MECH ENG 728: MANUFACTURING PROCESSES I
Course Outline

Instructor: Philip KOSHY
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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:
- 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)
- 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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