Faculty of Engineering
McMaster University, Hamilton
Term II (January – April 2021)

MECH ENG 4D03: MANUFACTURING PROCESSES — METAL REMOVAL

Course Outline

Instructor: Phil KOSHY
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Class Schedule: Monday, Wednesday | 11:30 – 12:20
Friday | 1:30 – 2:20

Learning Outcomes:

Upon successful completion of the course, the student will have the ability to:

1. Analyze fundamental phenomena in metal cutting and grinding, through application of the principles of mechanics, materials, and allied engineering fields;
2. Develop quantitative and qualitative skills necessary to address practical issues pertaining to machining productivity and innovation;
3. Demonstrate an understanding of current machining research through exposure to published literature.

Graduate Attributes

This course helps provide students the opportunity to develop the following measures of graduate attributes:

Graduate Attributes	*Learning Objectives where it is measured*
Knowledge base for Engineering (Indicator 4)	1,2,3

Text:

- Boothroyd and Knight, *Fundamentals of Machining and Machine Tools,* Marcel Dekker (1989) ISBN: 0824778529.

Further Reading:

Texts:
- Toenshoff and Denkena, *Basics of Cutting and Abrasive Processes*, Springer (2013)
- Shaw, *Metal Cutting Principles*, Oxford University Press (2005)
- Trent and Wright, *Metal Cutting*, Butterworth Heinemann (2000)
- Stephenson and Agapiou, *Metal Cutting Theory and Practice*, Marcel Dekker (1997)

Journals:
- *CIRP Annals: Manufacturing Technology*, Elsevier
- *International Journal of Machine Tools and Manufacture*, Elsevier
- *Journal of Materials Processing Technology*, Elsevier
- *Journal of Manufacturing Science and Engineering*, ASME
- *The International Journal of Advanced Manufacturing Technology*, Springer

Distribution of Marks:

Assignments:	20%
Term test (closed book; crib sheet):	25%
Term paper:	15%
Final examination (closed book; crib sheet):	40%

(The percentage marks will be converted to a final letter grade using the standard conversion scale shown in the McMaster Undergraduate Calendar.)

Lecture Content:

Introduction

- Historic and economic context, terminology and classification of primary metal removal processes, current trends in metal cutting research.

Mechanics of metal cutting

- Essential features of metal cutting, mechanisms of chip formation, chip control.
- Mechanics of orthogonal cutting: Forces, stresses, energy consumption in the primary and secondary cutting zones, measurement and prediction, shear strain and shear stress in cutting.

Tribological aspects of metal cutting

- Friction: Mechanisms and theories, stress distribution on tool face, friction at the tool/chip interface.
- Tool wear and tool life: Wear mechanisms and theories, application of theory to tool design.
- Heat in metal cutting: Cutting temperatures, energy dissipation in cutting, heat transfer models and analyses, effect of cutting conditions and tool geometry.
- Cutting fluids: Cutting fluid requirements for low speed and high speed applications, effect of cutting fluid on mechanism of chip formation.

Material considerations in machining

- Tool materials: Conflicting requirements, selection of tool material, compatibility with workpiece for minimum tool wear, design and performance of coatings.
- Workpiece materials: Machining characteristics of alloy and hard steels, cast iron, aluminum, titanium and nickel-based alloys, and new materials.

Integrity of machined surfaces

- Surface finish: specification, measurement, effect of cutting conditions.
- Machining-induced residual stresses.

Principles of abrasive machining

- Abrasives and grinding wheels, mechanics of grinding, grinding forces and specific energy, wheel wear and grinding performance, grinding temperature, surface generation in grinding.

Teaching Assistant:

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Policy Reminders

Students are reminded of the following Policies, which could be relevant to activities in this course.

Equity, Diversity and Inclusion:
Every registered student belongs in this course. Diversity of backgrounds and experiences is expected and welcome. You can expect your Instructor to be respectful of this diversity in all aspects of the course, and the same is expected of you.

The Department of Mechanical Engineering is committed to creating an environment in which students of all genders, cultures, ethnicities, races, sexual orientations, abilities, and socioeconomic backgrounds have equal access to education and are welcomed and treated fairly. If you have any concerns regarding inclusion in our Department, in particular if you or one of your peers is experiencing harassment or discrimination, you are encouraged to contact the Chair, Associate Undergraduate Chair, Academic Advisor or the Equity and Inclusion Office.

Physical and Mental Health:
For a list of McMaster University's resources, please refer to the Student Wellness Centre.

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-roceduresguidelines/

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 that 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, usernames 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.

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 behaviors 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.

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