DESIGN OF MACHINE ELEMENTS - I

Course Code: 13ME1120

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Pre requisites:

Engineering Mechanics, Mechanics of solids and Material science

Course Outcomes:

At the end of course, a student will be able to

CO 1 Identify impact of engineering design on society and select materials for engineering design

CO 2 Compute stresses in machine members, stress concentration, deflection of beams and buckling of columns

CO 3 Apply theories of failure in design and select suitable factor of safety

CO 4 Design for fatigue life and apply theories of failure for fatigue

CO 5 Apply theories of wear, identify surface damage, determine stresses due to contact, impact and torsional loads

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.

Materials: Introduction, static tensile stresses, engineering stress-strain curves, true stress – strain curves, energy – absorbing capacity, hardness tests, machinability, materials selection charts.

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 (08 Lectures)

SURFACE DAMAGE:

Introduction, types of wear, adhesive, abrasive, fretting, analytical approach to wear, Hertz contact stresses, surface fatigue failure.

Impact: Introduction, stress-deflection caused by linear and bending impact, causes by torsional impact, effect of stress raisers on impact strength.

TEXT BOOK:

R.C. Juvinall and K M Marshek, *"Fundamental of Machine Components Design"*, John Wiley&Sons, 4th Edition, 2000.

REFERENCES:

1. Shigley and Mishke, *"Design of Machine Elements"*, McGraw Hill Publication, 5th Edition. 1983.
2. Hall, Holowenko and Laughlin, *"Theory and problems of Machine Design"*, Schaums Outline series, Tata McGraw-Hill, New Delhi, Fifth reprint 2011.
3. V.B. Bhandari, *"Design of Machine Elements"*, 3rd Edition, TMH, 2010.

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