**Faculty of Engineering**
**McMaster University, Hamilton**
**Term II (January – April 2024)**

# MECH ENG 728: MANUFACTURING PROCESSES I
## Course Outline

**Instructor**: Philip KOSHY
https://www.philkoshy.com

**Lecture Schedule**: Tue, Wed | 4:30 – 6:00 | JHE 323

**Course Objectives**:
- To realize a fundamental understanding of the physics of metal cutting and grinding, through application of the principles of mechanics, materials, and allied engineering fields
- To develop quantitative and qualitative skills necessary to address practical issues pertaining to machining productivity and innovation
- To gain an exposure to current machining research.

**Recommended Text**:
- Shaw, Metal Cutting Principles, Oxford University Press (2005)

**Further Reading**:
Texts:
- Toenshoff and Denkena, Basics of Cutting and Abrasive Processes, Springer (2013)
- Boothroyd and Knight, Fundamentals of Machining and Machine Tools, Marcel Dekker (1989)
- Stephenson and Agapiou, Metal Cutting Theory and Practice, Marcel Dekker (1997)
- Trent and Wright, Metal Cutting, Butterworth Heinemann (2000)
- Childs et al, Metal Machining, Arnold (2000)
- Altintas, Manufacturing Automation, Cambridge University Press (2000)
- Astakhov, Metal Cutting Mechanics, CRC Press (1998)

Journals:
- Journal of Manufacturing Science and Engineering, ASME
- CIRP Annals: Manufacturing Technology, International Institution for Production Engineering Research
- International Journal of Machine Tools and Manufacture, Elsevier
- Journal of Engineering Manufacture, Institution of Mechanical Engineers, UK
- Journal of Materials Processing Technology, Elsevier
- The International Journal of Advanced Manufacturing Technology, Springer
- Precision Engineering, Elsevier
- Wear, Elsevier
- Machining Science and Technology, Taylor and Francis
- Journal of Manufacturing Processes, Society of Manufacturing Engineers

Trade Magazines:

- Manufacturing Engineering
- Modern Machine Shop Online
- American Machinist
- Cutting Tool Engineering

**Distribution of Marks**:

| | |
|---|---|
| Assignments | 10% |
| Test | 25% |
| Final Exam | 45% |
| Presentations: | 20% |

**Course 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 and oblique 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.

**CONDUCT EXPECTATIONS**
As a McMaster graduate 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.

**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, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.