

## MSE 6406: CORROSION OF MATERIALS

Spring Semester, 2013

**Objective:** To introduce students to basic thermodynamic and kinetic phenomena associated with the corrosion of materials by gases and liquids.

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### Class Hours/

**Location:** 4 credit hours. Tue, Thur at 9:35-10:55 am. Love 299.

**Textbook:** List of required reading for this course will be provided separately for each section. Relevant information will also be posted on the web site for this course

**Grading:** 34% - 1<sup>st</sup> and 2<sup>nd</sup> Exams (covering Aqueous Corrosion)  
34% - 3<sup>rd</sup> and 4<sup>th</sup> Exams (covering High Temperature Oxidation)  
32% - 8 quizzes (4 from each section, but the lowest quiz grade from each section will be dropped in the final grade calculations)

**Exams:** Exams will be given in class at the scheduled time. Exceptions (only for very good reasons) will require making prior arrangements with the instructors.

## CLASS TOPICS

### I. Aqueous Corrosion (Weeks 1 to 7.5)

#### A. Reactivity in Aqueous Environments

1. Introduction to electrochemical processes
2. Electrochemical nature of corrosion
3. Thermodynamics
  - a. Reversible electrode potentials
  - b. Electromotive Force Series
  - c. Pourbaix Diagrams
4. Kinetics
  - a. The laws of electrolysis
  - b. Double Layer, Exchange Current
  - c. Corrosion Current, Polarization
  - d. Mixed Potential Theory
  - e. Passivity

#### B. Measurement Techniques

1. DC Polarization Methods
2. AC Impedance Method

C. Types of Corrosion

1. Galvanic Corrosion, Dealloying
2. Concentration Cell, Pitting, Crevice Corrosion
3. Environment Induced Cracking (Stress corrosion cracking, Corrosion fatigue, Hydrogen embrittlement)

D. Other Related Applications

1. Metal Extraction Processes
2. Electroplating, Electropolishing and Electro-machining

II. High Temperature Oxidation (Weeks 7.5 to 15)

A. Introduction

1. Thermodynamics of Oxidation
2. Point Defect Equilibria

B. Measurement of Kinetics/Oxidation Rate Laws

C. External Oxidation

1. Parabolic Scaling
2. Short Circuit Diffusion
3. Oxidation of Oxygen Soluble Metals
4. Oxidation with Multiple Oxide Scales
5. Selective Planar Oxidation
6. Stability of Planar Interfaces and Displacement Reactions
7. Phase Boundary Controlled Oxidation

D. Internal Oxidation