CBCS SCHEME

USN | | | | | | | | | | |

21MT34

Third Semester B.E. Degree Examination, June/July 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. Define the following : i) Poisson's Ratio ii) Proof stress iii) Hook's law iv) Modulus of Rigidity v) Bulk modulus. **(10 Marks)**

b. The bar shown in Fig Q1(b) in tested in universal testing machine. It is observed that at a load of 40kN the total extension the bar is 0.285mm. Determine Young's modulus of the materials.

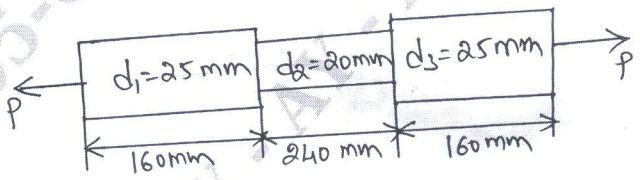

Fig Q1(b) **(10 Marks)**

OR

2 a. Derive an impression for relation between E, G and μ as $E = 2G(1 + \mu)$. **(10 Marks)**

b. A stepped bar is subjected to forces as shown in Fig Q2(b). Determine the magnitude of the force P, allowable stresses for the material is 90MPa. Also find the net deformation induced in the bar. Take $E = 2 \times 10^5 N/mm^2$.

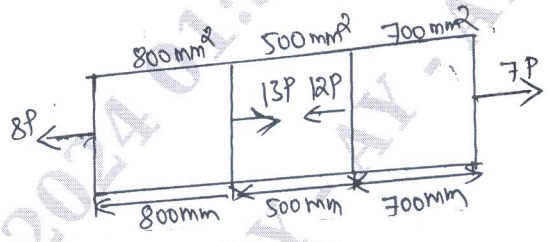

Fig Q2(b) **(10 Marks)**

Module-2

3 a. Derive an expression for element subjected to biaxial direct stresses. **(10 Marks)**

b. The state of stress at a point in a stained material is as shown in Fig Q3(b). Determine : i) Direction of principle plane ii) Magnitude of principle stresses iii) Magnitude of maximum shear stress and their location.

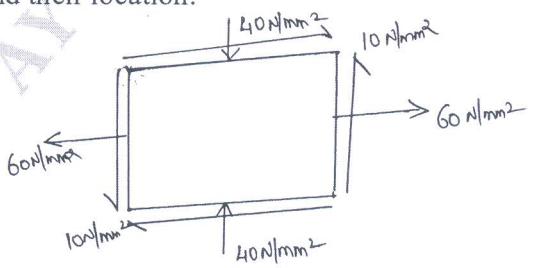

Fig Q3(b) **(10 Marks)**

OR

4 The state of stress at a point in strained material is shown in Fig Q4. Determine :
   i) The direction of the principal planes
   ii) The magnitude of principal stresses
   iii) The magnitude of the maximum shear stress and its direction
   iv) Draw Mohr's circle and verity the results obtain analytically.

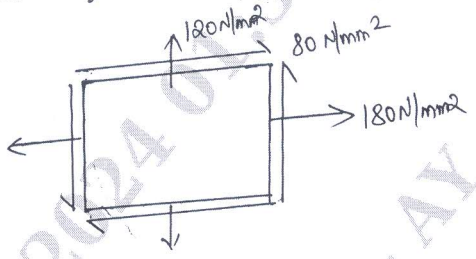

Fig Q4 **(20 Marks)**

Module-3

5 a. With assumption derive the expression for torsinal equation. **(10 Marks)**

   b. A hollow circular steel shaft has to transmit 60kW at 210rpm such that the maximum shear stress does not exceed 60MN/m^2. If the ratio of internal to external diameter is equal to ¾ and the value of rigidity modulus is 84GPa. Find the dimension of the shaft and angle of twist in a length of 3m. **(10 Marks)**

OR

6 a. Derive an expression for a critical load in a column subjected to compressive load, when both ends are fixed. **(10 Marks)**

   b. A Hollow CI column whose outside diameter is 200mm has a thickness of 20mm. It is 4.5m long and is fixed at both ends. Calculate the safe load buy Rankin's formula using a factor of safety of 4. Calculate slenderness ratio and the ratio of Euler's and Rankine's critical loads.

   Take $f_c = 550N/mm^2$, $\alpha = \frac{1}{1600}$ in Rankine's formula and $E = 9.4 \times 10^4 N/mm^2$. **(10 Marks)**

Module-4

7 a. Define the following properties of fluid. i) Dynamic viscosity ii) Kinematic viscosity iii) Surface tension iv) Capillarity v) Specific gravity. **(10 Marks)**

   b. State and derive Pascal's law. **(10 Marks)**

OR

8 a. Derive an expression for total pressure and centre of pressure for a vertical plane submerged in liquid. **(10 Marks)**

   b. Determine the total pressure on a circular plate of diameter 1.5m which is placed vertically in water such a way that the centre of plate is 3m below the free surface of water. Also find the position of centre of pressure. **(10 Marks)**

Module-5

9 a. Derive an expression for continuity equation in three dimensions. **(10 Marks)**

   b. The stream function for a two dimensional flow is given by $\psi = 2xy$, calculate the velocity at the point P(2, 3). Find the velocity potential function ϕ. **(10 Marks)**

OR

10 a. Explain the types of Fluid Flow. **(10 Marks)**

   b. Water is flowing through a pipe having diameter 300mm and 200mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.52N/cm^{-2} and the pressure at the upper end is 9.81N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 40 ℓit/sec. **(10 Marks)**

* * * * *