

MSE-475 Surface Engineering

Credit Hours: 2-0

Pre-requisites: Nil

Course Description

This course focuses on exploring the surface properties of materials and improving them to enhance material performance. The students will learn various aspects of surface modification, improving appearance, hardness, wear resistance, corrosion resistance, and tribological properties.

Course Contents

- Tribology of surfaces: surface integrity; surface roughness and waviness; measurement of surface roughness and texture; friction and theories; types of wear and their mechanisms; lubrication and its regimes; applications of lubrications in wear.
- Mechanical surface treatment: Propelling abrasive media; blasting techniques; selection of abrasive media; different peening techniques. Surface finishing methods: selection and applications; tumbling; vibratory finishing; belt Sanding; wire brushing, buffing and electro-polishing. Chemical cleaning of surfaces: selection and applications; alkaline cleaning; solvent cleaning and vapor degreasing; molten salt bath cleaning; ultrasonic cleaning; acid cleaning; pickling and descaling.
- Coatings: Paints and organic coatings; powder coating; hot-dip coating; chemical conversion coatings; blackening; coloring of metals; electroplating, electrophoretic deposition; anodizing; electroless-plating; mechanical plating; Chemical vapor deposition (CVD) and Physical vapor deposition (PVD) techniques; Thermal and cold spraying methods; Sputtering; sol gel method. A brief overview of surface hardening methods. Cladding techniques; roll bonding; explosive welding; applications of cladding in nuclear, marine and other technological fields.

Course Outcome

At the end of the course, students will be able to:

- Apply the concept of surface science and tribology to engineering materials.
- Use different surfaces cleaning methods to remove surface defects.
- Compare and distinguish various surface deposition and surface treatment technologies.
- Design durable and sustainable surfaces with improved characteristics for engineering applications.

Weekly Plan

Week	Topics
1	Tribology of surfaces: surface integrity; surface roughness and waviness
2	Measurement of surface roughness and texture; friction and theories
3	Types of wear and their mechanisms; lubrication and its regimes; applications of lubrications in wear.
4	Mechanical surface treatment: Propelling abrasive media; blasting
5	techniques; selection of abrasive media
6	Surface finishing methods: selection and applications; tumbling; vibratory finishing; belt Sanding; wire brushing, buffing and electro-polishing
7	
8	
9	Mid-Semester Exams
10	Chemical cleaning of surfaces: selection and applications; alkaline cleaning; solvent cleaning and vapor degreasing; molten salt bath cleaning; ultrasonic cleaning; acid cleaning; pickling and descaling.
11	
12	Coatings: Paints and organic coatings; powder coating; hot-dip coating; chemical conversion coatings; blackening; coloring of metals; electroplating, electrophoretic deposition; anodizing; electroless-plating; mechanical plating;
13	
14	Chemical vapor deposition (CVD) and Physical vapor deposition (PVD) techniques; Thermal and cold spraying methods; Sputtering; sol gel method.
15	
16	A brief overview of surface hardening methods. Cladding techniques; roll bonding; explosive welding; applications of cladding in nuclear, marine and other technological fields
17-18	End Semester Exams

Suggested Books

- Surface Engineering: Enhancing Life of Tribological Components by D. K. Dwivedi. 1st ed. Springer (2018)
- Tribology and Surface Engineering for Industrial Applications edited by C. I. Pruncu, A. Aherwar, S. Gorb, 1st ed. CRC Press (2021)
- Manufacturing Processes for Engineering Materials by S. Kalpakjian, S. R. Schmid. 6th ed. Pearson (2021)