieve at least 50% of the marks assigned to the midterm and final exams, the weighting of the lab reports and quizzes in your final grade will be zero. An overall final grade of 50% is required to pass the course.

6.1 Assessment Details

Quizzes (7.5%)

Quiz1 Sep. 20th

Quiz 2 Oct. 4th

Quiz 3 Oct. 25th

Quiz 4 Nov. 8th

Quiz 5 Nov. 27th

Assignments (0%)

study assignments will be posted at the end of a chapter or a group of chapters, with the solutions to follow about one week later. Assignments will not be marked. It is strongly recommended that you work through these assignments as they are valuable study aids and similar to the types of questions that may be asked on an exam.

Lab reports and Project (20%)
For lab reports and project report due dates , please refer to course link for detials.

Midterm(s) (25%)
Two midterms

October 11th 2018 In class

November 15th 2018 In class

Each student is allowed one ***single-sided*** 8.5" x 11" note sheet for the exam. Each note sheet must be prepared by you (typed or handwritten) and be your own original work (i.e. not a copy). Numerical solution or steps for solving problems are not allowed.

Final Exam (47.5%)
Date: Tue, Dec 4, 11:30 AM - 1:30 PM, Room TBD
Final Exam date, time and location is set by the University Registrar.

Each student is allowed one ***double-sided*** 8.5" x 11" note sheet for the exam. Each note sheet must be prepared by you (typed or handwritten) and be your own original work (i.e. not a copy).Numerical solution or steps for solving problems are not allowed.

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7 Course Statements

7.1 Introduction

1. **Sharing of calculators, formula sheets, if applicable, or use of smart phones as calculators is not allowed**.
2. **Grading is based on the procedure, correctness of numerical calculations and final answer.**
3. **The instructor, at his discretion, may entertain requests by the class to adjust assessment dates, except final exam, with the unanimous consent of the class.**
4. **check your lab section*. You are only allowed to attended the section you are registered in.***

7.2 Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic

Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor at the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing grade: Students must achieve at least 50% of the marks assigned to the midterm and final exams in order for the labs and quizzes to be counted in the final grade. If you do not achieve at least 50% of the marks assigned to the midterm and final exams, the weighting of the lab reports and quizzes in your final grade will be zero. An overall final grade of 50% is required to pass the course.

Missed midterm exams: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of the missed test will be added to the final exam. There will be no makeup midterm exams.

Lab Work: You must attend and complete all labs. Doors to the lab will be closed 15 minutes after the scheduled lab time. **Students arriving after the lab doors are closed are considered absent.** If you miss a lab due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab. Unless academic consideration is granted, failure to complete a lab will result in a mark of zero for that lab report.

The laboratory work is group based. Check course link for your group. **You will not be allowed to conduct the project or labs unless you attend the safety session and sign a form indicating that you have done so.**

Each group will be responsible for conducting the labs and writing a single report for each lab. You will be equally responsible for your group's laboratory reports. Each group member must make a significant contribution to the writing of the lab report and sign the lab report cover page in order to receive a lab report mark. Lab reports will be marked and the marks posted on Courselink. **Note that up to 20% of the lab mark may be deducted for poor lab report format, poor graph or table format, or poor English (spelling, grammar, etc.).** Any reports judged to be entirely unacceptable will be returned without marking for rewriting. If you have questions about your mark, see the GTA responsible for that lab and they will discuss it with you.

Late Lab Reports: There will be a late penalty of 20%/day or part thereof for any late lab reports. That is, reports submitted within 24 hours after the initial due date will lose 20%, reports submitted between 24 and 48 hours after the initial due date will lose 40%, and so on. Lab reports are considered late if they are submitted after the specified time they are due.

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8 School of Engineering Statements

8.1 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink

but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

8.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

In case of doubt, always ask.

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9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar.

9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required, however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance, and not later than the 40th Class Day.

More information: www.uoguelph.ca/sas

9.6 Academic Misconduct

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

9.7 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.
