Exam.Code:0939
Sub. Code: 7042

1129

M.E. (Mechanical Engineering)
Third Semester
MEC-302: Mechanics of Materials – I

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Unit.

x-x-x

I. Attempt the following:-

a) What is principle of super position?

b) Derive the relation for change in length of a bar hanging freely under its own weight.

c) Give the relation between modulus of elasticity and modulus of rigidity.

d) Sketch the bending and shear stress distribution for a 'T' section.

e) Define product of Inertia

UNIT -I

II a) A bar of cross section 8 × 8 mm is subjected to an axial pull of 7000 N. The lateral dimension of the bar is found to be changed to 7.9985 mm × 7.9985 mm. If the modulus of rigidity of the material is 0.8×10^5 N/mm^2, determine the poisson's ratio and modulus of elasticity.

b) A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If at a temperature of 10 °C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200 °C. Take Es = 220 GN/ m^2 *and Ec = 110* GN/ m^2, $\alpha c=6.5\times10^{-6}$ /°C and $\alpha s= 12.55\times10^{-6}$ /°C. (5,5)

III a) Explain the steps in deflection of bars using differential equation approach with suitable example.

b) Derive the relation between elastic constants (E, G and K). (5,5)

IV a) A thick cylinder of 150 mm outside radius and 100 mm inside radius is subjected to an external pressure of 30 MN/m^2 and internal pressure of 60 MN/m^2. Calculate the maximum shear stress in the material of the cylinder at the inner radius.

b) A thin cylindrical shell 1.5 m long, internal diameter 300 mm and wall thickness 10 mm is filled up with a fluid at atmospheric pressure. If the additional fluid of 300×10^3 mm^3 is pumped in the shell, find the pressure exerted by the fluid on the shell. Take E = 2.0×10^5 N/mm^2 and 1/m=0.3. Also find the hoop stress induced. (5,5)

UNIT -II

V a) A Solid alloy shaft 60 mm diameter is to be coupled in series with a hollow steel shaft of the same external diameter. Find the internal diameter of the steel shaft if the angle of twist per unit length is to be 75% of that of the alloy shaft. Determine the speed at which the shafts are to be driven to transmit 400 kW, if the limits of the shearing stress are to be 60 N/mm^2 and 80 N/mm^2 in alloy and steel

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respectively. Take C_{steel}=2.2 C_{alloy}.

b) Discuss the following

(i) Elastic Curves (ii) Singularity Functions (5,5)

VI a) State any four assumptions made in theory of simple bending and derive bending formula $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$

b) A solid steel shaft 120 mm diameter and 1.5 m long is used to transmit power from one pulley to another. Determine the maximum strain energy that can be stored in the shaft, if the maximum allowable shear stress is 50 MPa. Take shear stress modulus as 80 GPa. (5,5)

VII a) A 300 mm × 150 mm I- grinder has 12 mm thick flanges and 8 mm thick web. It is subjected to a shear force of 150 kN at a particular cross-section. Find the ratio of maximum shear stress to minimum in the web. What is the maximum shear stress in the flange? Also draw the shear stress distribution diagram.

b) The stiffness of a close coiled helical spring is 15 N/mm of compression under a maximum load of 60 N. The maximum shearing stress produced in the wire of the spring is 125 N/mm^2. The solid length of the spring is given as 5 cm. Find

(i) Diameter of wire

(ii) Mean coil diameter of the coils and

(iii) Number of coils required. Take modulus of rigidity = 4.5 × 10 N/mm^2

(5,5)

x-x-x