

# Course Outline

## 1. COURSE INFORMATION

<b>Session Offered</b>	Fall 2024	
<b>Course Name</b>	Manufacturing Engineering	
<b>Course Code</b>	MECH ENG 3C03	
<b>Program Name</b>	Bachelor of Mechanical Engineering	
<b>Calendar Description</b>	<p>Study of mechanical properties and behavior of materials in manufacturing, including elastic-plastic deformation and property assessments.</p> <p>Overview of manufacturing processes including metal removal and forming processes, heat treatment, and surface engineering techniques.</p> <p>Study of physics-based manufacturing models, residual stresses, and sustainable manufacturing practices.</p>	
<b>Instructor</b>	Dr. Maryam Aramesh	E-Mail: <a href="mailto:arameshm@mcmaster.ca">arameshm@mcmaster.ca</a> Office Hours: Tuesdays, 14:30 to 16:30 Location: virtual/MS teams
<b>T.A.s</b>	Ahmadniafeizabadi, Masoud Akande, Damilare Lateefat (Lateefat) Hashemi Khosrowshahi, Javad Rahimi, Mohammad Rimal, Luke Anthony Seyam, Mahmoud Shiravi Khouzani, Hosseinali (Hossein) Soliman, Hatem	

## 2. COURSE SPECIFICS

<b>Course Description</b>	<p>This course introduces the fundamentals of materials science and behavior, emphasizing conditions characterized by large strain, high strain rates, and elevated temperatures experienced in manufacturing processes.</p> <p>It also covers materials characterization techniques and constitutive equations, including the Johnson-Cook model for predicting material behavior during manufacturing. Students will explore the fundamentals of heat treatment, including techniques used in surface engineering. The course will also introduce metal removal processes, including the study of physics-based models to predict shear angles, cutting forces, cutting temperatures, and also discussed wear and failure mechanisms in machining operations. Furthermore, it provides an introduction to metal forming processes. Sustainable manufacturing practices are highlighted throughout the course.</p>		
<b>Instruction Type</b>	<b>Code</b>	<b>Type</b>	<b>Hours per term</b>
	C	Classroom instruction	36
	L	Laboratory, workshop or fieldwork	
	T	Tutorial	
	DE	Distance education	
	<b>Total Hours</b>		36
<b>Resources</b>	<b>ISBN</b>	<b>Textbook Title &amp; Edition</b>	<b>Author &amp; Publisher</b>

	ISBN 978-0-470-05512-0	DeGarmo's Materials and Processes in Manufacturing	J.T. Black and R.A. Kohser Wiley
	ISBN 978-1-119-45391-8	Materials Science and Engineering	William D. Callister Jr., David G. Rethwisch Wiley
	ISBN 978-1-305076761	The Science and Engineering of Materials, 7th Edition	Donald R. Askeland, Wendelin J. Wright Cengage
	<b>Other Supplies</b>	<b>Source</b>	
<b>Prerequisite(s)</b>			
<b>Corequisite(s)</b>			
<b>Antirequisite(s)</b>			
<b>Course Specific Policies</b>	<p>This course will be using a range of software. 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 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 this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor. The instructor may also use other software including: e-mail and Avenue</p> <p>All assignments must be handed in class and on schedule. All assignments must be handwritten.</p>		
<b>Departmental Policies</b>	<p>Students must maintain a GPA of 4.0 on a 12 point scale to continue in the program.</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 not in class.</p>		

3. SUB TOPIC(S)		
Week 1	<ul style="list-style-type: none"> <li>- Introduction to manufacturing processes and sustainability in manufacturing</li> <li>- Introduction to physical and mechanical properties of materials</li> </ul>	
Week 2	<ul style="list-style-type: none"> <li>- Introduction to physical and mechanical properties of materials-continued               <ul style="list-style-type: none"> <li>o Energy required to induce elastic and plastic deformation.</li> </ul> </li> </ul>	
Week 3	<ul style="list-style-type: none"> <li>- Plastic behaviour of materials               <ul style="list-style-type: none"> <li>o Crystal structure of materials</li> <li>o Mechanisms of plastic deformation</li> </ul> </li> </ul>	
Week 4	<ul style="list-style-type: none"> <li>- Constitutive models: Johnson-Cook model               <ul style="list-style-type: none"> <li>o Effect of strain hardening, and temperature on plastic deformation,</li> <li>o Mathematical modeling of material behavior, incorporating conditions such as strain hardening and thermal softening</li> </ul> </li> </ul>	
Week 5	<ul style="list-style-type: none"> <li>- Constitutive models: Johnson Cook model-continued               <ul style="list-style-type: none"> <li>o Mathematical modeling of material behavior, incorporating conditions such as strain rate sensitivity</li> <li>o Chemical Composition and its effects on mechanical properties</li> </ul> </li> </ul>	
Week 6	<ul style="list-style-type: none"> <li>- Effect of mechanical properties on design and manufacturing processes               <ul style="list-style-type: none"> <li>o Case study on Low carbon high strength steel for automotive applications.</li> </ul> </li> </ul>	
Week 7	<ul style="list-style-type: none"> <li>- Reading Week</li> </ul>	

Week 8	- Mid Term	
Week 9	- Basics of heat treatment <ul style="list-style-type: none"> <li>o An overview of phase diagrams</li> </ul>	
Week 10	o Heat treatment techniques in surface engineering <ul style="list-style-type: none"> <li>o Carbunizing</li> <li>o Nitriding</li> <li>o Surface hardening</li> </ul>	
Week 11	- Basics of metal cutting processes <ul style="list-style-type: none"> <li>o Friction in machining</li> <li>o Wear and failure in machining</li> <li>o Temperature in machining</li> <li>o Forces in machining</li> </ul> - Merchant's circle, relating shear angle, friction angle and rake angle on cutting and feed force.	
Week 12	- Mechanics of metal cutting <ul style="list-style-type: none"> <li>o Orthogonal and oblique cutting configuration,</li> <li>o Introduction to primary shear zone, secondary deformation zone, tertiary deformation zone, shear angle, rake angle, cutting edge radius and edge preparation,</li> </ul>	
Week 13	- Mechanics of metal cutting <ul style="list-style-type: none"> <li>o Shear Angle Models</li> <li>o Merchant's shear angle model,</li> <li>o Lee and Shaffer Slip Line shear angle model.</li> </ul> - Introduction to forming operations	

Final Examination	<a href="#">Final Exam</a> <a href="#">Marking Scheme for Final Exam</a>
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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 University may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes.

4. ASSESSMENT OF LEARNING	Weight
Assignments/Quizzes	30%
Term Test	35%
Project	
Labs	
Participation	
Final Examination	35%
<b>TOTAL</b>	<b>100%</b>

Course results determined on a percentage scale will be converted to an official letter grade, as indicated in the Undergraduate Calendar. The results of all courses attempted will appear on your transcript as letter grades.

5. LEARNING OUTCOMES
1. Competence in Mathematics applied to manufacturing process.
2. Competence in Natural Science (Friction and temperature)
3. Competence in Specialized Engineering knowledge
4. Ability to identify reasonable assumptions that could or should be made before a solution path is proposed
5. Ability to Identify a range of suitable engineering fundamentals that would be potentially useful for analyzing a technical problem
6. Ability to decompose and organize a problem into manageable sub-problems

7. Ability to obtain substantiated conclusions as a result of a problem solution including recognizing the limitations of the solutions

8. Triple bottom line – an ability to design and evaluate complex open ended engineering system using a triple bottom line of sustainability dimensions: social, economic and environment

## 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/Anti-Discrimination%20policy.pdf>

### Academic Integrity

Attention is drawn to the Statement on Academic Ethics and the Senate Resolutions on Academic Dishonesty as found in the Senate Policy Statements distributed at registration and available in the Senate Office. Any student who infringes one of these resolutions will be treated according to the published policy.

Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and 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, specifically Appendix 3, located at:

<http://www.mcmaster.ca/policy/Students-AcademicStudies/AcademicIntegrity.pdf>

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

The McMaster Student Absence Form is a self reporting tool for **Undergraduate Students** to report absences that last up to 5 days and provides the ability to request accommodation for any missed academic work. Please note, this tool cannot be used during any final examination period.

You may submit a maximum of 1 Academic Work Missed requests per term. It is YOUR responsibility to follow up with your Instructor immediately regarding the nature of the accommodation.

If you are absent more than 5 days or exceed 1 request per term you MUST visit your Associate Dean's Office (Faculty Office). You may be required to provide supporting documentation.

This form should be filled out immediately when you are about to return to class after your absence.

<http://www.mcmaster.ca/msaf/>

### 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. 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 will be expected to submit their work electronically to Turnitin.com and in hard copy so that it can be checked for academic dishonesty. 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/>

### **Protection of Privacy Act (FIPPA)**

The Freedom of Privacy 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**

The Centre for Student Development is committed to the continuous improvement of accessibility for students with disabilities. Students are encouraged to contact CSD as early as possible before each term starts to become familiar with the services offered and to confirm their accommodations.

Students must forward a copy of the CSD 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 CSD accommodation and chooses to sit for a regular exam, a petition for relief may not be filed after the examination is complete. <http://csd.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://judicialaffairs.mcmaster.ca/pdf/SCC.pdf>