

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

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Lecture Schedule: Wed, Thurs | 3:00 – 4:30 | 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 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.

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