

## **Failure Analysis**

**3 Credits (3-1-0)**

**Introduction to Failure analysis and Prevention:** Concepts, root causes analysis, primary root causes, design deficiencies, material defects, manufacturing/installation defects, categories of failure, failure prevention

**Type of Stresses:** Elastic stress distributions for simple shapes, Thermal residual stresses, Metallurgical residual stresses, Mechanical residual stresses, Chemical effects on residual stresses.

**Mode of Fractures:** Brittle fracture, Brittle fracture of normally ductile steels, Characteristics of Brittle fracture, Microstructural aspect of brittle fracture, Combined fracture modes, Ductile fracture, Characteristics of ductile fracture, Microstructural aspects of ductile fracture, Fatigue fracture, Types of fatigue fracture, Stages of fatigue fracture, Microscopic and macroscopic characteristics of fatigue fracture.

**Different Type of Failures:** Wear failure, Abrasive and adhesive wear, Fretting wear, Wear failures-fatigue, Corrosion failure, Life cycle of a metal, Basic nature of corrosion, Forms of corrosion (Galvanic corrosion, Uniform corrosion, Crevice corrosion, Stress-corrosion cracking), Corrosion fatigue, Hydrogen embrittlement in alloys, Elevated-temperature failure, Creep, Elevated-temperature fatigue, Thermal fatigue, Metallurgical instabilities, Environmentally induced failure, Cooling methods.

**Tools and Techniques in Failure Analysis:** General Practices, Photography, X-rays, metallographic techniques, Fractography. Examples of component failures in metals, Ceramics, polymers and plastics.

### **Books and References:**

1. Hertz berg R W, "Deformation and fracture mechanics of Engineering materials" second edition John Wiley sons inc, New York 1983.
2. Knott. J.F, "Fundamentals of Fracture Mechanics" Butterworth London, 1973
3. Evalds H L and RJH Warnhil, "Fracture Mechanics", Edward Arnold Ltd, Baltimore, 1984.
4. Deformation and Fracture Mechanics of Engineering Materials/R. W. Hertzberg/ John Wiley & Sons. 1996.