3E1631

Roll No. _____ Total No of Pages: 7

3E1631

B. Tech. III Sem. (Main/ Back) Exam., Feb. 2015

Mechanical

3ME1A Mechanics of Solids - I

Common to 3AN1, 3PI1A and 3AE1A

Time: 3 Hours

Maximum Marks: 80
Min. Passing Marks:
Main: 26
Back: 24

Instructions to Candidates:

*Attempt any **five questions,** selecting **one question** from **each unit.** All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be **assumed** and stated clearly.*

*Units of quantities used/calculated **must** be stated clearly.*

Use of following supporting material is permitted during examination.

1. NIL 2.NIL

UNIT-I

Q. 1 (a) Define the terms: [4×2=8]

(1) Elasticity

(2) Elastic limit

(3) Young's modulus

(4) Bulk modulus

(b) A steel bar ABC 16 mt. long having cross- sectional area of $4mm^2$ weighs 20N as shown in figure 1. If E for wire material is 200GPa, find the deflection at C & B. [8]

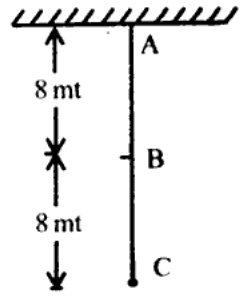

Fig - 1

OR

Q. 1 A metallic bar 250mm × 100mm × 50mm is loaded as figure 2. Find the change volume. Take E= 2×10^5 N/mm^2 & Poisson's Ratio = 0.25. rtuonline.com
Also find the change that should be made in the 4 MN load in order that there shou be NO change in the volume of the bar. [1

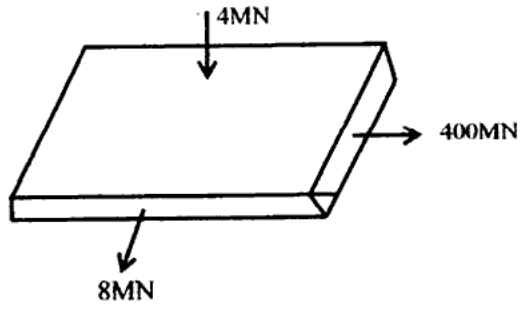

Fig 2

UNIT-II

Q. 2 (a) Define and explain the following theories of failure: [2×3=6]

(1) Maximum principal stress theory

(2) Maximum shear stress theory

(3) Maximum strain energy theory

(b) On a mild steel plate, a circle of diameter 50mm is drawn before the plate is stressed as shown in figure 3. Find the lengths of the major and minor axis of an ellipse formed as a result of the deformation of the circle marked. [10]

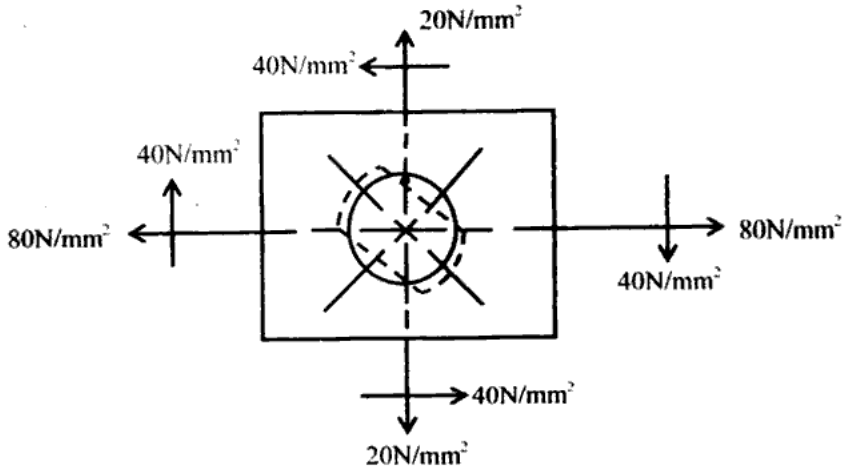

Fig 3

OR

Q. 2 (a) A rectangular bar is subjected to two direct stresses (σ_1 and σ_2) in two mutually perpendicular directions. Prove that the normal stress (σ_n) and shear stress (σ_t) on an oblique plane which is inclined at an angle θ with the axis of minor stress are given by - [10]

$$\sigma_n = \frac{\sigma_1 + \sigma_2}{2} + \frac{\sigma_1 - \sigma_2}{2}\cos 2\theta$$

and $$\sigma_t = \frac{\sigma_1 - \sigma_2}{2}\sin 2\theta$$

(b) Write short notes on Mohr's circle. [6]

UNIT-III

Q. 3 (a) Explain theory of simple bending and prove that: [12]

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

Where,

M = Bending moment

I = Moment of Inertia

σ = Bending stress

y = Distance from Neutral axis

E = Young modulus

R = Radius of curvature

(b) Write short notes on section modulus and its application. [4]

OR

Q. 3 (a) Draw the Shear Force and Bending Moment diagram for a overhanging beam carrying uniformly distributed load of 2 kN/m over the entire length as shown in figure 4. Also locate the point of contra flexure. [10]

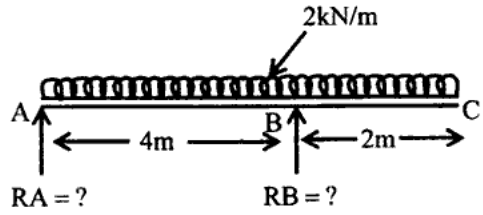

Fig 4

(b) Explain Beam and different type of loads on Beam? [6]

UNIT-IV

Q. 4 (a) Prove that the Maximum Shear Stress in circular section of a beam is 4/3 times the average shear stress. [8]

(b) A rectangular beam 100mm wide and 250mm deep is subjected to a maximum shear force of 50kN. Determine: [8]

(1) Average shear stress and maximum shear stress

(2) Shear stress at a distance of 25mm above the neutral axis

OR

Q. 4 (a) A cylinder of thickness 1.5 cm has to withstand maximum internal pressure of $1.5N/m^2$. If the ultimate tensile stress in the material of the cylinder is $300N/mm^2$, factor of safety 3.0 and joint efficiency 80%, determine the diameter of the cylinder. [8]

(b) A I- section beam 350mm × 150mm has a web thickness of 10mm and a flange thickness of 20mm. If the shear force acting on the section is 40kN, find the maximum shear stress developed in the I- section. [8]

UNIT-V

Q. 5 (a) Define the terms:- [6]

(1) Torsion

(2) Tensional Rigidity

(3) Polar Moment of Inertia

(b) Two shafts of the same material and same length are subjected to the same toque. It the first shaft is a solid circular section and the second shaft is of hollow circular section, whose internal diameter is $\frac{2}{3}$ of the outer dia and the maximum shear stress developed in each shaft is the same. Compare the weight of the shaft. [10]

OR

Q. 5 (a) Derive the expression for Euler's crippling load for a long column with both ends of column being hinged. **[8]**

(b) A 1.5 m long column has a circular cross-section of 5cm diameter. One of the ends of the column is fixed in direction and position and other end is free. Take factor of safety as 3, calculate the safe load using Rankine formula. Take yield stress $\sigma_c = 560 N/mm^2$ and $a = \frac{1}{1600}$ for pinned ends. **[8]**

--------x-------x-------