

## Course Outline

### 1. COURSE INFORMATION

<b>Session Offered</b>	Fall 2018	
<b>Course Name</b>	Design and Manufacture of Machine Elements	
<b>Course Code</b>	MAN TECH 4MM3	
<b>Date(s) and Time(s) of lectures</b>	Wednesday Evenings 6:30 pm – 9:30 pm September 5th – December 5th (excluding October 10th)	
<b>Program Name</b>	Manufacturing Engineering Technology	
<b>Calendar Description</b>	Theory and methodology related to conceptual design, methods used in stress analysis. The role and characterization of manufacturing technology within the manufacturing enterprise is examined.	
<b>Instructor(s)</b>	Mr. David Buryta	E-Mail: burytad@mcmaster.ca Office Hours & Location: Email for appointment

### 2. COURSE SPECIFICS

<b>Course Description</b>	<p>Theory and methodology related to conceptual design; review of the methods used in stress analysis; theories of failure; design factor approach; variable loads; stress concentrations; bolted joints in shear and tension; welded joints; shaft design; gears; clutches and brakes.</p> <p>The function, description and analysis of various manufacturing technologies are also examined. Topics include an overview of; material behavior, temperature, strain rate sensitivity, friction and lubrication effects during metal forming. Bulk deformation processes; hot and cold rolling, forging, extrusion, wire and bar drawing. Sheet metal forming operations such as; bending, drawing; stretching, roll forming, spinning and high energy rate forming.</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>
	978-0-07-352928-8	Shigley's Mechanical Engineering Design, 9 <sup>th</sup> or 10 <sup>th</sup> Edition	Budynas, R.G and Nisbett, K, McGraw Hill.
	978-0470-467008	Fundamentals of Modern Manufacturing Materials, Processes, and Systems, 4th Edition	Groover, M.P., John Wiley and Sons.
	<b>Other Supplies</b>	<b>Source</b>	
<b>Prerequisite(s)</b>	ENG TECH 3FA3: Finite Element Analysis MAN TECH 4FT3: Forming Technology		
<b>Corequisite(s)</b>	N/A		

<b>Antirequisite(s)</b>	MAN TECH 4MT3: Machining Technology
<b>Course Specific Policies</b>	<p>Lecture attendance is mandatory as some assignments which are to be submitted for grading (which will be part of the student's final grade - 10%) may be based on particular in class lecture material and discussions. Not all assignments to be handed in for grading will be posted or available online. <b>Late assignments will not be accepted and must be submitted at the beginning of class on the date specified by the professor. Illegible solutions, incoherent solutions and solutions not properly referenced will not be accepted.</b></p> <p>Students are to bring the required text, a calculator and any lecture notes or reference materials which have been provided online to the lectures.</p> <p>Homework problems will be posted on line (or distributed in class) along with solutions which will be opened for review in a timely fashion as the course progresses. It is the student's responsibility to attempt all homework problems and review the solutions provided.</p> <p>The final examination will be comprehensive and a printed hardcopy of the text will be allowed. No electronic text books will be allowed. Students must achieve a minimum grade of 50 % on the final examination to achieve a passing grade in the course.</p> <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, Avenue, LearnLink, web pages, capa, Moodle, Thinking Cap, etc.</p>
<b>Departmental Policies</b>	<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>
<b>3. SUB TOPIC(S)</b>	

Week 1	<p><b><u>Review of Strength of Materials 1</u></b></p> <ul style="list-style-type: none"> <li>- Cartesian vector methods for 3D equilibrium and equivalent force/moment systems.</li> <li>- Axial stresses and strains, pure bending, torsional, transverse shear stresses and their respective distributions.</li> <li>- Bearing stresses</li> <li>- Generalized Hooke's law and Multi-Axial loading.</li> <li>- Shear and bending moment diagrams, graphical, mathematical relations between shear and bending moments and use of singularity functions</li> <li>- Introduction to MDSOLIDS software</li> </ul>	<p>Reference(s)</p> <p>Course Notes</p> <p>Beer, Johnston and DeWolf, "Mechanics of Materials", McGraw Hill</p> <p>Philpot, T.A., "MDSOLIDS"</p> <p><a href="http://www.mdsolids.com">http://www.mdsolids.com</a></p>
Week 2	<p><b><u>Review of Strength of Materials 2</u></b></p> <ul style="list-style-type: none"> <li>- Transformations of stress and strain and applications of Mohr's circle to cases of plane stress and plane strain</li> <li>- Determination of maximum shearing stress for 3D cases.</li> <li>- Determination of principle stresses for cases of combined loads.</li> <li>- Theories of failure; MSST, MDET, MNST</li> <li>- Selection of failure criteria</li> </ul>	<p>Reference(s)</p> <p>Beer, Johnston and DeWolf, "Mechanics of Materials" McGraw Hill</p> <p>Shigley CH 5 Sec's 5-1 to 5-5, 5-7,5-8, 5-10, 5-11 and 5-14</p>
Week 3	<p><b><u>Fatigue Failure Resulting from Variable Loading 1</u></b></p> <ul style="list-style-type: none"> <li>- Characteristics of fatigue failures in metals</li> <li>- Fatigue and Stress Life methods</li> <li>- Fatigue Strength, low cycle failure relationships</li> <li>- Stress concentration factors and notch sensitivity</li> <li>- The Endurance limit and modifying Marin factors</li> <li>- Characteristics of fluctuating stresses and Fatigue failure criteria including Modified Goodman, Soderberg , ASME-Elliptic and Langer</li> </ul>	<p>Reference(s)</p> <p>ASM, "Fatigue Failures" DVD</p> <p>Shigley CH 6</p> <p>Sec's 6-1 to 6-4, 6-7 to 6-18</p>
Week 4	<p><b><u>Fatigue Failure Resulting from Variable Loading 2</u></b></p> <ul style="list-style-type: none"> <li>- Applications of fatigue analysis to design of shafts undergoing reversed bending and steady torque and combinations of fluctuating loading conditions</li> <li>- Determination of critical sections, factors of safety guarding against fatigue and determination of cycle life</li> <li>- Application of ASME shaft design criteria</li> <li>- Shaft rigidity and dynamic considerations</li> <li>- Shaft components; keys and pins</li> </ul>	<p>Reference(s)</p> <p>Continued from Week 3</p> <p>Including Shigley CH 7 Sec's 7-4,7-7</p>
Week 5	<p><b><u>Screws, Fasteners and Design of Nonpermanent Joints 1 and 2</u></b></p> <ul style="list-style-type: none"> <li>- Mechanics of power screws, generalized equations for raising and lowering torques and efficiency for any thread form</li> <li>- Bolt strength, standards for specification</li> <li>- Bolted tension joints; fastener and member stiffness's</li> <li>- Effect of preload due to torque on a bolted tension connection exposed to an externally applied static load</li> <li>- Analysis of bolted tension connection integrity</li> </ul>	<p>Reference(s)</p> <p>Course Notes</p> <p>Juvinal, R.C. and Marshek, K.M, "Fundamentals of Machine Component Design" 5<sup>th</sup> Ed'n, J. Wiley. Sec 10-3</p>

	- Fatigue loading of bolted tension joints	Shigley CH 8, Sec's 8-1 to 8-9  Shigley CH 8, Sec's 8-11,8-12
<b>Mid-term Recess: Monday, October 8 to Sunday, October 14, 2018</b>		
Week 7	<b>MIDTERM EXAMINATION</b>	
Week 8	<b><u>Weld Design</u></b> - Fundamentals of welding processes - Pre and post welding procedures - Effect of welding on parent material metallurgical properties - Introduction to CSA, CWB and AWS standards - Butt and fillet weld analysis - Analysis of weldments exposed to combined bending and shear loads. - Fatigue analysis of welds	Reference(s)  BBC Technical Studies, "Welding Techniques" DVD  <a href="http://www.weldcanada.com/welding_software_demo1.php">http://www.weldcanada.com/welding_software_demo1.php</a> Shigley CH 9, Sec's 9-1 to 9-7
Week 9	<b><u>Design of Gears</u></b> - Gear train ratio analysis, simple, compound and epicyclic - Evolution of gear strength and wear analysis; Lewis , Barth, and Buckingham's equations - Application of AGMA Strength and Wear equations	Reference(s) Course Notes Shigley CH 13 and 14
Week 10	<b><u>Clutches and Brakes</u></b> - Internal expanding rim clutches and brakes - External contracting rim clutches and brakes - Frictional contact axial clutches - Disk brakes - Energy and temperature rise considerations - Friction materials	Reference(s) Shigley CH 16 Sec's 16-2 to 16-6, 16-8, to 16-10
Week 11	<b><u>Fundamentals of Metal Forming Processes</u></b> - Material behaviour during deformation - Temperature effects - Strain rate sensitivity of metals during forming - Types of friction and lubrication in metal forming	Reference(s) Groover CH 18
Week 12	<b><u>Sheet Metal Forming</u></b> - Cutting and bending operations; shearing, blanking, fine blanking, trimming, V and edge bending - Analysis of drawing and other sheet metal forming operations; - Description of dies and presses for sheet metal forming - Other sheet metal operations; stretch forming, roll bending and forming, spinning and high energy-rate forming	Reference(s) Groover CH 20  BBC Technical Studies, "Presswork" DVD
Week 13	<b><u>Bulk Deformation Processes</u></b> - Description and analysis of hot and cold rolling operations - Description and analysis of forging operations - Extrusion processes	Reference(s) Groover CH 19

	<ul style="list-style-type: none"> <li>- Forging processes</li> <li>- Description and analysis of wire and bar drawing</li> </ul>	BBC Technical Studies, "Rolling" DVD BBC Technical Studies, "Forging" DVD
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Classes end: Wednesday, December 5, 2018  
Final examination period: Friday, December 7 to Thursday, December 20, 2018  
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 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 *including dates*	Weight
Assignments	10 %
Mid-term test	40 %
Project	N/A
Labs	N/A
Final examination (tests cumulative knowledge)	50 %
<b>TOTAL</b>	<b>100%</b>

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

#### 5. LEARNING OUTCOMES

1. Design and analyze mechanical components through the application of engineering principles and practices.
2. Apply knowledge of manufacturing processes to the design and analysis of machine components.
3. Apply knowledge of materials and engineering principles to manufacturing operations and processes.

#### 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](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](mailto: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://judicialaffairs.mcmaster.ca/pdf/SCC.pdf> and <http://www.mcmaster.ca/policy/Students-AcademicStudies/StudentCode.pdf>