

Course Outline

1. COURSE INFORMATION

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| Session Offered | Fall 2020 | |
| Course Name | Structure and Properties of Materials | |
| Course Code | AUTOTECH 2MT3 | |
| Date(s) and Time(s) of lectures | Tuesdays 12:30-2:20 Wednesdays 1:30-2:20 | |
| Program Name | Automotive and Vehicle Technology | |
| Calendar Description | Physical properties including tensile and impact of materials, ductile and brittle fracture, testing, applications and selection of ceramics, metals and alloys, polymers and advanced materials used in automobiles and vehicles. Metal casting for automotive applications. Case studies. | |
| Instructor(s) | Doris Clayton | E-Mail: claytodb@mcmaster.ca |

2. COURSE SPECIFICS

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| Course Description | | | |
| Instruction Type | Code | Type | Hours per term |
| | C | Classroom instruction | 39 |
| | L | Laboratory, workshop or fieldwork | 39 |
| | T | Tutorial | |
| | DE | Distance education | |
| | Total Hours | | 78 |
| Resources | Other Supplies | Source | |
| | AUTO TECH 2MT3 Laboratory Manual | available on Avenue to Learn | |
| | Course notes and reference materials | available on Avenue to Learn | |
| Prerequisite(s) | ENG TECH 1CH3, 1ME3, 1PH3 | | |
| Corequisite(s) | Students must attend and participate in all laboratory exercises in order to receive credit for each experiment. Late report submissions will not be accepted. | | |
| Antirequisite(s) | <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 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> | | |

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| | Instructor has the right to submit work to software to identify plagiarism. |
| Course Specific Policies | Students must attend and participate in all laboratory exercises in order to receive credit for each experiment. Late report submissions will not be accepted. |
| 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 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> |
| SUB TOPIC(S) | |
| Week 1 | Module 1: Introduction Overview of Materials Science Classes of materials Property considerations for specific applications |
| Week 2 | Module 2: Structure of Materials Atomic structure and bonding Crystal structure Density calculations Crystallographic planes and directions |
| Week 3 | Module 2: Structure of Materials X-ray diffraction Nucleation and grain growth of crystals Defects in crystalline solids |
| Week 3, 4 | Module 3: Measurement of Mechanical Properties Tensile testing Hardness Impact testing Fatigue and creep testing |
| Week 5 | Module 4: Metals Forming operations Alloys and phase diagrams Lever rule calculations |
| Week 6 | Module 4: Metals |

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| | The iron-carbon phase diagram Equilibrium and non-equilibrium phases The heat treatment of carbon steels |
| Week 6, 7 | Module 4: Metals Precipitation hardening Aluminum alloys Copper Alloys |
| Week 8 | Module 5: Corrosion Electrochemical cells and the galvanic series Types of corrosion Materials selection and design for corrosion prevention Cathodic and anodic protection Coatings |
| Week 9 | Module 6: Polymers Polymer chemistry Polymer structure Production of polymers Mechanical properties of polymers |
| Week 10 | Module 7: Composite materials Properties, synthesis and design of fibre composites Properties and examples of particulate composites Laminar and sandwich composites |
| Week 11 | Module 8: Transformations of Stress Calculations involving plane stresses and principal stresses Maximum shearing stress |
| Week 12 | Module 8: Transformations of Stress Stress transformations using Mohr's circle Three-dimensional analysis of stresses |
| Week 13 | Module 9: Deflection of Beams Deformation of a beam under transverse loading Equation of the elastic curve Determination of the elastic curve from load distribution |
| Week 14 | Review |
| Classes end: Wednesday, December 9 Final examination period: Thursday, December 10 to Friday, December 23 All examinations MUST be written during the scheduled examination period. | |
| List of experiments | |
| Lab 1 | Plastic deformation |
| Lab 2 | Mechanical properties of metals |
| Lab 3 | Plastic deformation |
| Lab 4 | Annealing heat treatment |
| Lab 5 | Hardening of steel |
| Lab 6 | Tempering of steel |
| Lab 7 | Precipitation hardening of aluminum alloy |
| Lab 8 | Characterization of composites |

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| Lab 9 | Mechanical properties of plastics |
| Lab 10 | AMRC lab tour and workshop (<i>subject to availability</i>) |
| Lab 11 | Electron microscopy demo (<i>subject to availability</i>) |

| ASSESSMENT OF LEARNING | WEIGHT |
|---|-------------|
| Mid-term test #1 (1.5 hours, week 5 (approx.)) | 20 |
| Mid-term test #2 (1.5 hours, week 10 (approx.)) | 20 |
| Labs | 30 |
| Final examination (tests cumulative knowledge) | 30 |
| TOTAL | 100% |

Percentage grades will be converted to letter grades and grade points per the University calendar.

5. LEARNING OUTCOMES

1. Relate the microstructures of materials to their physical and mechanical properties
2. Perform various mechanical tests (including tensile, hardness, impact) on both metals and non-metals and report the results
3. Prepare metallographic samples and examine basic microstructures using an optical microscope
4. Use binary phase diagrams to interpret the results of heat treating ferrous and non-ferrous metals and recommend heat treatment schedules for specific applications
5. Differentiate between the different types of corrosion and select strategies for minimizing corrosion
6. Evaluate the state of stress on various materials under various loading conditions
7. Apply the principles of mechanics of materials to the deflection of beams and shafts under various loads

6. COURSE OUTLINE – APPROVED ADVISORY STATEMENTS

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 expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. It is your responsibility to understand what constitutes academic dishonesty.

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. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty: The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

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.

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the Code of Student Rights & Responsibilities (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, whether in person or online.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

McMaster Student Absence Form (MSAF): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

ACADEMIC ACCOMMODATION FOR RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVANCES (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests. <http://www.mcmaster.ca/policy/Students-AcademicStudies/Studentcode.pdf>

COPYRIGHT AND RECORDING

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.