EX/PRN/PE/T/122/2017

B.PRINTING ENGG. EXAMINATION, 2017

(1st Year, 2nd Semester)

STRENGTH OF MATERIALS

Time : 3 hrs. Full marks : 100

(Attempt any five questions)

1. (a) What do you mean by section modulus? Find the section modulus for a (i) Rectangular section (ii) hollow circular section. (4)

   (b) Prove the relation : **$M/I = \sigma/Y = E/R$** , where M=bending moment, **I= M.O.I. Y=distance from N.A of any layer, σ= bending stress, E= young modulus, R= radius of curvature.** (8)

   (c) A square beam **20mm X 20mm** in sections and **2metres** long is supported At the ends. The beam fails when a point load of **400 N** is applied at the centre Of the beam. What **uniformly distributed load (ω) per metre length** will Break a cantilever of the same material **40mm wide, 60mm deep** and **3 metres** Long? (8)

2. (a) Show that the slope and deflection of a cantilever carrying uniformly distrib--uted load over the whole length are given by : **slope = $\omega L^3/6EI$** and **deflection = $\omega.L^4/ 8.E.I$** , where **ω= uniformly distributed load, L= length of the beam, E.I = flexural rigidity.** (10)

   (b) A cantilever of **length 2metres** carries a uniformly distributed load of **2.5 kN/m** Run for a length of **1.25 m** from the fixed end and a point load of **1 kN** at the Free end. Find the deflection at the free end if the section is rectangular **12 Cm.** Wide and **24 Cm and $E= 10^4$ N/ mm^2.** (10)

3. (a) A rectangular body is subjected to direct stresses **σ_1 (major)** and **σ_2(minor)** in Two mutually perpendicular directions accompanied by a **shear stress(τ).** Show that the **normal stress (σ_n)** and **tangential stress(σ_t)** on an oblique Plane inclined at an **angle Θ with** the plane of major direct stress are given

By : $\sigma_n = (\sigma_1 + \sigma_2)/2 + (\sigma_1 + \sigma_2)/2 \cdot \cos 2\theta + \tau \cdot \sin 2\theta$ and

$\sigma_t = (\sigma_1 + \sigma_2)/2 \cdot \sin 2\theta - \tau \cdot \cos 2\theta$ **(10)**

(b) A point in a strained material is subjected to stresses shown in **FIGURE-1,** **Using MOHR's circle** method, determine **the normal and tangential stresses** Across the oblique plane. **Check the answer analytically.** **(10)**

4. (a) Draw the **shear force** and **bending moment diagrams** for a simply supported Beam carrying a uniformly distributed load of '**ω**' **per unit length** over the ent--ire span. Also calculate **the maximum B.M.** **(10)**

(b) A simply supported beam as shown **in FIGURE-2,** of length 9metres and carry--**ing a uniformly distributed load** of **10 kN/m** for a distance of **6m** from the left end . Draw : **(i) S.F.D.** (ii) **B.M.D.** (iii) **Maximum B.M.at the section.** **(10)**

5. (a) Define the terms :
(i) Torsional rigidity (ii) Polar modulus **(4)**

(b) Show that torque transmitted by a hollow shaft subjected to torsion given by:

$T = \pi/16 \times \tau(D_2^4 - D_1^4)/D_2$, **where** D_2 **=outer diameter,** D_1 **= inner diam--eter** of the hollow shaft, τ **= maximum shear stress.** **(8)**

(c) A hollow shaft, having an inside **diameter 60%** of its outer diameter,is to rep--lace a solid shaft transmitting the same power at the same speed. **Calculate The percentage saving in material,** if the material to be used is also the Same. **(8)**

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6. (a) Define and explain the terms : (i) **longitudinal and lateral strain**
(ii) Poisson's ratio. **(4)**

(b) Show that the total extension of a uniformly tapering rod of **diameters** D_1 **and** D_2 $(D_2 > D_1)$, when the rod is subjected to an **axial load** '**P**' is given by :

$dL = 4.P.L / \pi.E.D_1.D_2$, where L = total length of the rod. **(6)**

(c) A metallic **bar 300mm X 100mmX 400mm** is subjected to a force of **5kN (tensile), 6kN(tensile) and 4kN (tensile) along x, y and z** directions resp--ectively. Determine the change in volume of the block.
Given **$E = 2 X 10^5$ N/ mm²** and **poisson's ratio = 0.25.** **(10)**

7. (a) A rod whose ends are fixed to rigid supports, is heated so that rise in temper--ature **is t^0 C.** Show that the thermal strain and thermal stresses set up in the Rod are given by : **Thermal strain = $\alpha.t$, Thermal stress = $\alpha.t.E$.**
Where **α = co-efficient of linear expansion.** **(10)**

(b) A rod is **2 metres** long at a temperature of **10°C.** Find the expansion of the Rod, when the temperature is raised to **80°C.** If the expansion is prevented, Find the stress induced in the material of the rod.
Given **$E = 10^5$ MN/m²** and **$\alpha = 0.000012$ /°C.** **(10)**

8. (a) Show that the deflection of a close-coiled helical spring at the centre due to Axial load 'W' is given by : **$\delta = 64.W.R^3.n / C.d^4$** where **R = mean radius** Of the spring coil, n= **number of coils, d= diameter of the spring wire, C= modulus of rigidity.** **(10)**

(b) A close coiled helical spring of **Φ10 Cm.** Mean diameter is made up of **Φ10mm** Rod and has **20 turns.** The spring carries an axial load of **250N.** Taking the Value of **modulus of rigidity = 8.4 X 10^4 N/mm².**
Determine : (i) the shearing stress (ii) the deflection (ii) stiffness of the Spring (iv) frequency of the free vibration for a mass hanging from it **(10)**

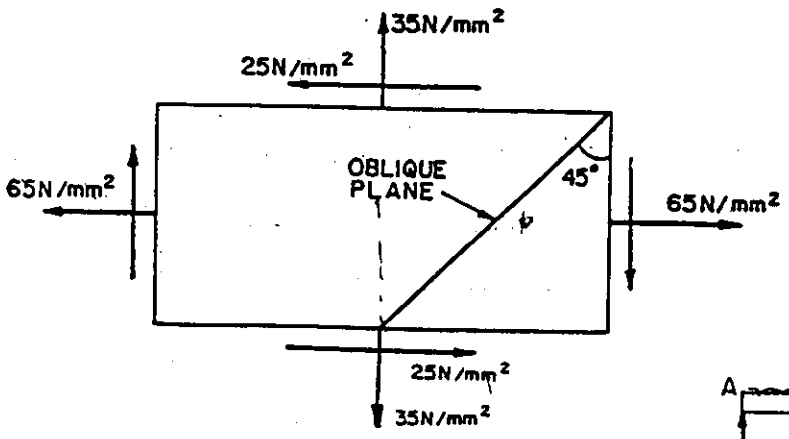

FIGURE-1.

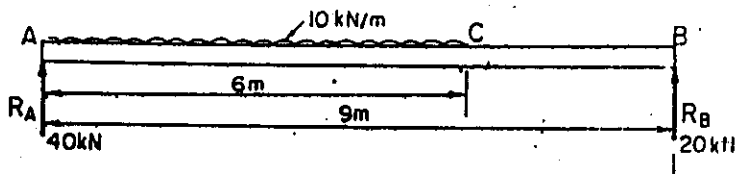

FIGURE -2.