GWANDA STATE UNIVERSITY

EMR: 5203

FACULTY OF ENGINEERING AND THE ENVIRONMENT

DEPARTMENTS OF METALLURGY ENGINEERING

CORROSION AND WEAR

EPOCH MINE CAMPUS

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AUGUST 2021: EXAMINATION

Time : 3 hours

Candidates should attempt **Question 1** and **ANY OTHER THREE** questions from this paper with question (25 marks each).

Instructions and requirements

a) Use of calculators is permissible.

b) Periodic table of elements.

c) SRP (E^{θ}) Tables

Question 1 ***(compulsory)***

a) Define the following terms in related to corrosion and wear of metals:
   i) Passivity of metals [5]
   ii) Hysteresis [4]

b) What is meant by coefficient of adhesion and what is its relationship of the coefficient with the coefficient of friction? [6]

c) How is wear resistance of a material defined or described? [4]

d) Steel is placed in aerated seawater with a neutral pH. Is corrosion of the steel possible, why? (Assume valence of 2) [6]

Question 2

a) A circular copper coupon is rotated in seawater. A gradient in the metal ion concentration is set up on the disk surface. On periphery of the disk copper ion concentration is 0.001 M. Near the center of the disk the copper ion concentration is 12M. What are the potentials of anodic and cathodic sites on copper? Where will the metal loss occur? Assume STP. [12]

b) Compare wet and dry theories of corrosion [8]

c) Define and explain dezincification [5]

Question 3

a) A steel coupon with an anode surface area of 2000 cm^2 is placed in an electrolyte. The corrosion current is measured to be 2 mA. *(Assume valence of 2, Atomic mass Fe = 55.85)*
   i) What mass of steel will be lost in 3 hours? [5]

ii) What is the corrosion rate in $\mu g/cm^2/day$? [4]

b) Describe two laboratory methods used for testing corrosion in metals [12]

c) Explain the basic concept of adhesive wear [4]

Question 4

a) What is meant by the term tribochemical wear [5]

b) Explain the working principle of a lubricant [4]

c) Surface coating of metals is one way of preventing corrosion. Explain , with examples the mechanism of protection involved with the following types of coatings

i) Metal coatings (galvanizing) [10]

ii) Organic coatings [6]

Question 5

a) Compare cathodic and anodic protection [8]

b) Define and explain the following forms of corrosion

i) Crevice corrosion [6]

ii) Corrosion fatigue [6]

c) Explain how a differential environment affects corrosion [5]