

B.E. METALLURGICAL AND MATERIAL ENGINEERING
THIRD YEAR FIRST SEMESTER EXAM 2019
ELECTRO-CHEMISTRY AND CORROSION

Time Three hours

Full Marks 100
 Answer question any five

1. Draw a polarization diagram of steel in aqueous environment. Explain how the thermodynamic and kinetic factors influence the rate. Show the effect of activation and concentration polarization on rate of corrosion. Write an equation of the rate influenced by these factors. What happens to the rate of corrosion when the solution is aerated and deaerated? Is polarization a beneficial or not wanted? 3+3+5+3+2+2
2. Explain why: for the following statements, draw diagram if needed 4X5
- Corrosion rates change differently for carbon steel and stainless in seawater, if the water is stagnant, then agitated to different fluid speeds
 - Steel corrodes in acid but Cu does not but if aerated Cu will also corrode
 - Corrosion of steel in acid is governed by activation polarization while in water by concentration polarization.
 - A steel is more prone to Hydrogen induced cracking if cathodic protection is applied.
 - Hysteresis of cyclic polarization of an active-passive alloys gives important information whether pits initiated in it can be repassivated
3. Distinguish the following in tabular form 6+3+4+4+3
- Crevice Corrosion and Pitting corrosion
 - E M F series and Galvanic Series
 - Erosion Corrosion and Cavitation Damage;
 - Metal spraying and Metal Diffusion coating
 - Exchange current density and limiting current density
- 4a What is hydrogen induced cracking (HIC)? Explain the steps how does it occur leading to disintegration of structure. What are hydrogen embrittlement and hydrogen blistering? 10
- 4b What is SCC? Discuss how it occurs and the parameters influencing it. For testing of SCC, why slow and critical strain rate is maintained? What is the significance of K_{ISCC} ? 10
- 5.a Explain how the parameters of i. Humidity, ii. Pollutants iii. Temperature, iv. wind flow affect the atmospheric corrosion of steel structure. Why Cu steel and HSLA steel has better corrosion resistance in atmosphere than plain carbon steel? 8
- 5b. What is the difference between Aqueous Oxidation and Dry Oxidation? Explain how oxidation of metal, at high temperature, proceeds with formation of n and p-type oxides. Describe with neat sketches the effects of doping with lower and higher valent elements in p and n type oxides 3+9
- 6a. The hull of the ship of trapezium of lengths parallel sides l_1 , l_2 and p the distance between them. Find out an equation to determine the amount of Zn required for n yrs protection. If the potential attenuates with equation $E = E_0 e^{-\alpha x}$, where E_0 is potential at the point of connection, x is the distance, show at what distance interval you would place the Zn. 10
- 6.b How does an inhibitor function in mitigating corrosion? 5+5
 Distinguish between (i) scavenger and passivator; (ii) vapour phase inhibitor and pickling inhibitor
7. Write short notes on 5+5+5+5
- E-pH diagram of steel
 - Organic coating
 - Electroplating and Anodization
 - Galvanizing and Sheradizing

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