

DEPARTMENT OF MECHANICAL & INDUSTRIAL ENGINEERING

MATERIALS SCIENCE MECH 221

**INSTRUCTOR Section (T):** Dr. M.Medraj, P.Eng. **OFFICE:** EV 12.185

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**CLASS:** Wed. & Fri 10:15 – 11:30 Room: H531

**TUTORIALS:** TA, TB, TC

**COURSE HOMEPAGE:** <http://users.encs.concordia.ca/~mmedraj/mech221.html> **OFFICE HOURS:** Wednesday 2:30 – 4:00

**CALENDAR DESCRIPTION**

*MECH 221 Materials Science (3 credits) Prerequisite: CHEM 205 (Cegep Chemistry 101). Relationships between properties and internal structure, atomic bonding; molecular, crystalline and amorphous structures, crystalline imperfections and mechanisms of structural change. Microstructures and their development from phase diagrams. Structures and mechanical properties of polymers and ceramics. Thermal, optical, and magnetic properties of materials. Lectures: three hours per week. Tutorial: one hour per week.*

**TEXT BOOKS:** *“Materials Science and Engineering: An Introduction”* 10<sup>th</sup> Edition, Callister & Rethwisch, Wiley. The current edition is available only as an ebook through Wiley ( [www.wileyplus.com/class/654370](http://www.wileyplus.com/class/654370) ). You can purchase the ebook only, or subscribe to the WileyPlus experience which has additional resources to the text. A hardcopy of the 5<sup>th</sup> to 9<sup>th</sup> Edition will also work. Copies of my Overhead Transparencies are available in .pdf format on the Moodle site either as one slide per page, or two slides per page.

**Related Material:** There are other texts and reference material in the Library on all aspects of Engineering Materials if you require further information or a different explanation. Concordia University Library: TP1120 - Plastics, TP800 – Ceramics, TA400 – Materials, TA418.9 – Composites

**COURSE LEARNING OUTCOMES & GRADUATE ATTRIBUTES**

The objective of this course is to provide you with a basic understanding into the structure, behaviour and properties of the typical, common engineering materials - metals, ceramics, polymers and composites and the methods of observing, measuring and interpreting these properties. In the course of their professional lives, engineers often have to use scientific theories, experimental data and specific knowledge of certain practices in order to complete projects, solve problems or interact with other engineers and professionals. In this course this aspect will be included and comprehension and application of this knowledge will be covered by assignment and exam problems.

Attribute	Indicator	Level of knowledge
A knowledge base for engineering - <i>Demonstrated competence in university-level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.</i>	Knowledge-base of natural science	INTRODUCTORY

**COURSE LEARNING Outcomes (CLOs)**

Upon successful completion of MECH221, the students will be able to:

Course Learning Outcome	Graduate Attribute
Describe the importance of atomic bonding on the structure and behaviour of engineering materials	A knowledge base for engineering/ Knowledge-base of natural science
Demonstrate a knowledge and understanding of the different material systems, their structures and physical properties	A knowledge base for engineering/ Knowledge-base of natural science
Explain diffusion behaviour in solids through a knowledge of atomic structure and laws of diffusion	A knowledge base for engineering/ Knowledge-base of natural science
Demonstrate an understanding of the basic mechanical behaviour of materials and explain the difference between strength and stiffness	A knowledge base for engineering/ Knowledge-base of natural science
Use phase diagrams to describe alloy microstructures and calculate expected phase compositions and proportions, in particular in the Fe-Fe <sub>3</sub> C system	A knowledge base for engineering/ Knowledge-base of natural science
Explain how the bonding and atomic structure of the different materials affects their thermal, electrical and optical behaviour	A knowledge base for engineering/ Knowledge-base of natural science

**REASONING**

The reason why knowledge of materials is useful to you is that all engineers make use of materials in one form or other whether they are designing gas turbine engines, DVD players, roller blades or an artificial hip joint and the ability to make the correct selection of material for a particular application or to understand the response of a material to an applied condition, is of paramount importance. Choosing a suitable material for an application is a demanding task as mistakes can be costly in many ways, and an understanding of the structure and behaviour of materials are essential to go beyond the "well, this is what they used last time" approach.

**LECTURES**

You are strongly advised to attend all lectures and to go through the upcoming material before coming to class.

**SYLLABUS**

- Introduction to Materials Science (Chp. 1)
- Atomic Structure & Interatomic Bonding (Chp. 2)
- The Structure of Crystalline Solids (Chp. 3)
- Imperfections in Crystals (Chp. 4)
- Diffusion (Chp. 5)
- Mechanical Properties of Metals (Chp. 6.1 – end of 6.6, 6.10)
- Dislocations & Strengthening Mechanisms (Chp. 7.1 – end of 7.4)
- Phase Diagrams (Chp. 9.1 – end of 9.15, 9.18 – end of 9.19)
- Structures, Properties, Applications and Processing of Ceramics (Chps. 12 and 13)
- Polymer Structures (Chp. 14)
- Applications & Processing of Polymers (Chp. 15)
- Electrical, Thermal, and Optical Properties (Chps. 18.1-18.15, 19, 21)

**EVALUATION:**

In-Tutorial Assignment Problems .....	15 %
Midterm (In-class) .....	30 %
Final Exam (3hrs closed book).....	55 %

**Midterm Examination:** The date for the midterm has been tentatively scheduled for October 19<sup>th</sup> in class. The midterm is voluntary: if you do the midterm then it can count towards your final mark if it will improve your mark. If you do not do the midterm or do not do well in it, then it will not be included in your final mark. NOTE that you need to receive a passing mark on the coursework to be eligible for a medical deferral of the final exam should the need arise.

**Assignments & Tutorial Problems:** Sample questions will be posted on the web page. Solutions will be covered in tutorials. They will NOT be marked but these questions will be used as the basis for the In-Tutorial Assignment Problems which will take place every second tutorial and will be marked (15% total).

**Students must obtain a passing mark on the final exam in order to pass the course.**

**ACADEMIC ADVISING**

Student Academic Services – ENCS – EV 2.125 [<http://www.encs.concordia.ca/scs/index.html>]  
 Undergraduate Program Assistant – MIE - EV004.144 <[mie-upa@encs.concordia.ca](mailto:mie-upa@encs.concordia.ca)>

**Disclaimer**

*In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.*

## ADDENDUM TO THE COURSE OUTLINE

### ACADEMIC CONDUCT ISSUES

#### The basic ten rules that make you a good engineer

The B. Eng. program is set to satisfy most of the requirements for your education and prepares you for a professional engineering career that requires dedication and knowledge. What you learn, and how you learn, will be used extensively in your engineering profession for the next 30 to 40 years. Therefore, the four years spent in the engineering program are crucial towards your professional formation. The first step is for you to learn to “think like an engineer” which means:

- accept responsibility for your own learning
- follow up on lecture material and homework
- learn *problem-solving skills*, not just how to solve each specific homework problem
- build a body of knowledge integrated throughout your program
- behave responsibly, ethically and professionally

One of the mainstays of being a professional engineer is a professional code of conduct and as an engineering student this starts with the Academic Code of Conduct (Article 16.3.14 of the undergraduate calendar). However, you may encounter situations that fall outside the norm and in such cases, you use your common sense.

Further, the following issues should be given serious consideration:

- 1) Attendance at lectures and tutorials are major learning opportunities and should not be missed. The labs represent a unique opportunity for you to acquire practical knowledge that you will need in your career. Class and tutorial attendance is important for you to comprehend the discipline and make the connections between engineering skills. You are strongly encouraged to participate in the class, ask questions and answer the instructor’s questions. Tutorials are just extensions of the classes in which application of the concepts presented during the lectures are presented and problems are practically solved.
- 2) The decision to write tests that are not mandatory is entirely yours. For example, midterm test are often stated in many courses as optional. However, one the objectives of midterms is to check on your comprehension of the material and allow time for whatever action is necessary (from more study time to discontinuing a course). Plan to attend the class tests even if they are not mandatory. If you pay attention in the lectures, it will take you significantly shorter time to comprehend the material. **Note also** that if you are in the unfortunate position of being unable to write a final exam due to medical reasons and seek a deferral, this may not be possible if the instructor has no information indicating that you have been attending the course and assimilating the material (ie through midterms, quizzes, assignments etc).
- 3) Homework is usually mandatory and it has some weight in the final grade (such information is given in the course outline). Homework may also be conceived as training material for the class tests. Under all circumstances, it is highly recommended to carry out the home work on time and submit it on the prescribed date. Late submissions are not granted to individual cases regardless of the reason. This is part of the training for being in the workforce where deadlines have to be met. Please, plan your work such that you submit all the assignments and lab reports on time and in the correct place (not in the corridor or on the street!).
- 4) Office hours with tutors, lab instructors or class instructors are listed in the course outline/website/office doors. Please respect these office hours and in case you have a serious conflict, contact the instructor asking for a special time arrangement.

- 5) Class tests (midterms, quizzes) are returned to the student. The final exams are not. If you wish to see your exam paper, be aware that most instructors allow only a narrow window of time for that purpose. For the fall term, exams may usually be reviewed in January and May for the spring term.
- 6) When you see your marked work (assignments, midterms, final exam etc), be aware that you are supposed to review your material and see the type of errors you made and if marks have been added incorrectly. This is not an opportunity to try and “negotiate” a higher grade with the instructor. If you believe that your grade is not right, you may apply for a formal Course Reevaluation through the Birks Student Centre.
- 7) Writing tests and exams represents a major component of your course work. These tests and exams have rigorous requirements such as:
  - **No cell phone or other communication enabling tool is allowed on the student** during the examination period.
  - Only **specified faculty calculators** are allowed during tests and exams unless otherwise indicated by the instructor.
  - Usually, **no materials** are allowed in the exam unless otherwise announced.Get used to signing in and out of your exam. Make sure that you leave your exam papers with the invigilator. There are rules concerning general exam issues in the UG Calendar. These requirements are there to eliminate any possible misunderstanding and you are asked to **respect the rules**. Disciplinary measures are taken when the rules are not followed.
- 8) Respect your colleagues and those that you meet during the class: tutors, instructors, lab instructors, technical personnel, assistants, etc. Use appropriate communication means and language. Be considerate for all human beings. This includes small things such as turning off cell-phones before a class begins. Concordia University is a very diverse group of people and a very large multicultural community.
- 9) Communication is part of your future profession. Learn how to communicate effectively and efficiently in the shortest time possible. Write short but meaningful e-mails, make effective phone calls, etc. If your instructor accepts emails make sure that your request is clear with the course number and your name in the *Subject* line. Do not ask for special treatment as instructors have to treat all students equitably.
- 10) Respect all the above and you will get closer to your future profession.