Surface Engineering in Manufacturing

MECH ENG 727

Winter 2024

Instructor: Dr. Maryam Aramesh
MMRI, McMaster Innovation Park (MIP), 230 Longwood Road South
Email: arameshm@mcmaster.ca

Textbooks:

1. COATINGS TRIBOLOGY Properties, Techniques and Applications in Surface Engineering, Holmberg and Matthews
2. Materials and surface engineering in Tribology; J. Takadoum
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. 16th- Jan. 25th

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. 30th-Feb. 15th

Surface characterization and evaluation techniques including:

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

Optional: Surface Engineering Methods I - Conversion Techniques; Reading week: Feb.19 th- Feb. 22nd

Surface conversion techniques including:

- Carburizing
- Nitriding
- Diffusion coatings

3. Surface Engineering Methods II - Deposition Techniques; Feb.27 th - March 7th

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

4. Surface Engineering in Manufacturing-Tribology of cutting tools; March 12th – March 21st

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

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

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

Grading:

20%	Quizzes
15%	Lab Assignments
25%	Project
40%	Final exam

Final project - 40%

1. You should prepare a report (maximum of 7 pages) and submit it at the end of the term.
2. The report must include a front page, an abstract and an introduction (1 page) and a reference page at the end of the report (1 page).
3. Prepare a 15-minute presentation to present your report to the class.
4. Important dates for the project submission and presentation are mentioned below.
5. Note that the surface engineering techniques and manufacturing challenges are not limited to materials discuses in the class.

Important dates

Quiz # 1: Jan. 25th, 2024

Lab Assignments: Feb. 27th, 2024

Quiz # 2: March 7th, 2024

Quiz # 3: March 21st, 2024

Quiz # 4: April 9th, 2024

Project submission date: April 11th, 2024

Project Presentations: April 16th, April 18th, 2024