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| **Semester II**  **Subject code - 6PE5205ME** | **L**  **3** | **T**  **-** | **P**  **0** | **Credits**  **3** |

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| **Course Objectives**: | **Course Outcomes**: |
| 1. Know different Design Methods, calculate Weight & Metal Content and improve Rigidity & Strengthening of Mechanical Members and Structures. 2. Learn how to analyze products and be able to improve their manufacturability and lower costs. 3. Design machine components which are subjected to fluctuating loads. 4. Distinguish different design criterions and their procedure to carry out the required design steps for designing mechanical components. 5. To be able to carry out complete mechanical system design of various   mechanisms. | **After completion of the course, the student will be able to**   1. Predict failure of engineering components using failure theories 2. Identify and explain the types of fractures of engineered materials and their characteristic features 3. Understand LEFM approach 4. Estimate life of components using stress life and strain life 5. Categorize different types of surface failure |

**UNIT-I**

**General Design Procedure**: Design Philosophies, Design for Reliability, Concurrent Engineering, Aesthetics and Ergonomics.

Material Selection: Introduction, General characteristics of machine component applications, Material Selection Factors and Process, Material Selection Charts.

Manufacturing Process and Design Considerations: Design of Cast Members, Design of Welded Joints, Design for Forming, Design for Machining

**UNIT-II**

**Stress-Life (S-N) Approach**:

S-N curves, Statistical nature of fatigue test data, General S-N behavior, Mean stress effects, Different factors influencing S-N behavior, S-N curve representation and approximations, Constant life diagrams, Fatigue life estimation using S-N approach.

Review of Stresses, Strains and Theories of Failures:

Introduction, Plane Stress, Rotation of Coordinate Axes, Generalised Plane Stress, Principal Stresses and Maximum Shear Stress, 3D state of stress, Stresses on Octahedral plane, Plane strain, Strain gage rosettes. Theories of Failures: Distortion Energy, Maximum-Shear Stress, Maximum Normal Stress, Modified Coulomb-Mohr Theory, Comparison of theories of failures **UNIT-III**

**Fracture Mechanics**:

Introduction, Rise in stresses due to crack, Crack tip opening displacement, LEFM: Effect of crack on strength of ductile and brittle material, Crack opening modes and

Griffith theory, Concept of SIF and Crack Tip Plasticity, Use of K in design and analysis, Determination of plastic zone, size and shape, Limitations of LEFM

**UNIT-IV**

**Fatigue:**

Introduction, factors affecting fatigue behaviour, Theoretical stress concentration factor and notch sensitivity factor, Fatigue under complex stresses, cumulative fatigue design, Linear damage (Miner’s Rule), Manson’s method, Fatigue crack propagation and life estimation for constant and variable amplitude stress. Strain Based Approach to Fatigue: Strain Vs Life Curve, Mean stress effect, Strain-Life Equation, Life estimate for structural component

**UNIT-V**

**Surface Failure:**

Introduction, Surface geometry, Mating surface, Friction, Adhesive wear, Abrasive wear, Corrosion wear, Surface fatigue spherical contact, Cylindrical contact, General contact, Dynamic contact stresses, Surface fatigue strength.

**References:**

1. Mechanical Behaviour of Materials: Engineering Methods for Deformation Fracture an Fatigue 4\e N E Dowling Pearson.
2. Machine Design: An Integrated Approach 3\e R L Norton Pearson Education.
3. Fundamentals of Machine Design 5\e R C Juvinall & K M Marshek Wiley India
4. Metal Fatigue in Engineering R I Stephens, A Fatemi, RR Stephens and H O Fuchs. John-Wiley.
5. Elements of Fracture Mechanics Prashant Kumar McGraw-Hill.
6. Engineering Design Dieter, G McGraw-Hill
7. “Fatigue and Fracture”, ASM Hand Book, Vol 19, 2002.

Metal Fatigue in Engineering R I Stephens, A Fatemi, R R Stephens and H O Fuchs. John-Wiley.