Faculty of Engineering
McMaster University, Hamilton
Term II (January – April 2019)

MECH ENG 4D03: MANUFACTURING PROCESSES — METAL REMOVAL

Course Outline

Instructor: Phil KOSHY
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Class Schedule: Tuesday, Wednesday, Friday | 12:30-1:20 | JHE 329

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.

The instructor and 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. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

Calculators

Only McMaster Standard Calculator (Casio fx-991 MS or Casio fx-991 MS Plus) may be used during term tests and the final examination.

Adverse Discrimination

"The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible."

Academic Integrity (Ethics and Dishonesty)

"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/senate/academic/ac_integrity.htm The following illustrates only two forms of academic dishonesty: 1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained. 2. Copying or using unauthorized aids in tests and examinations."