

PG. METALLURGICAL & MATERIAL ENGINEERING 1st YEAR 1st SEMESTER EXAM 2025

M. E in Industrial Metallurgy and M. Tech in Material Engg

Subject: Environmental Degradation of Materials

Time: Three Hours

Full Marks: 100

A. Objective Questions(Answer any ten) 10x2=20 Marks

1. Which equation is used to calculate the cell potential of an electrochemical cell under non-standard conditions?
 - a) Arrhenius equation
 - b) Nernst equation
 - c) Butler-Volmer equation
 - d) Michaelis-Menten equation
2. Which method is used for surface preparation before painting?
 - a) Sandblasting
 - b) Electroplating
 - c) Phosphating
 - d) Solvent cleaning
3. Which factor does NOT significantly influence atmospheric corrosion?
 - a) Humidity
 - b) Pollutants
 - c) Altitude
 - d) Temperature
4. In cathodic protection, which of the following is used as a sacrificial anode?
 - a) Copper
 - b) Zinc
 - c) Lead
 - d) Silver
5. What is the main function of intumescent paint?
 - a) UV protection
 - b) Corrosion resistance
 - c) Fire protection
 - d) Water resistance
6. Which of the following is a cathodic corrosion inhibitor?
 - a) Chromates
 - b) Zinc salts
 - c) Polyphosphates
 - d) Both b and c
7. What is the primary anodic reaction during iron corrosion in water?
 - a) $\text{Fe} \rightarrow \text{Fe}^{2+} + 2\text{e}^-$
 - b) $\text{Fe}^{2+} + 2\text{e}^- \rightarrow \text{Fe}$
 - c) $\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$
 - d) $\text{Fe} + \text{H}_2\text{O} \rightarrow \text{Fe}(\text{OH})_2$
8. Which element in stainless steel is responsible for its corrosion resistance?
 - a) Iron
 - b) Nickel
 - c) Chromium
 - d) Carbon

9. Which type of paint provides sacrificial protection to steel?
 - a) Acrylic paint
 - b) Zinc-rich primer
 - c) Polyurethane paint
 - d) Epoxy paint
10. Which form of corrosion is most common in automobiles?
 - a) Crevice corrosion
 - b) Galvanic corrosion
 - c) Uniform corrosion
 - d) Pitting corrosion
11. Which method is NOT a metal coating technique?
 - a) Hot-dip galvanizing
 - b) Electroplating
 - c) Powder coating
 - d) Thermal spraying
12. Which material is commonly used for electroless plating?
 - a) Copper
 - b) Aluminum
 - c) Nickel
 - d) Lead

B. Short Notes (Answer any four) 4x5=20 Marks

1. Protection by Galvanising
2. Forms of Corrosion
3. Intergranular Corrosion
4. Pitting Resistance Equivalent Number
5. Electro Coat for Auto Body
6. Corrosivity guidelines (ISO 12944)

**C. Answer any four questions.
Marks**

4x15=60

1: Pourbaix Diagram & Iron-Water System

- a. What does a Pourbaix diagram represent?
- b. How does pH influence the stability of iron species in water?
- c. What forms of iron exist in highly acidic and highly alkaline conditions?

2: Atmospheric Corrosion & Its Factors

- a. What is atmospheric corrosion?
- b. How do humidity and temperature influence corrosion?
- c. Why are marine environments highly corrosive?

3: Organic & Intumescent Paints

- a. What are the main functions of organic paints?
- b. How does intumescent paint protect against fire?

- c. Where is intumescent paint commonly used?

4: Stainless Steel Corrosion Resistance & Issues

- a. How does chromium help stainless steel resist corrosion?
- b. What are two common types of corrosion affecting stainless steel?
- c. How can stainless steel be protected from chloride-induced corrosion?

5: Paint Components & Their Roles

- a. What are the major components of paint?
- b. How does a binder contribute to paint performance?
- c. What type of pigments provides corrosion resistance?

6: Corrosion in Automobiles & RCC

- a. Name two types of corrosion found in automobiles.
- b. How does carbonation affect reinforced concrete?
- c. Why are chloride ions dangerous for RCC structures?

7: Electrochemical Impedance Spectroscopy (EIS)

- a. What is Electrochemical Impedance Spectroscopy (EIS)?
- b. What information does a Nyquist plot provide?
- c. How is a Bode plot different from a Nyquist plot?