

Surface Engineering in Manufacturing

MECH ENG 727

Winter 2026

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Textbooks:

1. COATINGS TRIBOLOGY Properties, Techniques and Applications in Surface Engineering, Holmberg and Matthews
2. Materials and surface engineering in Tribology; J. Takadom
3. Tribology in manufacturing technology; Paulo Davim

Course Description:

This course is designed to provide a fundamental understanding of tribology and surface engineering in manufacturing. Topics include an introduction to surface engineering and surface properties; surface evaluations including investigation instruments and material characterization techniques; surface engineering techniques (surface treatments and coatings); surface engineering considerations in manufacturing applications including machining operations; selection, development, and identification of mechanical properties and material characteristics of thin coatings used in cutting tools.

Upon completion of the course, students will understand the general concepts related to tribology and surface engineering as well as the instrumentation commonly used. Students will also be exposed to applications in manufacturing including coatings used in cutting tools.

Course Outline

1. Introduction Surface Engineering - Surface Properties & Characterization; Jan. 15th- Jan. 29th

An introduction to surface engineering including:

- Importance and applications of surface engineering in manufacturing
- Surface engineering basics
- Coating properties-characteristics
- Coating evaluation/characterization techniques

2. Surface Characterization Lab; Jan. 29th -Feb. 12th

Surface characterization and evaluation techniques including:

- Nano-indentation
- Scratch testing
- Tribometry
- Heavy load tribometer
- Atomic Force Microscopy (AFM)
- Alicona, Optical Microscopy

3. Surface Engineering in Manufacturing-Tribology of cutting tools; Feb. 26th – March 12th

- Tribology of cutting tools
- Classical friction and seizure phenomenon
- Friction measurements
- Tool wear and process performance
- Lubrication in machining

4. Surface Engineering in Manufacturing-Cutting Tool Selection (Geometry, Material & Coating); March 12th –March 26th

- Cutting tool geometry
- Effect of tool geometry on tool wear
- Typical cutting tool substrate materials (optional)
- Typical cutting tool coatings (optional)

5. Surface Engineering Methods II - Deposition Techniques; March 26th – April 9th

- Thin coatings deposition methods:
- Physical Vapour Deposition (PVD)
- Coating Parameters
- Coating Defects

Grading:

15%	Quizzes
10%	Lab Report
25%	Final Exam
50%	Final Project (results, presentation)

Important dates

Lab report due: March 5th, 2026

Quiz # 1: January 29th, 2026

Quiz # 2: March 12th, 2026

Quiz # 3: March 26th, 2026

Quiz # 4: April 9th, 2026

Final project submission date: April 8th, 2026

Final project Presentations: April 9th, 2026

Final exam: April 16th, 2026