EX/PRN/PE/T/122/2019(old)

B.Printing Engineering Examination, 2019(old)

(1st Year, 2nd Semester)

STRENGTH OF MATERIALS

Time : 3 hrs. **Full marks : 100**

(Attempt any five questions)

3. (a) **Distinguish** between the following: (i) **Stress** and **Strain;** (ii)**Compressive stress.** (2+2)

(b) Three ropes **AD, BD,** and **CD** support at load 'P' as shown in **FIGURE – 1**. If the three ropes are of the same cross-sectional area the middle rope be vertical and the other ropres be θ with the vertical, find the load carried by each rope. (8)

(c) A bar of **ϕ30mm** is subjected to a pull of **60N**. The measured extension on gauge length of **200mm** is **0.1mm** and change in diameter is **0.004mm**.
Calculate: (i) **Young's modulus;** (ii) **Poission's ratio;** (iii) **Bulk modulus.** (8)

4. (a) **Draw** the **stress-strain diagram** and explain it in brief showing on the following- **Hook's zone, Yield points, Elastic zone, plastic zone** for **ductile material**. Also **find** the **relation** between **ultimate load safe load** and **factor of safety.** (10)

(b) Prove that the total extension of a uniformly tapering rod of diameters D_1 and D_2, when the rod is subjected to an axial load **P** is given by : $dl = 4PL / \pi E d_1 d_2$, where **L**=total length of the rod, **E** = Young's modulus. (10)

3. (a) **Define** the terms '**Polar Modulus**'. Find the **polar modulus** for a solid shaft and for a **hollow shaft.** (5)

(b) Show that the **torque transmitted** by a **hollow circular shaft** when subjected to torsion is given by:

$$T = (\pi/16) \times \tau_s \times (D_o^4 - D_i^4)/D_o;$$

where D_o= external diameter of the shaft; D_i = internal diameter of the shaft and τ_s = maximum shear stress induced at outer surface of the shaft. (8)

(c) A solid steel shaft has to transmit **75kW** at **200rpm.** Taking allowable shear stress as **70N/mm**, find suitable diameter for the shaft. If the maximum torque transmitted at each revolution exceeds the mean by **30%.** (7)

4. (a) Define thin cylinder. Name the stresses set up in a thin cylinder subjected to internal fluid pressure. (4)

(b) Prove that the **circumference stress(σ_1), longitudinal stress(σ_2)** are given by :

$$\sigma_1 = p.d/2t \quad \text{and} \quad \sigma_2 = p.d/4t$$

where, **p** = Internal fluid pressure, **d** = Internal diameter of thin cylinder,

t = thickness of wall of the thin cylinder. (8)

(c) A hollow cylinder drum **ϕ600mm diameter, 3metres** long has a **thickness of 10mm**. If the drum is subjected to an internal air pressure of **3N/mm^2,**

Determine the increase in the volume of the drum.

Given : $E = 2 \times 10^5$ N/mm^2 and poisson's ratio(μ) = 0.3. (8)

5.(a) Define the terms : (i) **principal planes;** (ii) **principal stresses.** (2 + 2)

(b) A rectangular bar is subjected to two direct stresses(**σ_1 and σ_2**) in two mutually perpendicular directions. Prove that the **normal stress(σn)** and **tangential stress(σt)** on an **oblique plane** which is inclined at an angle 'θ' with the axis of minor stress as shown in **FIGURE- 2**, are given by :

$$\sigma n = (\sigma_1 + \sigma_2)/2 + (\sigma_1 - \sigma_2)/2.\ Cos2\theta \quad \text{and} \quad \sigma t = (\sigma_1 - \sigma_2)/2\ .Sin2\theta$$ (6)

(c) A point in a strained material is subjected to stresses as shown in **FIGURE -3.** Using **MOHR's circle** method, determine the **normal and tangential stresses** across the **oblique plane. Check the answer analytically.** (10)

6. (a) Prove the relation : $M = E.I.(d^2y/dx^2)$

where **M**= bending moment, **E**= young's modulus, **I**= moment of inertia, **y**= deflection, **x**= length of the beam at any position. (7)

(b) Prove that the slope and deflection of a simply supported beam of length 'L' and Carrying a uniformly distributed load of '**ω**' **per unit length** over the entire length are given : **slope at supports(θ) =** $WL^2/24EI$ **and**

deflection at the centre = $(5/384)WL^3/EI$,

where, **W**= total load=**ωL**, **E**= Young's modulus of the beam materials, **I**= moment of inertia. (8)

(c) A beam **4metres** long, simply supported at its ends, carries a **point load 'W'** at its centre. If the slope at the ends of the beam is **not exceed 1°**, **find the deflection** at the centre of the beam. (5)

7. (a) Draw the **shear force and bending moment diagrams** of a simple supported beam Carrying a **uniformly varying load** from **zero** at one end to 'ω' **per unit length** at the **Other end.** Also calculate the **maximum B.M** for the beam. (3+3+4)

(b) A cantilever of length **2meters** as shown in **FIGURE-4**, carries a **uniformly distributed Load 1kN/m** run over a length of **1.5m** from the free end.

Draw : (i) the shear force diagram (ii) the bending moment diagram. (5+5)

8. (a) **Define** helical springs. Name the two important types of helical springs. helical springs. (4)

(b) Show that the maximum shear stress induced in the wire of a close-coiled helical spring is given by : $\tau_s = 16.W.R / \pi.d^3$ where, τ_s = maximum stress induced in the wire, **W**= axial load on spring , **R**= mean diameter of the spring coil, **d**= diameter of the spring wire. (6)

(c) A closed coiled helical spring made of **ϕ10mm** diameter steel wire has **15 coils** of **ϕ100mm** mean diameter. The spring is subjected to an axial load of **100 N.**

calculate :

(i) the maximum shear stress induced;

(ii) the deflection;

(iii) stiffness of the spring. (3+3+4)

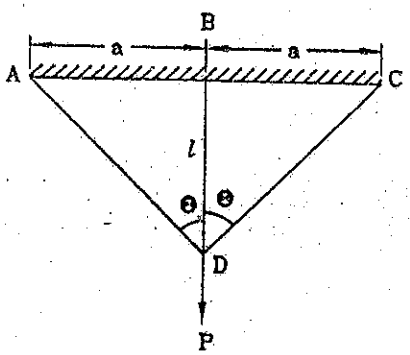
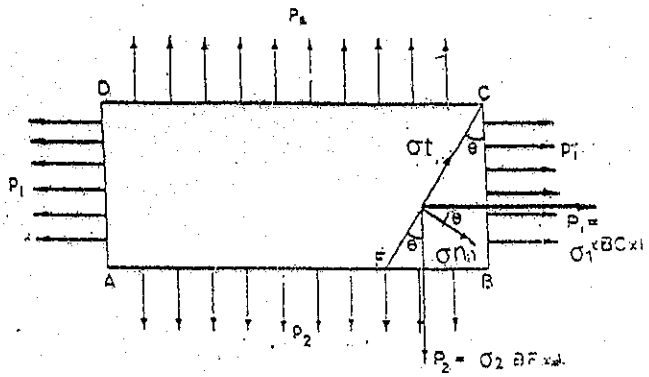


FIGURE- 1.



FIFGURE -2.

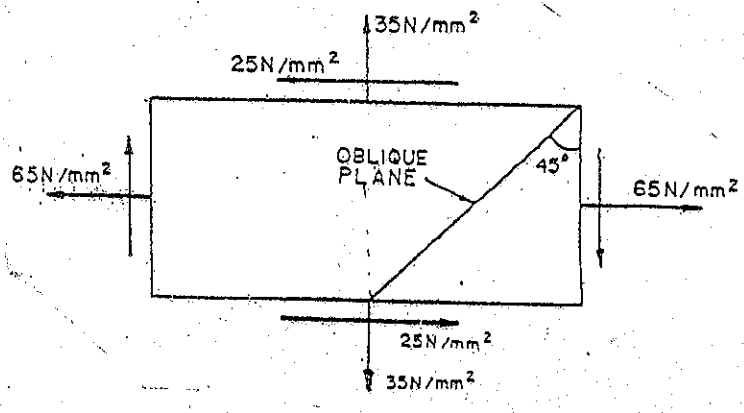


FIGURE -3.

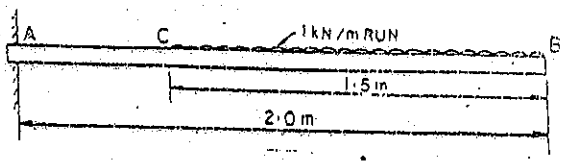


FIGURE – 4.