

**IV B.Tech I Semester Regular Examinations, November 2005****CORROSION ENGINEERING****(Chemical Engineering)****Time: 3 hours****Max Marks: 80**

**Answer any FIVE Questions**  
**All Questions carry equal marks**

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1. (a) Show with electrochemical reactions how rust forms on a piece of steel immersed into water ?  
(b) What is the redox potential of copper in 0.02 N ( $H_2SO_4$   $E_{Cu}^0 = 0.337$  V)  
(c) Why baby food can is coated within, although according to emf series tin cathodic to iron?  
(d) What is redox potential? Describe a method to find out redox potential of metals. [4x4=16]
2. (a) How the following affect the anode E-I curve of an active-passive metal?
  - i. Impurities
  - ii. temperature
  - iii. velocity and
  - iv. Hydrogen concentration(b) Explain the construction and working principle of silver-silver chloride reference electrode. [8+8]
3. (a) Indicate the special name for the atmospheric corrosion of the following metal/alloy.
  - i. Iron and iron base alloy
  - ii. Copper and Copper base alloy
  - iii. Nickel and Nickel base alloy
  - iv. Silver and Silver base alloy(b) Furnish isocorrosion charts for Dur iron in sulphuric and nitric acids. [8+8]
4. (a) Graphically represent the effect of stress level on SCC choosing two typical examples.  
(b) How SCC is influenced by presence of extraneous ions in the environment?  
(c) Briefly explain how reduction of stress and changing the alloy could remedy SCC. [8+4+4]
5. (a) Describe the effect of temperature on corrosion.  
(b) Explain about temperature control and testing method for heating tubes.  
(c) What are the factors to be considered while writing rate expression. [4+8+4]
6. (a) Discuss the principles of anodic protection.

- (b) With a neat sketch, show how the stray currents from an anode to protect a structure can cause corrosion of adjacent structures? Suggest a method to prevent this problem. [8+8]
7. (a) What is the difference between an electrolytic cell and a galvanic cell? Explain giving examples.
- (b) Explain: Mixed potential theory. [8+8]
8. Write on:
- (a) Potential pH diagram
- (b) Mixed electrodes [8+8]

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1. (a) Discuss about factors affecting corrosion resistance of on corrosion rate.  
(b) 'Corrosion of metals can be corrodend as extractive metallurgy in reverse'.  
Justify the statement. [8+8]
2. Write short notes on  
(a) Environmental effecty on Corrosion.  
(b) Metallurgical aspects on corrosion. [8+8]
3. (a) Define crevice corrosion. How is it normally associated? What are its other names?  
(b) How will you prevent crevice corrosion? (Furnish any eight points) [8+8]
4. (a) How cavitation corrosion is caused? Schematically represent steps involved in cavitation corrosion.  
(b) Describe any four methods to combat cavitation corrosion. [8+8]
5. (a) State Faradays law of corrosion penetration rate.  
(b) Explain the various parameters involved in Faraday's law.  
(c) Describe galvanic corrosion test with a suitable figure. [4+4+8]
6. Discuss and explain the significance of the following design rules:  
(a) Weld rather than rivet tanks and containers.  
(b) Design tanks for easy draining and easy cleaning  
(c) Design system for easy replacement of certain parts  
(d) Avoid areas of excessive stress concentrations. [4x4=16]
7. (a) Define : limiting current density, corrotion potential  
(b) Explain the electrode kinetic behaviour of pure iron in acid solution. [8+8]
8. Write on:  
(a) Tafel extrapolation method  
(b) Anodic protection of an active passive metal [8+8]

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1. (a) What is polarization? Explain the different types of polarization.  
(b) With the help of a dry cell battery analogy and explain the mechanism of corrosion. [8+8]
2. (a) State why ?
  - i. In a Daniel cell oxidation of Zinc and deposition of Copper are spontaneous directions.
  - ii. Cu and Ag are not corroded in acid solution but suffer corrosion if dissolved Oxygen is present.(b) Derive an equation that gives the free energy change associated with a corrosion reaction and state how far this equation is applicable to predict corrosion tendency of a system  
(c) Explain the construction and working principle of Silver-Silver Chloride reference electrode. [4+8+4]
3. (a) Indicate the special name for the atmospheric corrosion of the following metal/alloy.
  - i. Iron and iron base alloy
  - ii. Copper and Copper base alloy
  - iii. Nickel and Nickel base alloy
  - iv. Silver and Silver base alloy(b) Furnish isocorrosion charts for Dur iron in sulphuric and nitric acids. [8+8]
4. (a) What is intergranular corrosion? Which material is most susceptible to this phenomenon? Diagrammatically represent a grain boundary in sensitized type 304 stainless steel.  
(b) Why electric arc welding is used more than gas welding for stainless steels?  
(c) What are TTS or Rollason curves? Furnish such curves for type 347 stainless steel in boiling 65%  $HNO_3$  acid. [4+4+8]
5. (a) Describe the effect of temperature on corrosion.  
(b) Explain about temperature control and testing method for heating tubes.  
(c) What are the factors to be considered while writing rate expression. [4+8+4]
6. (a) Discuss the principles of anodic protection.

- (b) With a neat sketch, show how the stray currents from an anode to protect a structure can cause corrosion of adjacent structures? Suggest a method to prevent this problem. [8+8]
7. (a) What is the difference between an electrolytic cell and a galvanic cell? Explain giving examples.
- (b) Explain: Mixed potential theory. [8+8]
8. (a) Discuss the effect of galvanically coupling Zinc to platinum and zinc to gold electrode kinetics principles.
- (b) What are the various possible electro chemical reactions occurring in cathode of an electrochemical (galvanic) and electrolytical cell. [12+4]

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1. (a) Discuss, in detail, about emf series and galvanic series.  
(b) Explain the effect of different environmental variable on corrosion. [8+8]
2. (a) What conclusions can be made on the corrosion tendency of w metal from the changes in the Gibby energy of the system? Give suitable examples.  
(b) State why?
  - i. Iron corrode more rapidly than zinc in a dilute acid solution through reversible polarization difference for zinc-Hydrogen pair is much higher than that for an Iron-Hydrogen pair.
  - ii. Iron containing graphitic corrodes at a higher rate than pure iron in acid solution. [8+8]
3. Give a detailed account of mechanism of crevice corrosion involving initial and final stages with suitable illustrations. [16]
4. (a) Indicate the characteristic property for the following parameters towards SCC shown by an alloy :
  - i. Temperature increase
  - ii. Crack morphology
  - iii. Presence or absence of corrosion product in the crack
  - iv. Crack surface appearance
  - v. Stress level -  
(b) Schematically represent the effect of simultaneous tensile stress, susceptible metallurgical condition , and critical corrosive solution required for stress corrosion cracking.  
(c) Discuss graphically rate of SCC propagation as a function of crack depth and specimen extension as a function of time during constant-load stress-corrosion cracking test [5+5+6]
5. (a) Describe the effect of temperature on corrosion.  
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- (b) With a neat sketch, show how the stray currents from an anode to protect a structure can cause corrosion of adjacent structures? Suggest a method to prevent this problem. [8+8]
7. Explain the mechanisms of growth and breakdown of passive films. [16]
8. Explain the thermodynamics and kinetics principles involved in the study of electrochemical corrosion. [16]

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