Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: MEPC2001

3rd Semester Regular Examination: 2024-25
SUBJECT: Mechanics of Solids
BRANCH(S): ME, MECH, MANUTECH, C&EE, CE, AUTO, AME, AERO, CIVIL, MMEAM
Time: 3 Hours
Max Marks: 100
Q.Code: R457

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) State Hooke's law.
b) Distinguish between the "limit of proportionality" and "elastic limit".
c) Define the terms "principal stress" and "principal strain".
d) What is the use of Mohr's circle?
e) What do you understand by the term, 'point of contraflexure'?
f) Write any two assumptions in the theory of simple bending.
g) Write the expression for power transmitted by a shaft.
h) What is a spring? Write its uses.
i) The mean coil diameter of a helical spring and diameter of the coil are 100 mm and 10 mm respectively. Find the spring index if it carries an axial load of 20 N.
j) Define Slenderness ratio.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Derive the relationship between modulus of elasticity and modulus of rigidity.
b) The composite bar shown in Fig. 1 is subjected to a tensile force of 30 kN. The extension observed is 0.44. Find the Young's modulus of brass, if Young's modulus of steel is 2×10^5 N/mm^2.

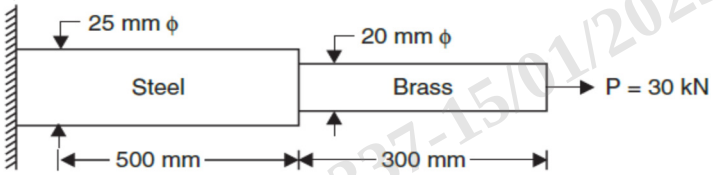

Fig. 1

c) An alloy bar 2 m long is held between two supports. Find the stresses developed in the bar, when it is heated through 30 K if both the ends (I) do not yield; and (II) yield by 1 mm. Take the value of E and α for the alloy as 120 GPa and 24×10^{-6}/K.
d) An element in a strained body is subjected to a tensile stress of 150 MPa and a shear stress of 50 MPa tending to rotate the element in an anticlockwise direction. Find (I) the magnitude of the normal and shear stresses on a section inclined at 40° with the tensile stress; and (II) the magnitude and direction of maximum shear stress that can exist on the element.

e) At a point in a stressed element, the normal stresses in two mutually perpendicular directions are 45 MPa and 25 MPa both tensile. The complimentary shear stress is these directions is 15 MPa. By using Mohr's circle method, determine the maximum and minimum principal stresses.

f) A cylindrical vessel 2 m long and 500 mm in diameter with 10 mm thick plates is subjected to an internal pressure of 3 MPa. Calculate the change in volume of the vessel. Take E = 200 GPa and Poisson's ratio = 0.3 for the vessel material.

g) Explain the following types of supports to beams:
(i) Simple support (ii) Hinged support (iii) Fixed support

h) Deduce a relation for the shear stress across a rectangular section. What is the maximum value of shear stress?

i) Draw the shear force and bending moment diagrams for a simply supported beam as shown in Fig. 2.

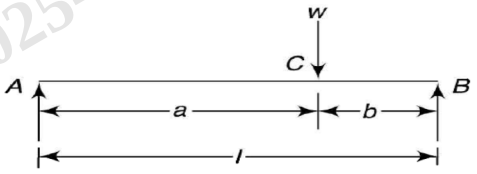

Fig. 2

j) A shaft transmits 280 kW of power at 160 rpm. Determine
I. The diameter of a solid shaft to transmit the required power.
II. The inner and outer diameters of a hollow circular shaft if the ratio of the inner to the outer diameter is 2/3.

k) A closely coiled helical spring of mean diameter 140 mm is made up of 12 mm diameter steel wire. Calculate the direct axial load, the spring can carry if the maximum stress is not to exceed 100 MPa.

l) Describe the assumptions in the Euler's column theory.

Part-III
Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Draw a typical stress-strain curve for mild steel, indicate salient point and define them. **(16)**

Q4 Prove the following expression in case of a circular shaft. **(16)**

$$\frac{T}{J} = \frac{G\theta}{l} = \frac{\tau}{R}$$

Q5 A cantilever of 10 m span carries loads of 4 kN and 6 kN at 2 m and 6 m respectively from the fixed end along with another load of 6 kN at the free end as shown in Fig. 3. Draw the shear force and bending moment diagrams. **(16)**

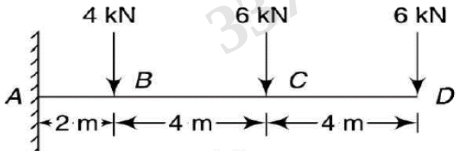

Fig. 3

Q6 Derive a relation for the Euler's crippling load for a column when (i) it has both ends hinged, and (ii) both ends fixed. **(16)**