

# **COURSE WORK SYLLABUS FOR MECHANICAL ENGINEERING**

**Subject code:18SPHDME01**

## **CORROSION ENGINEERING**

### **Module 1:**

Electrochemical aspects, electrochemical reactions, Pourbaix diagrams, mixed potential theory, polarization, Evans diagrams, passivity

### **Module 2:**

Effects of environment - oxygen and oxidizers, temperature, corrosive concentration, cathode/anode area ratio, galvanic coupling using mixed potential theory.

### **Module 3:**

Forms of corrosion - uniform, galvanic, crevice, intergranular, pitting, selective leaching, erosion, stress corrosion, corrosion fatigue, fretting.

### **Module 4:**

Corrosion rate measurements - Tafel and linear polarization, AC impedance, small - amplitude cyclic voltammetry. Corrosion testing. Interpretation of results,

### **Module 5:**

Corrosion protection: materials selection, alternative environment, design, cathodic and anodic protection, coatings, High - temperature corrosion: mechanisms and kinetics, high - temperature materials.

### **References:**

Mars G. Fontana, Corrosion, McGraw - Hill Book Company 1986.

David Talbot and James Talbot, Corrosion Science and Technology, CRC Press, New York, 1998.

Denny A. Jones, Principles and Prevention of Corrosion, Maxwell Macmillan 1992.

Metals Handbook, Vol.13, Corrosion, ASM Metals Book, Ohio 1987.

Subject code:18SPHDME02

## **MATERIALS CHARACTERISATION**

### **Module1**

Introduction, Basics of crystallography, X-rays: Generation, properties, Absorption and Filtering

### **Module2**

Diffraction of X-rays, Diffraction under non-ideal conditions, methods of diffraction. Intensity of diffracted beams.

### **Module3**

Powder method: Specimen preparation, Selection of radiation, Background radiation. Determination of Crystal structure. Solvus line, chemical Analysis, particle size Analysis.

### **Module4**

Stereographic projections, Determination of texture, Electron microscopy: General Principles, Electron-specimen interaction, Electron optics

### **Module5**

TEM: Image formation Scheme, Reciprocal lattice, Electron diffraction, Specimen Preparation.

SEM: Principles of signal generation, modes of operation, specimen preparation.

### **References:**

P. G. Grundy and G. A. Jones, Electron Microscopy in Study of Materials, Edward Arnold, 1976.

B. D. Cullity, Elements of X-ray Diffraction, Addison - Wesley Publications, 1978.

P. E. J. Flewitt & R. K. Wild, Physical Methods of Materials Characterization, IOP, 1994 Publishing Ltd.

Metals Hand Book, Vo.10, ASM, Metals Park, Ohio, 1986.

## **SURFACE ENGINEERING**

### **Module 1**

Surface Cleaning: Classification and Selection of Cleaning Processes Finishing Methods: Classification and Selection of Finishing Processes; Topography of Surfaces; Microstructural Analysis of Finished Surfaces

### **Module 2**

Plating and Electroplating: Electrodeposition Processes: Copper Plating; Nickel Plating; Zinc Plating; Zinc Alloy Plating; Selective (Brush) Plating; Electroforming. Nonelectrolytic Deposition Processes: Electroless Nickel Plating; Electroless Alloy Deposition Dip, Barrier and Chemical Conversion Coatings: Batch Hot Dip Galvanized Coatings;

### **Module 3**

Phosphate Coatings; Chromate Conversion Coatings; Rust Preventive Compounds; Painting; Ceramic Coatings and Linings; Anodizing. Vacuum and Controlled - Atmosphere Coating and Surface Modification Processes: Thermal Spray Coatings; Chemical Vapor Deposition of Nonsemiconductor Materials; Chemical Vapor Deposition of semiconductor Materials;

### **Module 4**

Plasma - Enhanced Chemical Vapor Deposition; Growth and Growth - related Properties of Films Formed by Physical Vapor Deposition; Vacuum Deposition, Reactive Evaporation, and Gas Evaporation; Sputter Deposition; Ion Plating; Ion-Beam-Assisted Deposition; Arc Deposition;

### **Module 5**

Ion Implantation; Diffusion Coatings; Pulsed - Laser Deposition. Testing and Characterization of Coatings and Thin Films: Film Thickness Measurements Using Optical Techniques; Corrosion Testing; Evaluation of Mechanical Properties of Thin Films.

### **References:**

P. K. Dutta & I. S. Gray, Surface Engineering, Vol. I - III, Royal Society of Chemistry, 1993.

ASM Hand Book, Vol.5, ASM International, Metals Park, Ohio, 1999.

Kenneth G. Budinsk, Surface Engineering for wear resistance, Prentice Hall, NJ1988.

