

Course Outline

1. COURSE INFORMATION

Session Offered	Fall 2021	
Course Name	Design and Manufacture of Machine Elements	
Course Code	MAN TECH 4MM3	
Date(s) and Time(s) of lectures	Wednesday Evenings 6:30 pm – 9:30 pm September 9th – December 9th (excluding October 14th)	
Program Name	Manufacturing Engineering Technology	
Calendar Description	Theory and methodology related to conceptual design; simple design factor; variable loads; stress concentrations; bolted joints; shaft and bearing design; characterization of manufacturing in design.	
Instructor(s)	Mr. David Buryta	E-Mail: : burytad@mcmaster.ca Office Hours & Location: Email for appointment

2. COURSE SPECIFICS

Course Description	<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>		
Instruction Type	Code	Type	Hours per term
	C	Classroom instruction	36
	L	Laboratory, workshop or fieldwork	
	T	Tutorial	
	DE	Distance education	
	Total Hours		36
Resources	ISBN	Textbook Title & Edition	Author & Publisher
	978-1-26056999-5	Shigley's Mechanical Engineering Design, 11 th Edition	Budynas, R.G and Nisbett, K, McGraw Hill.

	Other Supplies	Source
Prerequisite(s)	ENGTECH 4FA3, and registration in Manufacturing Engineering Technology or ENGTECH 3FE3 and registration in Automotive Engineering Technology	
Corequisite(s)	N/A	
Antirequisite(s)	MAN TECH 4MT3: Machining Technology	
Course Specific Policies	<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 are to be handed in for grading and will be posted or available online. Late assignments will not be accepted and must be submitted at the beginning of class time scheduled on the date specified by the professor. Illegible solutions, incoherent solutions and solutions not properly referenced will not be accepted.</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. Electronic textbooks are not recommended. 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>	
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>	

	Instructor has the right to submit work to software to identify plagiarism.	
3. SUB TOPIC(S)		
Week 1	<p><u>Review of Strength of Materials 1</u></p> <ul style="list-style-type: none"> - Cartesian vector methods for 3D equilibrium and equivalent force/moment systems. - Axial stresses and strains, pure bending, torsional, transverse shear stresses and their respective distributions. - Bearing stresses - Generalized Hooke's law and Multi-Axial loading. - Shear and bending moment diagrams, graphical, mathematical relations between shear and bending moments and use of singularity functions - Introduction to MDSOLIDS software 	<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>http://www.mdsolids.com</p>
Week 2	<p><u>Review of Strength of Materials 2</u></p> <ul style="list-style-type: none"> - Transformations of stress and strain and applications of Mohr's circle to cases of plane stress and plane strain - Determination of maximum shearing stress for 3D cases. - Determination of principle stresses for cases of combined loads. - Theories of failure; MSST, MDET, MNST - Selection of failure criteria 	<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><u>Fatigue Failure Resulting from Variable Loading 1</u></p> <ul style="list-style-type: none"> - Characteristics of fatigue failures in metals - Fatigue and Stress Life methods - Fatigue Strength, low cycle failure relationships - Stress concentration factors and notch sensitivity - The Endurance limit and modifying Marin factors <ul style="list-style-type: none"> - Characteristics of fluctuating stresses and Fatigue failure criteria including Modified Goodman, Soderberg , ASME- Elliptic and Langer 	<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><u>Fatigue Failure Resulting from Variable Loading 2</u></p> <ul style="list-style-type: none"> - Applications of fatigue analysis to design of shafts undergoing reversed bending and steady torque and combinations of fluctuating loading conditions - Determination of critical sections, factors of safety guarding against fatigue and determination of cycle life - Application of ASME shaft design criteria - Shaft rigidity and dynamic considerations - Shaft components; keys and pins 	<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><u>Screws, Fasteners and Design of Nonpermanent Joints 1 and 2</u></p>	<p>Reference(s)</p>

	<ul style="list-style-type: none"> - Mechanics of power screws, generalized equations for raising and lowering torques and efficiency for any thread form - Bolt strength, standards for specification - Bolted tension joints; fastener and member stiffness's - Effect of preload due to torque on a bolted tension connection exposed to an externally applied static load - Analysis of bolted tension connection integrity - Fatigue loading of bolted tension joints 	<p>Course Notes</p> <p>Juvinal, R.C. and Marshek, K.M, "Fundamentals of Machine Component Design" 5th Ed'n, J. Wiley. Sec 10-3</p> <p>Shigley CH 8, Sec's 8-1 to 8-9</p> <p>Shigley CH 8, Sec's 8-11,8-12</p>
Week 6	Mid-term Recess: Monday, October 11 to Sunday, October 17, 2020	
Week 7	MIDTERM EXAMINATION	
Week 8	<p><u>Weld Design</u></p> <ul style="list-style-type: none"> - 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 	<p>Reference(s)</p> <p>BBC Technical Studies, "Welding Techniques" DVD</p> <p>http://www.weldcanada.com/welding_software_demo1.php</p> <p>Shigley CH 9, Sec's 9-1 to 9-7</p>
Week 9	<p><u>Design of Gears</u></p> <ul style="list-style-type: none"> - 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 	<p>Reference(s)</p> <p>Course Notes</p> <p>Shigley CH 13 and 14</p>
Week 10	<p><u>Clutches and Brakes</u></p> <ul style="list-style-type: none"> - 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 	<p>Reference(s)</p> <p>Shigley CH 16</p> <p>Sec's 16-2 to 16-6, 16-8, to 16-10</p>
Week 11	<p><u>Fundamentals of Metal Forming Processes</u></p> <ul style="list-style-type: none"> - Material behaviour during deformation - Temperature effects - Strain rate sensitivity of metals during forming -Types of friction and lubrication in metal forming 	<p>Reference(s)</p> <p>Groover CH 18</p>
Week 12	<p><u>Sheet Metal Forming</u></p> <ul style="list-style-type: none"> - 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 	<p>Reference(s)</p> <p>Groover CH 20</p>

	- Other sheet metal operations; stretch forming, roll bending and forming, spinning and high energy-rate forming	BBC Technical Studies, "Presswork" DVD
Week 13	Bulk Deformation Processes - Description and analysis of hot and cold rolling operations - Description and analysis of forging operations - Extrusion processes - Forging processes - Description and analysis of wire and bar drawing	Reference(s) Groover CH 19 BBC Technical Studies, "Rolling" DVD BBC Technical Studies, "Forging" DVD
Week 14	REVIEW (Wednesday December 8, 2020)	

Midterm Recess: Monday, October 11 to Sunday, October 17

Classes end: Wednesday, December 8

Final examination period: Thursday, December 9 to Wednesday, December 22

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
TOTAL	100%

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. 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.

EXTREME CIRCUMSTANCES

ENGINEERING
McMaster-Mohawk
Bachelor of Technology
Partnership



The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.