

Course Outline

1. COURSE INFORMATION

Session Offered	Summer 2022	
Course Name	Structure and Properties of Materials	
Course Code	ENGTECH 3SP3-C01	
Date(s) and Time(s) of lectures	Friday, May 6 th to August 5 th , 2021 6:30 – 9:30 pm (please see the course schedule)	
Program Name	Manufacturing Engineering Technology & Civil Engineering Infrastructure	
Calendar Description	Crystal structures; imperfections in solids; mechanical properties of metals; dislocations and strengthening mechanisms; fracture and failure; phase diagrams; phase transformation in metals; processing of metal alloys; composites; structures and properties of ceramics and polymers.	
Instructor(s)	Dr. Gordana Cingara	E-Mail: cingara@mcmaster.ca Office Hours & Location: online WebEx

2. COURSE SPECIFICS

Course Description			
Instruction Type	Code	Type	Hours per term
	C	Classroom instruction	36
	L	Laboratory, workshop or fieldwork	3
	T	Tutorial	
	DE	Distance education	
	Total Hours		36
Resources	ISBN	Textbook Title & Edition	Author & Publisher
	ISBN: 978-1-119-40549-8.	Materials Science and Engineering, An Introduction, 10 th or 9 th Ed.	William D. Callister, Jr. & David Retwisch, Publ. John Wiley
	Other Supplies	Source	
Prerequisite(s)	Registration in Manufacturing Engineering Technology / Civil Engineering Infrastructure		
Corequisite(s)	None		
Antirequisite(s)	ENG TECH 2MN3, 3MN3		
Course Specific Policies			
Departmental Policies	<p>Students must maintain a GPA of 3.5/12 to continue in the program.</p> <p>In order to achieve the required learning objectives, on average, B.Tech. students can expect to do at least 3 hours of “out-of-class” work for every scheduled hour in class. “Out-of-class” work includes reading, research, assignments and preparation for tests and examinations.</p> <p>Where group work is indicated in the course outline, such collaborative work is mandatory.</p> <p>The use of cell phones, iPods, laptops and other personal electronic devices are prohibited from the classroom during the class time, unless the instructor</p>		

	<p>makes an explicit exception.</p> <p>Announcements made in class or placed on Avenue are considered to have been communicated to all students including those individuals that are not in class.</p> <p>Instructor has the right to submit work to software to identify plagiarism.</p>	
3. SUB TOPIC(S)		
Week 1	<p>Introduction</p> <ul style="list-style-type: none"> • Classification of materials, bonding 	Chapter 1, 2
Week 2	<p>Structure of Crystalline Solids</p> <ul style="list-style-type: none"> • Crystal structures • Crystallographic directions and planes • Crystalline and noncrystalline materials, anisotropy 	Chapter 3
Week 3	<p>Mechanical Properties</p> <ul style="list-style-type: none"> • Elastic properties of materials, stress-strain behavior • Plastic deformation, tensile testing • Hardness measurements 	Chapter 6
Week 4	<p>Imperfections in Solids</p> <ul style="list-style-type: none"> • Vacancies; dislocations and plasticity • Grain boundaries <p>Miscellaneous imperfections, volume defects in solidification</p>	Chapter 4
Week 5	<p>Microscopy Examination and Characterization Techniques</p> <ul style="list-style-type: none"> • XRD, optical, SEM and TEM • Grain size 	Chapter 4
Week 6	<p>Strengthening Mechanisms in Metals and Alloys</p> <ul style="list-style-type: none"> • Slip systems, slip in single crystals and plastic deformation of polycrystalline materials. • Mechanisms of strengthening in metals. • Annealing (recovery, recrystallization) 	Chapter 7
Week 7	Mid-term test (date conditional)	
Week 8	<p>Failure</p> <ul style="list-style-type: none"> • Brittle and ductile fracture, toughness, fractography • Fatigue, S-N curve, fatigue fracture; Creep • Failure analysis concept 	Chapter 8
Week 9	<p>Phase Transformations in Metals</p> <ul style="list-style-type: none"> • Solubility and solid solutions • Binary phase diagrams (isomorphous, eutectic, peritectic) and microstructure development <p>Materials of importance (led free alloys, automotive alloys)</p>	Chapter 9
Week 10	<p>Iron-Carbide Phase Diagram</p> <ul style="list-style-type: none"> • Definitions and basic concepts of steels and cast irons • Microstructural and property changes in iron-carbon alloys • Heat treatment of steels, TTT diagrams, tempering, carburizing 	Chapter 10
Week 11	<p>Applications and Processing of Alloys</p> <ul style="list-style-type: none"> • Ferrous and nonferrous alloys • Classifications of steels, stainless and tool steels • Aluminum alloys, classification and application • Precipitation hardening 	Chapter 11
Week 12	<p>Corrosion and Degradation of Materials</p> <ul style="list-style-type: none"> • Electrochemical considerations, corrosion of metals, forms, 	Chapter 17

	and prevention. Ceramic Materials <ul style="list-style-type: none"> • Ceramic structures and mechanical properties • Types, properties and applications of ceramics • Glasses, Clays, Refractories, Abrasives & Advanced Ceramics 	Chapters 12, 13
Week 13	Polymer materials <ul style="list-style-type: none"> • Polymer structure Mechanical behavior and mechanisms of deformation <ul style="list-style-type: none"> • Composite materials Introduction to metal matrix composites, polymer matrix composites and ceramic matrix composites <ul style="list-style-type: none"> • <i>Review</i> 	Chapter 15 Chapter 16
Week 14	Final Exam, August 5 th	
Classes end: Friday, August 5 th Final Examination Period: Final Week of Classes All examinations MUST be written during the scheduled examination period.		
Note that this structure represents a plan and is subject to adjustment term by term. The instructor and the University reserve the right to modify elements of the course during the term. The U may change the dates and deadlines for any or all courses in extreme circumstances. If either type of mo becomes necessary, reasonable notice and communication with the students will be given with explana the opportunity to comment on changes.		
ASSESSMENT OF LEARNING *including dates*		Weight
4. Assignments & Quizzes		30%
Mid-term test		30%
Project		
Labs		
Final examination (tests cumulative knowledge)		40%
TOTAL		100%
Percentage grades will be converted to letter grades and grade points per the University calendar.		
5. LEARNING OUTCOMES		
Categorize material strengthening process based on chemical composition and microstructure.		
1. Classification of material failure mechanism from post mortem examination of fracture surfaces.		
2. Categorize structure of crystalline solids and discuss the imperfections in solids.		
3. Recommend the use of specific material as a function of microstructure, mechanical properties, manufacturability, mechanical loading application and environmental conditions.		
4. 6. POLICIES		
Anti-Discrimination		
The Faculty of Engineering is concerned with ensuring an environment that is free of all discrimination. If there is a problem, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible. http://www.mcmaster.ca/policy/General/HR/Discrimination_Harassment_Sexual_Harassment-Prevention&Response.pdf		
Academic Integrity		
You are required to exhibit honestly and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned		

academic credit or advantage. This behaviour can result in serious consequences e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, located at: <http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf>.

The following illustrates only three forms of academic dishonesty:

1. Plagiarism. E.g. the submission of work that is not own or for which other credit has been obtained
2. Improper collaboration in group work
3. Copying or using unauthorized aids in tests and examinations.

Requests for Relief for Missed Academic Term Work (Assignments, Mid-Terms, etc.)

The McMaster Student Absence Form is an on-line self-reporting tool for Undergraduate Students to report absences for:

- 1) Relief for missed academic work worth less than 25% of the final grade resulting from medical or personal situations lasting up to three calendar days:
 - Students may submit a maximum of one academic work missed request per term. It is the responsibility of the student to follow up with instructors immediately (within the 3 day period that is specified in the MSAF) regarding the nature of the accommodation. All work due in that time period however can be covered by one MSAF.
 - MSAF cannot be used to meet religious obligation or celebration of an important religious holiday, for that has already been completed or attempted or to apply for relief for any final examination or its equivalent.
- 2) For medical or personal situations lasting more than three calendar days, and/or for missed academic work worth 25% or more of the final grade, and/or for any request for relief in a term where the MSAF has not been used previously in that term:

Students must visit their Associate Dean's Office (Faculty Office) and provide supporting documentation.

E-Learning Policy

Consistent with the Bachelor of Technology's policy to utilize e-learning as a complement to traditional classroom instruction, students are expected to obtain appropriate passwords and accounts to access Avenue To Learn for this course. Materials will be posted by class for student download. It is expected that students will avail themselves of these materials prior to class. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, user names for the McMaster e-mail account, and program affiliation may become apparent to all other students in the course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about this disclosure please discuss this with the course instructor. Avenue can be accessed via

<http://avenue.mcmaster.ca>.

Communications

It is the student's responsibility to:

- Maintain current contact information with the University, including address, phone numbers, and emergency contact information.
- Use the University provided e-mail address or maintain a valid forwarding e-mail address.
- Regularly check the official University communications channels. Official University communications are considered received if sent by postal mail, by fax, or by e-mail to the student's designated primary e-mail account via their @mcmaster.ca alias.
- Accept that forwarded e-mails may be lost and that e-mail is considered received if sent via the student's @mcmaster.ca alias.

Check the McMaster/Avenue email and course websites on a regular basis during the term.

Turnitin (Optional)

This course will be using a web-based service (Turnitin.com) to reveal plagiarism. Students submit their assignment/work electronically to Turnitin.com where it is checked against the internet, published works and Turnitin's database for similar or identical work. If Turnitin finds similar or identical work that has not been properly cited, a report is sent to the instructor showing the student's work and the original source. The instructor reviews what Turnitin has found and then determines if he/she thinks there is a problem with the work. Students who do not wish to submit their work to Turnitin.com must still submit a copy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, etc.). To see the Turnitin.com Policy, please go to <http://www.mcmaster.ca/academicintegrity/turnitin/students/>

Protection of Privacy Act (FIPPA)

The Freedom of Information and Protection of Privacy Act (FIPPA) applies to universities. Instructors should take care to protect student names, student numbers, grades and all other personal information at all times. For example, the submission and return of assignments and posting of grades must be done in a manner that ensures confidentiality. <http://www.mcmaster.ca/univsec/fippa/fippa.cfm>

Academic Accommodation of Students with Disabilities Policy

Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information consult McMaster's policy for Academic Accommodation of Students with Disabilities <http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicAccommodation-StudentsWithDisabilities.pdf>

Students must forward a copy of the SAS accommodation to the instructor of each course and to the Program Administrator of the B.Tech. Program immediately upon receipt. If a student with a disability chooses NOT to take advantage of a SAS accommodation and chooses to sit for a regular exam, a petition for relief may not be filed after the examination is complete. <http://sas.mcmaster.ca>

Student Code of Conduct

The Student Code of Conduct (SCC) exists to promote the safety and security of all the students in the McMaster community and to encourage respect for others, their property and the laws of the land. McMaster University is a community which values mutual respect for the rights, responsibilities, dignity and well-being of others. The purpose of the Student Code of Conduct is to outline accepted standards of behavior that are harmonious with the goals and the well-being of the University community, and to define the procedures to be followed when students fail to meet the accepted standards of behavior. All students have the responsibility to familiarize themselves with the University regulations and the conduct expected of them while studying at McMaster University. http://studentconduct.mcmaster.ca/student_code_of_conduct.html