Corrosion Engineering

1.1 Course Number: CH202

1.2 Contact Hours: 2-0-0 Credits: 6

1.3 Semester-offered: 4th Year-Even

1.4 Prerequisite: Materials Science, Thermodynamics and Kinetics, Mass Transfer

1.5 Syllabus Committee Member: Dr Deepak Dwivedi, Dr Amit Ranjan

2. **Objective:** The objective of this course is to enable the students to understand the industrial corrosion scenarios and to develop understanding on microscopic and electrochemical origins of the corrosion phenomena. This course will also help students to understand the factors responsible for industrial corrosion and to design corrosion mitigation strategies by using appropriate engineering methods.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

Unit	Topics	Sub-topic	Lectures
1	Introduction and Corrosion Principles	General Introduction, corrosion rate expression, electrochemical reactions, polarization, passivity	2
2	Types of Corrosion	Galvanic (two-metal corrosion), Pitting, selective leaching, crevice corrosion, stress corrosion, hydrogen damage, erosion corrosion, intergranular corrosion, microbial corrosion, high temperature corrosion	3
3	Important Engineering Materials	Metals and alloys (cast iron, carbon steels, low alloy steels, stainless steels, Al and its alloys, Cu and its alloys, Ni and its alloys), Nonmetallics, Thermoplastics	2
4	Corrosion Prevention	Materials selection (metals and alloys, nonmetallics)	4
		Alteration of environment (changing medium, inhibitors)	
		Design (wall thickness, design rules)	
		Cathodic and Anodic Protection	
		Coatings (metallic and inorganic)	

5	Materials for Corrosive Environments (Mineral Acids)	Materials for sulfuric acid, materials for nitric acid, hydrochloric acid, hydrofluoric acid, phosphoric acid	4
6	Corrosion in Petroleum Industry	Corrosion problem at (a) production, (b) transportation and storage and (c) refinery operations	2
7	Modern Theory of Corrosion	Thermodynamics (Free energy, Cell potentials, EMF series)	6
		Electrode Kinetics (Exchange current density, activation polarization, concentration polarization, combined polarization, mixed potential theory)	
8	Application of Modern Theory	Predicting corrosion behaviour (Galvanic coupling and alloy behaviour)	4
		Corrosion Prevention (Anodic protection, noble-metal alloying)	
		Corrosion Rate Measurement (Tafel Extrapolation and Linear Polarization)	
9	High Temperature Corrosion	Metal-Gas Reaction (Hot corrosion of alloys)	1
		Total	**28**

4. Readings

4.1 Text Books:

1. Corrosion Engineering (third edition) by Mars G. Fontana, Tata McGraw-Hill.
2. Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering (third edition) by Herbert H. Uhlig and R. Winston Revie, John Wiley and Sons.
3. Corrosion Engineering: Principles and Practice (first edition) by Pierre R. Roberge, McGraw-Hill.

4.2 Reference Books:

1. Principles and Prevention of Corrosion (second edition) by D.A. Jones, Prentice-Hall.

5. Outcome of the Course: Upon completion of this course, students will be able to rationally arrive at the solutions for corrosion mitigation. They will also be able to select the materials for corrosion control and to analyze the failures caused by corrosion.