MSE 4010: Environmental Degradation of Materials (required)

Catalog Description: (3-0-3)

Prerequisite: MSE 2001

Theory of environmental degradation of metals, ceramics, and polymers. Emphasis on the scientific principles of metallic corrosion. To introduce students to the basic principles of interaction between materials and environments and degradation in properties of engineering materials due to exposure to environment. To provide an understanding of fundamentals of corrosion processes so that students can recognize different corrosion mechanisms.

Textbook: D. A. Jones: *Principles and Prevention of Corrosion*, Macmillan Publ. Co., 1996.

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Topics Covered:

1. Basics of Corrosion
2. Different forms of Corrosion
3. Electrochemical corrosion
4. Thermodynamic principles of electrochemical reactions
5. Electromotive Force Series, Pourbaix Diagrams, Evans Diagrams,
6. Mixed Potential Theory, Passivity,
7. Electrochemical methods to Measure Corrosion: DC Polarization, AC Impedance,
8. Environmentally Induced Cracking, Corrosion Fatigue, Hydrogen Induced Cracking, Application of Fracture mechanics,
9. Atmospheric Corrosion,
10. Oxidation in Gaseous Environments, Ellingham Diagrams, Role of Protective Scale, Molten Salt Corrosion,
11. Environmental degradation of ceramics,
12. Degradation of Polymeric Materials, Microbial corrosion,
13. Corrosion of Bio-Implants,
14. Corrosion Prevention methods.

Course Outcomes

1. Understand the thermodynamic and electrochemical principles behind corrosion reactions.
2. Identify different forms of corrosion and describe mechanisms of different forms of corrosion
3. Be able to use electrochemical principles to understand corrosion test procedures and be able to analyze data and to solve problems
4. Be able to apply knowledge to select appropriate materials and design to mitigate corrosion under different environments

5. Prepare a term paper and present a lecture on a specific topic on corrosion problem, its mechanism, prevention strategies, and its economic/environmental impact

Correlation between Course Outcomes and Student Outcomes:

Course Outcomes	Student Outcomes										
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
1. Understand the thermodynamic and electrochemical principles behind corrosion reactions.	x					x		x			
2.Identify different forms of corrosion and describe mechanisms of different forms of corrosion	x		x			x		x			x
3.Be able to use electrochemical principles to understand corrosion test procedures and be able to analyze data and to solve problems	x		x			x		x			x
4. Be able to apply knowledge to select appropriate materials and design to mitigate corrosion under different environments	x		x					x			
5.Prepare a term paper and present a lecture on a specific topic on corrosion problem, its mechanism, prevention strategies, and its economic/environmental impact	x			x	x		x	x	x	x	x
Entire Course	**3**	**0**	**3**	**2**	**1**	**3**	**1**	**3**	**1**	**1**	**2**
0 = None or insignificant; 1 = Some; 2 = Moderate; 3 = Strong											

School of Materials Science and Engineering Student Outcomes:

a) an ability to apply knowledge of mathematics, science and engineering
b) an ability to design and conduct experiments, as well as to analyze and interpret data
c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d) an ability to function on multidisciplinary teams
e) an ability to identify, formulate, and solve engineering problems
f) an understanding of professional and ethical responsibility
g) an ability to communicate effectively
h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i) a recognition of the need for, and an ability to engage in life-long learning
j) a knowledge of contemporary issues
k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice