

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BRANCH NAME: METALLURGY**  
**SUBJECT NAME: SURFACE COATING TECHNOLOGY**  
**SUBJECT CODE: 2172107**  
**B.E. 7<sup>th</sup> SEMESTER**

**Type of course:** Science & Engineering

**Prerequisite:** Knowledge of Material degradation & Prevention.

**Rationale:** The course on Surface Coating Technology, Sometimes called as surface engineering, which defines as “treatment of the surface and near-surface regions of a material to allow the surface to perform functions that are distinct from those functions demanded from the bulk of the material.” These surface-specific functions include protecting the bulk material from mild to aggressive corrosive environments, providing improved fatigue resistance, providing low- or high-friction contacts with other material such as Friction Lubricating & Wear Resistance coating technologies, providing thermal barrier Coating and providing a particular aesthetic appearance.

This course on Surface Coating Technologies covers the various techniques of surface modifications for applications such as engineering components, in which the substrate / bulk material properties are the primary consideration and the surface properties must be modified for aesthetics, oxidation resistance, hardness, wear resistance, fatigue resistance or other considerations. This course shall be very helpful to the engineering student to develop essential skill & knowledge of the surface coating technologies in demand.

## Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			C	ESE (E)	PA (M)		ESE (V)		PA (I)	
				PA	ALA	ESE	OEP			
4	0	2	6	70	20	10	20	10	20	150

## Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Surface engineering: Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings.	08	13
2	Chemical Conversion Coating: Chromating, Phosphating, Anodizing, Thermochemical processes: Methodology used, mechanisms, important reactions involved, Process parameters and applications.	10	17
3	Metallic coating: Hot Dipping, Galvanizing, Electrolytic and Electro less plating: Methodology used, mechanisms, important reactions involved, Process parameters and applications. Testing/ evaluation of metallic coatings.	10	17
4	Coating from Vapour Phase: PVD, and CVD: Various Methods used, mechanisms, important reactions involved, Process parameters and applications.	6	10
5	Different methods for surface modification:	8	13

	Surface modification by use of directed energy beams, Plasma, Sputtering & Ion Implantation. Surface modification by Friction stir processing. Surface composites.		
<b>6</b>	Thermal spray coatings: Processes, Types of spray guns, Comparison of typical thermal spray processes, Surface Preparation, Finishing Treatment, Coating Structures and Properties, Applications.	<b>8</b>	<b>13</b>
<b>7</b>	Diffusion Coating: Carburizing, Carbonitriding, Siliconizing, Chromizing, Aluminizing, Boronizing, Boronitriding: Various Methods used, mechanisms, important reactions involved, Process parameters and applications.	<b>6</b>	<b>10</b>
<b>8</b>	Case studies based on coatings and surface modification of important engineering components.	<b>4</b>	<b>7</b>
	Total	60	100

### Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
<b>10</b>	<b>35</b>	<b>35</b>	<b>10</b>	<b>10</b>	<b>00</b>

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

1. J. R. Davis-Surface Engineering for Corrosion and Wear Resistance.
2. George J. Rudzki -Surface Finishing Systems. metal and non-metal finishing handbook-guide, Metals Park : ASM, 1983
3. James A. Murphy- Surface Preparation and Finishes for Metal, McGraw-Hill, New York 1971
4. P. G. Sheasby and R. Pinner - Surface treatment and finishing of Aluminium and its alloy, Volume-2, 5th ed., ASM, Metals Park, 1987
5. K. E. Thelning -Steel and its Heat Treatment Bofors Handbook, London : Butterworths, 1975
6. Surface Engineering Hand Book, edited by Keith Austin, London : Kogan Page, 1998
7. Friction Stir Welding and Processing, Rajiv Sharan Mishra, Partha Sarathi De, Nilesh Kumar, Springer, ISBN: 978-3-319-07042-1 (Print)
8. Friction Stir Welding and Processing, R.S. Mishra and M.W. Mahoney, ASM International, 2007, ISBN: 978-0-87170-840-3
9. Advances in Friction-Stir Welding and Processing, M-K Besharati-Givi and P. Asadi, Elsevier, ISBN: 978-0-85709-454-4

### Course Outcome:

After learning the course the students should be able to:

- Decide the surface preparation methods suitable for different substrate materials.
- Apply knowledge on properties offered by different Coatings based on the application requirement.
- Understand & interpret testing & evaluation of metallic coatings.
- explain importance of specific coatings & its applications on specific Engineering components.
- explain the effect of process parameters on the properties & microstructure of the surface coating processes.
- Understand the importance & role of surface modifications to achieve several technological properties.

### List of Experiments:

1. To study & Compare different Surface Preparation methods.
2. To study & Perform Iron Phosphating Coating on Mild steel.
3. To study Anodizing Treatment on Aluminum.
4. To study Electroplating process and perform the electroplating of copper on a given base metal.
5. To study & understand Galvanizing on mild steel sheets.
6. To study and demonstrate ability of Vertical milling machine in surface modification by Friction stir Principals.
7. To Study & understand Carburizing on low carbon steels.
8. To study & understand Nitriding on medium carbon steels.
9. To study & understand various Surface Coating on Engineering Products for improving Corrosion resistance. CASE STUDY I
10. To study & understand various Surface Coating on Engineering Products for improving Wear resistance. CASE STUDY II

**Design based Problems (DP)/Open Ended Problem:**

- Collecting scrape automobile components from scrape yard / automobile garage / workshop & identifying surface coatings by suitable characterization Methods.
- Develop any electro-less Plating Process on suitable substrate.
- Chart of different coating methods.
- Group discussion and Presentations on Recent trend in surface modifications and protection.
- Any other problem decided by faculty based on syllabus.

**Major Equipment:** Set up for performing Phosphating Process, Set up for Performing Anodizing Process, electrolytic tank , Modified Vertical milling machine for FSP etc.

**List of Open Source Software/learning website:**

1. [www.nptel.iitm.ac.in](http://www.nptel.iitm.ac.in)
2. [www.btechguru.com](http://www.btechguru.com)
3. [www.ocw.mit.edu](http://www.ocw.mit.edu)
4. [www.corrosion-doctors.org](http://www.corrosion-doctors.org)

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.