ENGG*2120 Material Science

Winter 2018
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - January 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	2:30 PM – 3:50 PM	ALEX 100
Thursday	2:30 PM – 3:50 PM	ALEX 100

Laboratory:

Thursday	Sec 01	10:30 AM - 12:20 PM	THRN 1008
Friday	Sec 02	9:30 AM - 11:20 AM	THRN 1008
Wednesday	Sec 03	11:30 AM - 1:20 PM	THRN 1008
Wednesday	Sec 04	1:30 PM - 3:20 PM	THRN 1008
Monday	Sec 06	9:30 AM - 11:20 AM	THRN 1008
Tuesday	Sec 07	11:30 AM - 1:20 PM	THRN 1008

Friday Sec 08 8:30 AM - 10:20 AM THRN 1008

1.3 Final Exam

Sat Apr 14, 7:00 PM – 9:00 PM, Room TBA on WebAdvisor

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2 Instructional Support

2.1 Instructor(s)

Abdallah Elsayed Ph.D, EIT

Email:	aelsay01@uoguelph.ca
Telephone:	+1-519-824-4120 x56933
Office:	RICH 2523
Office Hours:	Tuesdays 4:00 PM - 5:00 PM and by appoitment

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:	Han Chen
Email:	hchen01@uoguelph.ca
Office Hours:	By appointment.
Teaching Assistant:	Stephanie Shaw
Email:	stephanie.shaw@uoguelph.ca
Office Hours:	By appointment.
Teaching Assistant:	Michael Snowdon
Email:	snowdonm@uoguelph.ca
Office Hours:	By appointment.
Teaching Assistant:	Rutvik Soni
Email:	sonir@uoguelph.ca
Office Hours:	By appointment.

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3 Learning Resources

3.1 Required Resources(s)

Courselink (Website)
https://courselink.uoguelph.ca
Course material, news, announcements, and grades will be regularly posted to the

ENGG*2120 Courselink site. **You are responsible for checking the site regularly.**

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

I-Clicker (Equipment)
I<Clickers for quizzes.

3.2 Recommended Resources(s)

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

3.3 Additional Resources(s)

Lecture Information (Notes)
An incomplete set of lecture notes will be posted on Courselink prior to lecture. During lecture, additional notes and examples will be provided. It is expected that you will have a copy of the posted lecture notes for each class.

Lab Information (Other)
The lab manual and schedule for the laboratory exercises are posted on CourseLink. Be sure to read the appropriate lab section prior to attending the lab.

Assignments (Other)
Study assignments will be posted at the end of a chapter or a group of chapters, with the solutions to follow. 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

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.

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. 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: metals, semiconductors, ceramics, polymers, and composites through a material identification project.
2. Create simple lab experiments to measure material properties and evaluate the effectiveness of the experiment in measuring those properties through a material identification project.
3. Recognize the link between the atomic structure of a material and its macroscopic properties through testing of material properties such as strength, stiffness, and impact behaviour.
4. Explain how the microstructure of a material can be manipulated by altering the operating environment, strain hardening, and heat treatment through lab report discussion questions.
5. Compare measured material properties such as compressive strength, tensile strength, and elastic modulus with the expected theoretical results and explain discrepancies through lab report discussion.
6. Select an appropriate material for a given application based on knowledge of material properties through class examples, exams, and lab report discussion.
7. Read and interpret phase diagrams through practise problems, quizzes, and exams.
8. Present, analyze, and discuss experimental data through well written lab reports.

4.2 Engineers Canada - Graduate Attributes

Successfully completing this course will contribute to the following:

#	Outcome Set Name	Course Learning Outcome
1	Knowledge base	1, 3, 4, 6, 7
1.3	Comprehend and apply fundamental engineering concepts	1, 3, 4, 6, 7
1.4	Comprehend and apply program-specific engineering concepts	1, 3, 4, 6, 7
3	Investigation	2, 5, 8
3.1	Propose and test working hypotheses	2, 5, 8
3.2	Design and apply an investigation plan	2, 5, 8
3.3	Analyze and interpret experimental data	2, 5, 8
3.4	Assess validity of conclusions within limitations of data and methodologies	2, 5, 8
5	Use of engineering tools	2, 5
5.1	Select appropriate engineering tools from various alternatives	2, 5

#	Outcome Set Name	Course Learning Outcome
5.2	Apply selected engineering tools	2, 5
5.3	Recognize limitations of selected engineering tools	2, 5
7	Communication skills	2, 8
7.1	Develop and deliver clear, key concepts using methods appropriate for the intended audience	2, 8
7.2	Critically evaluate received information	2, 8
7.3	Demonstrate active listening and follow instructions	2, 8

5 Teaching and Learning Activities

5.1 Lecture

Topic(s): Lecture Schedule

Date	Topics(s)	References
Lecture 1	Introduction	Chapter 1
Lecture 2, 3	Mechanical Properties	Chapter 6
Lecture 4, 5	Failure Mechanisms	Chapter 7
Lecture 6	Atomic Structure	Chapter 2
Lecture 7	Ferrous & Non-Ferrous Alloys	Chapter 13, 14
Lecture 8	Ceramics	Chapter 15
Lecture 9, 10	Polymers	Chapter 16
Lecture 11	Composites	Chapter 17
Lecture 12, 13	Atomic Arrangement	Chapter 3
Lecture 14, 15	Imperfections in Atomic Arrangement	Chapter 4
Lecture 16	Semiconductors	Chapter 19
Lecture 17, 18	Solid Solutions	Chapter 10

Lecture 19, 20	Dispersion Strengthening - Phase Diagrams	Chapter 11
Lecture 21, 22	Dispersion Strengthening - Phase Transformations	Chapter 12
Lecture 23	Heat Treating of Steel	Chapter 13
Lecture 24	Strain Hardening	Chapter 8

5.2 Lab

Topic(s): Lab Schedule

A detailed lab schedule will be posted on Courselink. The Laboratory Schedule table summarizes when the labs are performed and when the corresponding reports are due. **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.

Lab	**Groups (for all sections)**	**Lab Performed**	**Report Due Date**
Lab Safety and Project Introduction	1-4	Jan 8 - Jan 12	
	5-8	Jan 8 - Jan 12	
Project Testing	1-4	Jan 15 - Jan 19	Jan 29 - Feb 2
	5-8	Jan 15 - Jan 19	Jan 29 - Feb 2
Compressive Testing of Materials	1-4	Jan 22 - Jan 26	Feb 5 - Feb 9
	5-8	Jan 22 - Jan 26	Feb 5 - Feb 9
Tensile Testing of Materials	1-4	Feb 5 - Feb 9	Feb 26 - Mar 2
	5-8	Feb 12 - Feb 16	Mar 5 - Mar 9
Midterm Review	1-4	Feb 26 – Mar 1	Midterm: Mar 1
	5-8	Feb 26 – Mar 1	Midterm: Mar 1

Impact Testing of Metals	1-4	Mar 5 - Mar 9	Mar 19 - Mar 23
	5-8	Mar 5 - Mar 9	Mar 19 - Mar 23
Heat Treatment of Metals	1-4	Mar 12 - Mar 16	Mar 26 - Mar 30
	5-8	Mar 19 - Mar 23	Apr 2 - Apr 6

5.3 Lab Schedule

A detailed lab schedule will be posted on Courselink. The Laboratory Schedule table summarizes when the labs are performed and when the corresponding reports are due. **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.

5.4 Other Important Dates

- Monday, January 8, 2018: Classes commence
- Tuesday, January 9, 2018: First day of ENGG 2120
- Monday, February 19 - Friday, February 23, 2018: Winter break
- Friday, March 9, 2018: 40th class day, drop date
- Friday, April 6, 2018: Last day of classes

See Schedule of Dates for other important dates in the academic year.

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6 Assessments

The best 5 of 7 quizzes will be used to calculate the final quiz grade.

The final grade will be the better of Marking Scheme A or Marking Scheme B.

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 Marking Schemes & Distributions

Name	Scheme A (%)	Scheme B (%)
Quizzes	10.00	0.00
Lab Assignments	20.00	20.00
Project	5.00	5.00
Midterm	25.00	30.00
Exam	40.00	45.00
Total	100.00	100.00

6.2 Assessment Details

Quizzes (0.00%)

There will be several i>clicker quizzes during the lectures throughout the semester as scheduled. Students are expected to be present and use their own i>clicker during these quizzes. The quizzes are intended to help you better understand the course content and account for 10% of the course marks. Prior to the first quiz, you must register your i>clicker serial number by clicking on the “Student i>clicker Registration” link on the right side of the webpage:

https://www.uoguelph.ca/courselink/widgets/clickers/

If you miss a quiz due to grounds for granting academic consideration, your worst quiz mark will be dropped. There will be no makeup quizzes.

Quiz 1 (2.00%)

Date: Thu, Jan 18, In class

Quiz 2 (2.00%)

Date: Thu, Feb 1, In class

Quiz 3 (2.00%)

Date: Tue, Feb 13, In class

Quiz 4 (2.00%)

Date: Tue, Feb 27, In class

Quiz 5 (2.00%)

Date: Tue, Mar 13, In class

Quiz 6 (2.00%)

Date: Tue, Mar 28, In class 💬

Quiz 7 (2.00%)

Date: Thu, Apr 5, In class

Lab Reports (20.00%)

See the Lab Schedule (section 5.2) for lab schedule and report due dates.

Project (5.00%)

Date: Mon, Jan 29 - Fri, Feb 2

See the Lab Schedule (section 5.2) for Project schedule and report due dates.

Midterm (25.00%)

Date: Thu, Mar 1, 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 and be your own original work (i.e. not a copy). Typing is permitted, but summarizing handwritten notes is highly encouraged.

Exam (40.00%)

Date: Sat, Apr 14, 7:00 PM - , 9:00 PM, 7:00 PM to 9:00 PM, Room TBA, see WebAdvisor

Each student is allowed one double-sided 8.5” x 11” note sheet for the exam. Each note sheet must be prepared by you and be your own original work (i.e. not a copy). Typing is permitted, but summarizing handwritten notes is highly encouraged.

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7 Course Statements

7.1 Course 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.

Accommodation of Religious Obligations:

If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the first class to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations.

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.

Remarking of midterm exams:

Consideration for remarking of midterm exams will only be allowed if they are brought to the attention of the instructor within two weeks of when midterm results are released.

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 **prior** to your scheduled 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. You will need to organize yourselves into groups of three (3) or four (4) within your lab section by **Monday, January 16th**. Be sure to choose your lab partners wisely! The sign-up sheets for lab groups will be available in the Materials Lab in THRN 1008 during the introductory lab session. **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.

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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.

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