

King Fahd University of Petroleum & Minerals
MECHANICAL ENGINEERING DEPARTMENT
ME 472: Corrosion Engineering 1

Catalogue Description: (3-0-3)

Technical and economic aspects of corrosion problems. Types of corrosion: pitting, crevice, intergranular, galvanic, and stress corrosion cracking. Mechanism and prevention of corrosion failures. Cathodic protection, corrosion control using inhibitors, Coatings. Metallurgical aspects of corrosion. Design consideration in prevention of corrosion failures.

Status in Curriculum (Required or Elective): Elective (offered Fall & Spring)

Prerequisites: ME 215

Textbook: R. W. Revie & H. H. Uhlig, 4th Edition, John Wiley and Sons, 2008.

References:

- 1) Denny A. Jone, Principles and Prevention of Corrosion, 2nd Edition, Prentice Hall, 1996.
- 2) Corrosion Engineering by Fontana, McGraw-Hill (1986)
- 3) ASM Metals Handbook, vol. 13

Instructor: Dr. Ihsan Ul Haq Toor

Goals:(general objectives)

This course introduce the basic concepts of corrosion engineering. These concepts will help the students in understanding the fundamental nature of corrosion problems and applying the knowledge of corrosion protection to mitigate the corrosion.

Course Outline (Lecture Topics):

Topics Covered:

1. Economic importance of corrosion. Mechanisms of corrosion (2 classes)
2. Types of cells. Calculation of E.M.F. Measurement of pH. Oxygen electrode E.M.F. and galvanic potential. Reference half cells (6 classes)
3. The phenomena of polarization. Types and causes of polarization. Hydrogen over-voltage. Influence of polarization on corrosion rate. Calculation of corrosion rate from polarization data (5 classes)
4. Major forms of corrosion: uniform, pitting, crevice, fretting, and cavitation (5 classes)
5. Intergranular corrosion and stress corrosion cracking.(4 classes)
6. Principles of cathodic protection. Polarization of steel structures, Impressed current systems and sacrificial anode systems. Potential and environment. Current requirement tests. Tests for coated and uncoated pipelines. Measurement of coating resistance, soil resistivity, and pipe-to-soil potential, Instrumentation requirements, Ground bed design. (6 classes)
7. Stainless steels. Classification of steels. Intergranular corrosion of ferritic, austenitic, and martensitic steels. Pitting and crevice corrosion (3 classes)
8. Theory of stress corrosion cracking. Hydrogen embrittlement, metallurgical factors. Methods of prevention of cracking in martensitic, precipitation-hardened and ferritic steels (4 classes)
9. Fundamentals of coating. Metallic and non-metallic coatings, failures of coatings and applications (4 classes)
10. Inhibitor corrosion control (3 classes)
11. Design of corrosion prevention. Principles and important case histories (3 classes)

Design Activities/Projects:

Term paper will be assigned to give the student hands on experience.

Computer Usage:

Students are encouraged to solve some assigned homework problems using the available engineering software's such as Gamry software and MS office..

Laboratory:

None

Assessment Tools:

- i- 1st Major and 2nd Major
- ii- Homework Assignments
- iii- Quizzes
- iv- Final Exams

Course Learning Outcomes:

- I- Students will learn clear knowledge about some of the basics of corrosion science such as

thermodynamics and kinetics.

- II- Students will be able to calculate polarization diagrams with given corrosion data and to predict the spontaneity of corrosion reaction based on cell EMF calculations.
- III- Students will be able to identify different forms of corrosion and their root causes in different environments
- IV- Students shall be able to understand different corrosion protection strategies and will be able to use them in appropriate situations
- V- Students will be able to design for corrosion, based on their knowledge of type of corrosion and corrosion protection methods
- VI- Students will learn about different metallic alloys such as stainless steels and their corrosion problems and application for the industry

Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
Course-to-Student outcome mapping	I, II, III, IV, V, VI	I, II, III, VI		I, II, III, VI	I, III,		II, III, IV, V, VI	I,	IV, V	I,	IV, V
Emphasis*	S		M	M	L						

L: Little/None **M:** Moderate **S:** Strong

Status of Continuous Improvement review of this Course:

Date reviewed: -Dec. 20, 2014

Prepared by: Dr. Ihsan ul haq Toor