

## **Corrosion and Environmental Degradation of Materials Credits: 4**

**Unit-I:** Introduction and basics: Importance of corrosion, concept of classification of corrosion ,concept of Degradation process – Mechanical and chemical process, concept of electrochemical cells ,concept of corrosion cell formation ,concept of free energy and cell potential and EMF , Nernst equation , single electrode potential , concept of reference electrodes, Galvanic series and EMF series-applications in corrosion.

**Unit-II:** Thermodynamic Aspects: Pourbaix diagrams (EH-PH diagram) and fundamental aspects, construction of EH-PH diagrams for different systems,Concept of corrosion rate expressions, Faradays law, cathodic - anodic reactions, concept of polarization or over potential and classification,Concept of exchange current density, Butler – Volmer equation.

**Unit-III:** Kinetic Aspects & corrosion rate determination: Concept of Evans diagrams(Mixed potentials) and basics ,construction of Evans diagrams of corroding metals in different solutions and Bimetallic couples , Mixed potential theory- applications ,concept of Activation and diffusion control process , Corrosion rate measurement methods ,Linear polarization and Tafel methods.

**Unit-IV:** Passivity & Forms of corrosion: Faradays passivity experiment, passivity and influencing parameters and definitions, passivity diagrams. Theories of Passivation, factors and conditions for passivity ,Design of corrosion resistant alloys , Critical current density,Concept of Galvanic corrosion and beneficial applications , Different forms of corrosion and mechanisms , crevice corrosion ,stress corrosion cracking ,pitting and inter granular corrosion concept of Hydrogen attack and hydrogen embrittlement and blistering.

**Unit-V:** Prevention of corrosion: Corrosion prevention principles , concept of Material selection , concept of inhibitors and classification , concept of cathodic protection - principles, classification, cathodic protection - influencing factors and monitoring , Sacrificial anode, High Temperature Corrosion, Oxidation, Pilling Bedworth Ratio, practical examples of high temperature oxidation.

**Unit-VI:** High temperature corrosion, conversion coating and chemical degradation of non metallic materials: Oxide defect structures, semiconducting oxides, Wagner – Hauffe valence approach , Doping of oxides ,catastrophic and internal oxidation ,High temperature alloy

design, alloying elements and major defects , concept of conversion coating ,chemical degradation of non metallic materials like ceramics, plastics and rubbers, Bond rupture ,swelling and weathering.

#### **TEXT BOOKS;**

1. Principles of Electroplating and Electroforming - William Blum
2. Corrosion Engineering-Mars G. Fontana

#### **REFERENCES;**

- 1) M. G. Fontana, Corrosion Engineering
- 2) R. W. Revie & H. H. Uhlig, Corrosion and corrosion control,
- 3) Philip A. Schweitzer, Fundamentals of Corrosion
- 4) E.E. Stansbury & R.A. Buchanan, Fundamentals of Electrochemical Corrosion
- 5) Zaki Ahmad, Principles of Corrosion Engineering and Corrosion Control