CBCS SCHEME

USN

21MT34

Third Semester B.E. Degree Examination, Dec.2023/Jan.2024
Mechanics of Solids and Fluids

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Derive an expression for the extension of uniformly tapering rectangular bar when it is subjected to an axial load P. **(10 Marks)**

b. A brass bar having cross section area 300mm^2 is subjected to axial forces as shown in Fig. Q1(b). Find the total elongation of the bar E = 84 GPa. **(10 Marks)**

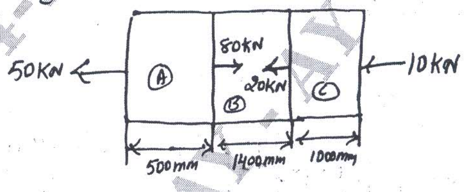

Fig. Q1(b)

OR

2 a. Establish a relationship between the modulus of elasticity and modulus of rigidity. **(10 Marks)**

b. In an experiment , a bar of 30mm diameter is subjected to a pull of 60kN. The measured extension on gauge length of 200mm is 0.09mm and the change in diameter is 0.0039mm. Calculate the Poisson's ratio and the values of the three moduli. **(10 Marks)**

Module-2

3 a. Define and explain i) Principal plane ii) Principal stress iii) Plane of maximum shear iv) Maximum shear stress. **(08 Marks)**

b. A plane element is subjected to stresses as shown in Fig. Q3(b). Determine i) Principal stresses ii) Maximum shear stress and their planes. Use Mohr's circle method. **(12 Marks)**

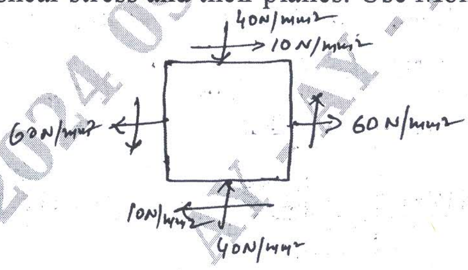

Fig. Q3(b)

OR

4 a. At a certain point in a strained material the values of normal stresses across two planes at right angles to each other are 80 MPa and 32 MPa, both are tensile and there is a shear stress of 32MPa. Clockwise on the plane carrying 80MPa stress. Determine principal stresses maximum shear stresses and their planes. **(12 Marks)**

b. Explain Procedure for construction of Mohr's Circle with tensile , Compressive and Shear stress acting on the component. **(08 Marks)**

Module-3

5 a. State the assumption made in pure torsion and derive $\frac{T}{J} = \frac{G\theta}{L} = \frac{\tau}{R}$ with usual meanings. **(10 Marks)**

b. A solid circular shaft has to transmit a power of 1000 kW at 120 rpm. Find the diameter of the shaft if the shear stress of the material must not exceed 80MPa. The maximum torque 1.25 times of its mean. What percentage of saving in material would be obtained if the shaft is replaced by a hollow one whose internal diameter is 0.6 times its external diameter, the length , material and maximum shear stress being same. **(10 Marks)**

OR

6 a. Derive an expression for Euler's Buckling load in long elastic column when both of its ends are hinged or pinned. **(10 Marks)**

b. A 1.5m long column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the FOS as 3, calculate the safe load using i) Rankine's formula taking yield stress 500MPa and $\alpha = 1/1600$.
ii) Euler's formula taking $E = 1.2 \times 10^5$ MPa. **(10 Marks)**

Module-4

7 a. Define the following terms with their SI units : i) Mass density ii) Weight density iii) Specific volume iv) Specific gravity v) Viscosity vi) Capillarity. **(12 Marks)**

b. If the velocity profile of a fluid over a plate is parabolic with the vertex 20cm from the plate where the velocity is 120cm/s. Calculate the velocity gradients and shear stresses at a distance of 0, 10 and 20cm from the plate, if the viscosity of the fluid is 8.5 poise. **(08 Marks)**

OR

8 a. Define the following terms : i) Total pressure ii) Center of pressure iii) Absolute pressure iv) Gauge pressure v) Atmospheric pressure vi) Vacuum pressure. **(12 Marks)**

b. The right limb of a simple U tube monometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is following. The centre of the pipe is 12cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20cm. **(08 Marks)**

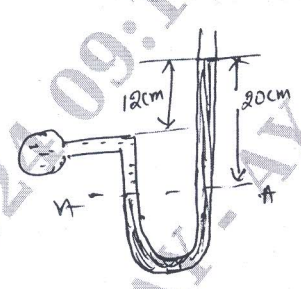

Fig. Q8(b)

Module-5

9 a. Describe the types of fluid flows. **(10 Marks)**

b. A 30cm diameter pipe converging water branches into two pipes of diameter 20cm and 15cm respectively. If the average velocity in the 30cm diameter pipe is 2.5m/s. Find the discharge in this pipe. Also determine the velocity in 15cm pipe if the average velocity in 20cm diameter pipe is 2m/s. **(10 Marks)**

OR

10 a. List the assumptions and applications of Bernoulli's equation. **(08 Marks)**

b. Name the different forces present in a fluid flow for the Euler's equation of motion and Bernoulli's equation of motion which forces are taken in to consideration. **(04 Marks)**

c. Derive Bernoulli's equation for the flow of an incompressible frictionless fluid. **(08 Marks)**

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