DESIGN OF MACHINE ELEMENTS - I

Course Code: 13ME1120

Pre requisites:
Engineering Mechanics, Mechanics of solids and Material science

Course Educational Objectives:
To learn,

- Overall design considerations, concepts of force flow, critical sections material properties.
- Design of straight and curved beams, columns and basics of finite element analysis.
- Prediction of failure with principal stresses and stress concentration, uses safety factors in calculations.
- Predict failure by fatigue under variable loading, S-N curves, Goodman and Soderberg principles.
- Types of wear, contact stresses, surface fatigue.
- Design of welded joints under static or dynamic loads.

Course Outcomes:

- Identify the critical section in a given component
- Calculate the stress, normal and shear, bending ,direct, torsional, axial, at a given point on the body
- For static loading calculate the principle stresses and predict the mode of failure
- For dynamic loading estimate fatigue stresses, impact stresses, surface damage as the case may be
- S-N curves, estimate endurance strength, fatigue life, remaining life
- Design of parts against surface damage, welded joints.
UNIT-I (16 Lectures)

MECHANICAL ENGINEER’S DESIGN IN BROAD PERSPECTIVE AND LOAD ANALYSIS:
Overview, safety, ecological, societal and overall design considerations, systems of units, methodology, work and energy, power, conservation of power, Introduction to load analysis, equilibrium equations and free body diagrams, beam loading, force flow concept, critical sections, redundant supports, force flow concept applied to redundant ductile structures.


UNIT-II (12 Lectures)

STATIC BODY STRESSES:
Introduction, axial loading, direct shear loading, torsional loading, pure bending in straight beams, transverse shear, combined stresses – Mohr circle, 3-D stresses, stress concentration factory Kt.

Deflection and stability: Introduction, deflection and spring rate, beam deflection, determining elastic deflection by secant formula, equivalent column stresses, and finite element analysis of plane truss.

UNIT-III (10 Lectures)

FAILURE THEORIES, SAFETY FACTORS, RELIABILITY:
Introduction, types of failure, theories of static failure, maximum normal stress theory, maximum shear theory, maximum distortion energy theory, modified selection and use of failure theories, concept of safety factors, selection, reliability, normal distribution.

UNIT-IV (14 Lectures)

FATIGUE:
Introduction, fatigue strength for rotation, bending, reverse bending and reverse biaxial loading, influence of size and surface on fatigue strength, summary of estimated fatigue strength for completely reversed loads, SN curves, effect of mean stress on fatigue strength, Goodman and Soderberg principles, effect of stress concentration with completely reversed fatigue.
loads and with mean and alternating loads, fatigue life prediction with random variable loads (Palmgren-Miner method)

**UNIT-V**  
**SURFACE DAMAGE:**  
Introduction, types of wear, adhesive, abrasive, fretting, analytical approach to wear, Hertz contact stresses, surface fatigue failure.


**TEXT BOOK:**

**REFERENCES:**

**Note:** Design data book will not be permitted during examination.