# **ENGINEERING 3911: Chemistry and Physics of Engineering Materials 1**

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| **Instructor** | Dr. Anand M. Sharan |  |
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| **Office Location** | EN-3047 |  |
| **Office Hours** | Wed, 11:30am–1:30pm |  |

 **TAs** N/A

 **Office Hours** N/A

 **Office Hours** N/A

**Website** <http://www.engr.mun.ca/~asharan/courses/3911_LECTURES/>

**Communication** Always check the file called ‘Notice Board 2015.doc’ from the website, for the Instructor’s messages to the students.

**CALENDAR ENTRY:** *Chemistry and Physics of Engineering Materials I is an introduction to the structure and properties of engineering materials, in particular materials, semiconductors, ceramics, glasses and polymers. Topics include a review of atomic bonding, discussion of basic crystalline and amorphous structures, point and line defects, and the role these structural features play in elastic and plastic deformations, yield, fracture, glass transition, thermal conductivity, thermal expansion, specific heat and electrical conductivity.*

 **Prerequisites:**  Chemistry 1050

 **Co Requisites:** the former ENGI 2205

 **Lab Hours:**  at least four 3-hour sessions per semester

 **Other Requirements:** tutorial, 1 hour per week

**Credit Value:** 3 Credits

**COURSE TYPE:** Compulsory

**LAB EXPERIENCE:** Hands-on experience (all)

**ACCREDITATION UNITS:**

Contact hours/week on average over 12 weeks (Lecture/Lab/Tutorial): 4 hours per week (avg)

**CONTENT CATEGORIES:** (expressed as %, no category can be 0 < c < 25)

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| --- | --- | --- | --- | --- |
| Math | Natural science | Complementary Studies | Engineering Science | Engineering Design |
|  | 35% |  | 65% |  |

**COURSE DESCRIPTION:**

This course is an introduction to how chemistry and physics affect engineering materials and principles. Teaching will be done through class time, tutorials, and lab work. Assessments will be taken through lab work, assignments, and examinations. Course content is described in more detail under “Major Topics”, as well as where to find these topics in the textbook.

**SCHEDULE:**

 Monday, Wednesday & Friday in room EN-2006 between 2:00 – 2:50

 Tuesday in rooms EN-1004 and 2043 –Problem Solving and EN 3047 Theory between 4:00 – 4:50

**RESOURCES:**

**Textbook (Required):** W.D. Callister, Jr., and D.G. Rethwisch, *Material Science and Engineering: An Introduction* (8th Edition), John Wiley & Sons, Inc., 2010, ISBN: 978-0-470-41997-7. (7th , 9th and 10th Editions will work as well).

**References:** Students are encouraged to make use of QE11 Library, the world-wide-web (www), and internet resources in addition to the textbook to help learn concepts and write reports.

**Lecture Notes:** <http://www.engr.mun.ca/~asharan/courses/3911_LECTURES/>

**MAJOR TOPICS:**

* Ch1: Introduction to Materials Science & Engineering
* Ch2: Atomic Structure & Interatomic Bonding
* Ch3: The Structure of Crystalline Solids
* Ch4: Imperfections in Solids
* Ch6: Mechanical Properties
* Ch7: Deformation & Strengthening Mechanisms
* Ch12: Structures & Properties of Ceramics
* Ch14: Polymer Structures
* Ch18: Electrical Properties
* Ch19: Thermal Properties
* Laboratories: REFER TO: <http://www.engr.mun.ca/~asharan/courses/3911_LABS/> for more information regarding LAB MANUALS
* Laboratory 1: ( a ) VERNIERS AND UNCERTAINITIES, ( b ) APPLICATIONS OF SEMICONDUCTORS IN THE FIELD OF ALTERNATE ENERGY
* Laboratory 2: ELASTIC PROPERTIES OF RUBBER
* Laboratory 3: ELECTRICAL RESISTANCE AND RESISTIVITY Laboratory 4: THERMAL CONDUCTIVITY

**ASSESSMENTS:**

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|  | **BETTER OF THE TWO OPTIONS** |
| **OPTION 1** | **OPTION 2** |
| **ASSIGNMENT**  | **5** | **5** |
| **LAB** | **15** | **15** |
| **TEST ( OCT 21, 2019)** **TENTATIVE** | **25** | **30** |
| **FINAL** | **55** | **50** |
| **TOTAL** | **100** | **100** |

Assignments are submitted using D2L only by **4 P.M. on the due date**. Late assignments will not be marked unless the student provides a medical doctors note (sickness). All labs are required to be performed and the students are required to read the lab manual before coming to the lab. If a student does not participate in a lab then he or she will receive an incomplete in the course. Lab reports can be written at home. These reports which are written at home must by uploaded by 5 P.M. on the 5th day from the day the lab is done. Count the day as 1 when the lab is performed. The students have to submit labs in group- one report per group.

 Calculators for midterm and final ***exam should performed using a simple non-programmableones only.. If notes or formulas can be stored on the calculator then they should be deleted prior to the midterm or final exam, since this constitutes an Academic Offence “using unauthorized aids” page 77 of the MUN 2012-2013 Calendar.***

Assignments   5% (1% each)

 Assignment 1(Ch2) Sept 25

 Assignment 2(Ch3) Oct. 2

 Assignment 3(Ch4) Oct. 9

 Assignment 4(Ch6) Oct 30

 Assignment 5(Ch7) Nov 6

**Labs (4 total) 15% Due at on the 5th day from the day the lab is performed.**

**PLEASE NOTE**:

1. TEST AND FINAL – CLOSED BOOK ;
	1. NO FORMULA SHEETS ALLOWED. PROBLEMS TO BE SOLVED USING FORMULAS GIVEN IN THE TEST OR FINAL
	2. SIMPLE CALCULATOR IS ALLOWED.
2. TEST AND FINAL TOGETHER = 80 MARKS , WHICH WILL HAVE THEORY QUESTIONS = 65 MARKS MORE OR LESS, AND NUMERICAL PROBLEMS = 15 MARKS APPROXIMATELY.
3. NUMERICAL PROBLEMS WILL BE SIMILAR TO ASSIGNMENTS QUESTIONS OR WORKED OUT PROBLEMS IN THE BOOK OR IN THE CLASS.
4. THE TEST OR FINAL –HAS TO BE WRITTEN IN INK WITH A FONT SIZE APPROXIMATELY EQUAL TO 12 OR GREATER
5. ANY SKETCHES DRAWN HAVE TO BE CLEAR AND CLEAN.
6. LAB INSTRUCTIONS CAN BE DOWNLOADED FROM MY WEBSITE <http://www.engr.mun.ca/~asharan/courses/3911_LABS/>
	1. FOR LAB 1, PLEASE DOWNLOAD THE FOLLOWING FILES FROM THE ABOVE WEBSITE :
		1. [LabManual2009.doc](http://www.engr.mun.ca/~asharan/courses/3911_LABS/LabManual2009.doc) 05-Sep-2009 15:35 40K
		2. [INSTRUCTIONS\_LAB1.pdf](http://www.engr.mun.ca/~asharan/courses/3911_LABS/INSTRUCTIONS_LAB1.pdf) 03-Sep-2009 14:08 691K
		3. [CALIP\_MICRO\_UNCERT\_V1.pdf](http://www.engr.mun.ca/~asharan/courses/3911_LABS/CALIP_MICRO_UNCERT_V1.pdf) 09-Sep-2009 14:25 568K
		4. [USE\_OF\_SEMICONDUCTING\_MATERIALS.docx](http://www.engr.mun.ca/~asharan/courses/3911_LABS/USE_OF_SEMICONDUCTING_MATERIALS.docx)
7. LAB TEACHING ASSISTANTS WILL SHOW - HOW TO DO THE LABS, AND WILL HELP YOU IN WRITING YOUR REPORTS. REPORTS CAN BE WRITTEN USING FIGURES IN THE INSTRUCTION MANUAL. YOU CAN BRING YOUR OWN DIGITAL CAMERA AND TAKE PHOTO OF THE APPARATUS WHICH CAN REPLACE SKETCHING WHILE EXPLAINING IN YOUR REPORT.
8. NAME OF EACH STUDENT HAS TO BE WRITTEN IN THE REPORT. LAB INSTRUCTORS WILL RECORD THE NAME OF ANY STUDENT WHO WILL BE ABSENT
9. AGAIN, ALL THE LABS ARE REQUIRED TO BE PERFORMED - TO COMLETE THE COURSE.
10. TO DOWNLOAD THE LECTURE TRANSPARENCIES – STUDENTS HAVE TO ( REQUIRED) PURCHASE 7th, or 8th, or 9th EDITION OF THE TEXTBOOK.
11. TEST MARKS RE-EVALUATION – IT HAS TO BE SUBMITTED FIRST FOR RE-EVALUATION. THIS RE-EVALUATION IS DONE WITHOUT LOOKING AT THE FIRST SET OF MARKS SIMILAR TO THAT DONE IN THE UNIVERSITY PROCEDURE FOR RE-EVALUATION.

**LEARNING OUTCOMES:**

Course Level Graduate Attribute Focus: KB-D, PA-I, Inv-I

Upon successful completion of this course, the student will be able to:

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|  | **LEARNING OUTCOMES** | **GRADUATE ATTRIBUTES. LEVEL OF COMPETENCE** | **Methods of Assessment** |
| 1 | Identify, draw, and describe the structures of crystalline solids | KB-I | Assignments, Labs, Test, Final |
| 2 | Define what crystal systems are and determine crystallographic directions and planes. | KB-D, PA-I | Assignments, Test, Final Exam |
| 3 | Define imperfections in solids and their effect on mechanical | KB-D | Assignments, Test, Final Exam |
| 4 | Define and describe stress-strain behavior of metals, polymers, and ceramics. | KB-D | Assignments, Labs, Test, Final Exam |
| 5 | Explain/recall the fundamental classes of materials and their structure/properties | KB-D | Assignments, Test, Final Exam |
| 6 | Show familiarity with experimental testing of tensile-compressive-loading hardness  | KB-D | Labs |
| 7 | Define and describe the features of a binary phase diagram (phases, compositions, mass fractions, microstructures). | KB-D | Assignments, Test, Final Exam |
| 8 | Describe the different crystal structures of ceramics. | KB-D | Assignments, Test, Final Exam |
| 9 | Describe the characteristic mechanical properties of ceramics. | KB-D | Assignments, Test, Final Exam |
| 10 | Describe the different types of polymers (thermoplastics, thermosets). | KB-D | Assignments, Test, Final Exam |
|  11 | Describe the characteristic mechanical properties of polymers. | KB-D | Assignments, Test, Final Exam |
|  15 | Use experimental techniques and computational skills, along with critical thinking, to analyze material properties. | KB-D, PA-I, Inv-I | Assignments, Test, Final Exam |

\*Each Graduate Attribute for each learning outcome is rated at a Content Instructional Level of I=Introduced, D=Intermediate Development, or A=Advanced Application.

See [www.mun.ca/engineering/undergrad/graduateattributes.pdf](http://www.mun.ca/engineering/undergrad/graduateattributes.pdf) for definitions on the 12 Graduate Attributes and the Content Instructional Levels.

**ACADEMIC INTEGRITY AND PROFESSIONAL CONDUCT:**

Students are expected to conduct themselves in all aspects of the course at the highest level of academic integrity. Any student found to commit academic misconduct will be dealt with according to the Faculty and University practices. More information is available at <http://www.mun.ca/engineering/undergrad/academicintegrity.php>

Students are encouraged to consult the Faculty of Engineering and Applied Science Student Code of Conduct at <http://www.mun.ca/engineering/undergrad/academicintegrity.php> and Memorial University’s Code of Student Conduct at <https://www.mun.ca/student/supports-and-resources/respectful-campus/student-code-of-conduct.php>.

**INCLUSION AND EQUITY:**

Students who require accommodations are encouraged to contact the Glenn Roy Blundon Centre, <http://www.mun.ca/blundon/about/index.php>.  The mission of the Blundon Centre is to provide and co-ordinate programs and services that enable students with disabilities to maximize their educational potential and to increase awareness of inclusive values among all members of the university community.

The university experience is enriched by the diversity of viewpoints, values, and backgrounds that each class participant possesses. In order for this course to encourage as much insightful and comprehensive discussion among class participants as possible, there is an expectation that dialogue will be collegial and respectful across disciplinary, cultural, and personal boundaries.

**STUDENT ASSISTANCE:** Student Affairs and Services offers help and support in a variety of areas, both academic and personal. More information can be found at [www.mun.ca/student](http://www.mun.ca/student).