Summer Examinations 2015

**ENG301915N**

Module Title: Corrosion Engineering  
Level: Six  
Time Allowed: Two hours

Instructions to students:

- Enter your student number **not** your name on all answer booklets.
- Answer **all** questions and include sketches and diagrams where asked or appropriate.
- All questions carry equal marks. Where a question has more than one part the division of marks is stated.
- Begin each answer on a separate page; label each page clearly with the number of the question you are answering.
- The use of a non-programmable calculator is permitted.
- Neither books nor notes may be taken into the examination.
- Students are permitted to remove this examination paper at the end of the examination.

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Answer all questions and include sketches and diagrams where asked or appropriate.

**Question 1**

Explain using labelled diagrams where appropriate the difference between pitting and crevice corrosion with regards to initiation and mechanism?

In your diagrams and answer you should differentiate between the initiation stages and stable stages of these mechanisms.  

(25 marks)

**Question 2**

This question is based around common corrosion protection methods you have studied; Anti-corrosion coatings and Cathodic protection.

a. Name the three main constituents of a typical paint coating prior to application and give an example of each (you can use a simple diagram to help explain this). What two important functions do the pigments in the primer coat fulfill? What are the mechanisms by which these functions operate?

(15 marks)

b. i. Why is -850 mV SSC (electrode potential) used for the cathodic protection potential for many steel structures?

ii. What are the dangers of using greater negative potentials with regards to the effects on the metal?

iii. Why does reducing the potential to (for example) -300 mV not reduce the corrosion rate by half of that produced by a potential of -150 mV?

(10 marks)

Total: 25 marks
Question 3

a. Using a sketch or schematic labeled Evans Diagram and mixed potential theory explain what happens with regards to Corrosion potential ($E_{corr}$) and Corrosion current ($I_{corr}$) when two dissimilar metals are joined as a couple in the presence of an electrolyte environment.

(15 marks)

b. Using copper and steel as an example with free potentials of -0.35 and -0.72 respectively, estimate the Couple potential.

(5 marks)

c. Using the Evans Diagram above indicate what happens to the Corrosion current.

(1 mark)

d. How does this relate to corrosion rate?

(1 mark)

e. List three factors affecting galvanic or dissimilar metal corrosion that make calculating exact corrosion rates difficult when data is extrapolated into large scale engineering situations.

(3 marks)

Total: 25 marks

Question 4

a. Name and give examples of the four categories of people identified as secondary mechanisms in corrosion control. How does each of these groups influence the management and control of a system?

(20 marks)

b. The probability of materials failure $P_m$ is 0.01 due to stringent inspection and quality control procedures. The probability of the environment changing to produce a corrosive environment ($P_e$) is 0.15. What is the probability of failure ($P_f$), when there is an aggravating factor rated at 1.6? Show all working.

(3 marks)

c. Comment on the answer you arrived at in (b) as your probability of failure.

(2 marks)

Total: 25 marks

End of Paper