

Year & Sem:	Course Code: ME4505	Course Name: Surface Engineering	No. of Credits: 4	L 2	T&PS 2	P 0
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Fundamentals of surface engineering

Introduction: Engineering components, surface dependent properties and failures, importance and scope of surface engineering. **Surface and surface energy:** Structure and types of interfaces, surface energy and related equations. Surface engineering: classification, definition, scope and general principles Surface engineering by material removal: Cleaning, pickling, etching, grinding, polishing, buffing / puffing (techniques employed, its principle). Role and estimate of surface roughness. Surface engineering by material addition: From liquid bath - hot dipping (principle and its application with examples). Surface engineering by material addition: Electro deposition / plating (theory and its scope of application), Surface modification of steel and ferrous components: Pack carburizing (principle and scope of application), Surface modification of ferrous and non-ferrous components: Aluminizing, calorizing, diffusional coatings (principle and scope of application).

Surface modification using liquid/molten bath: Cyaniding, liquid carburizing (diffusion from liquid state) (principle and scope of application), Surface modification using gaseous medium: Nitriding carbonitriding (diffusion from gaseous state) (principle and scope of application, Surface engineering by energy beams: General classification, scope and principles, types and intensity/energy deposition profile. Surface engineering by energy beams: Laser assisted microstructural modification – surface melting, hardening, shocking and similar processes. 13. Surface engineering by energy beams: Laser assisted compositional modification – surface alloying of steel and non-ferrous metals and alloys. 14. Surface engineering by energy beams: Laser assisted compositional modification – surface cladding, composite surfacing and similar techniques. 15. Surface engineering by energy beams: Electron beam assisted modification and joining. 16. Surface engineering by energy beams: Ion beam assisted microstructure and compositional modification. 17. Surface engineering by spray techniques: Flame spray (principle and scope of application). 18. Surface engineering by spray techniques: Plasma coating (principle and scope of application). 19. Surface engineering by spray techniques: HVOF, cold spray (principle and scope of application). 20. Characterization of surface microstructure and properties (name of the techniques and brief operating principle). 10 4. Lectures by Prof. S. K. R 21. Evaporation - Thermal / Electron beam 22. Sputter deposition of thin films & coatings – DC & RF 23. Sputter deposition of thin films & coatings – Magnetron & Ion Beam 24. Hybrid / Modified PVD coating processes 25. Chemical vapor deposition and PECVD 26. Plasma and ion beam assisted surface modification 27. Surface modification by Ion implantation and Ion beam mixing 28. Measurement of coatings thickness 29. porosity & adhesion of surface coatings 30. Measurement of residual stress & stability 31. Surface microscopy & topography by scanning probe microscopy 32. Spectroscopic analysis of modified surfaces Functional and nano-structured coatings and their applications in photovoltaics, bio- and chemical sensors 35. Surface passivation of semiconductors & effect on electrical properties 36-37. Surface engineering of polymers and composites 38-39. Thin film technology for multilayers & superlattices for electronic, optical and magnetic devices 40. Modeling

Reference Books:

1. K.G. Budinski, Surface Engineering for Wear Resistances, Prentice Hall, Englewood Cliffs, 1988.
2. M. Ohring, The Materials Science of Thin Films, Academic Press Inc, 2005.