C 15638 (Pages : 2) Name.....

Reg. No.....

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION, JUNE 2011

ME 09 403—MECHANICS OF SOLIDS

(2009 admissions)

Time : Three Hours Maximum : 70 Marks

Part A

Answer **all** *questions.*
Each question carries 2 *marks.*

1. Define Factor of safety, Poisson's ratio and strain energy.
2. State the assumptions made in the theory of torsion of circular shaft.
3. What do you mean by shear stress in beams ?
4. Define and explain principal planes and principal stresses.
5. Define slenderness ratio. State the limitations of Euler's formula.

(5 × 2 = 10 marks)

Part B

Answer any **four** *questions.*
Each question carries 5 *marks.*

1. Define stress, strain and elasticity. Derive a relation between stress and strain of an elastic body.
2. The Young's Modulus and modulus of rigidity of a material are 200 GPa and 80 GPa respectively. Determine the Poisson's ratio and bulk modulus of the material.
3. A solid shaft is 100 mm. in diameter. It transmits 120 kW at 200 r.p.m. Find the maximum intensity of shear stress induced and the angle of twist for a length of 6 meters. Take $C = 8 \times 10^4$ N/mm.^{2}
4. Derive the relation between Bonding Moment and Shear Force.
5. Explain the construction of Mohr's circle to obtain principal stresses.
6. How will you justify the Rankine's formula is applicable for all lengths of columns, ranging from short to long columns.

(4 × 5 = 20 marks)

Part C

Answer **all** *questions.*
Each question carries 10 *marks.*

1. Three bars made of Copper, Zinc and Aluminium are equal length and have cross-sectional areas of 400, 800 and 1200 mm.^{2} respectively. They are rigidly connected at their ends. If compound member is subjected to a longitudinal pull of 350 kN, estimate the proportion of load carried by each bar and induced stresses. Take elastic moduli of Copper, Zinc and Aluminium to be 1.2×10^5 N/mm.^{2} and 0.89×10^5 N/mm.^{2} respectively.

Or

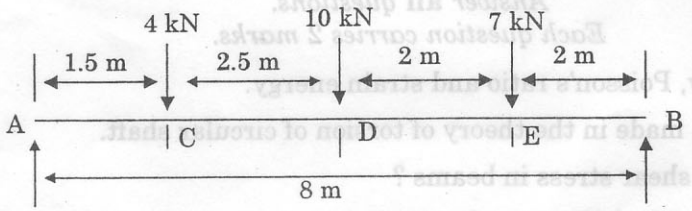
Turn over

2. In a tensile test on a tube of external diameter 16 mm., bore 4 mm., an axial load of magnitude 3 kN produced a stretch of 3.617 × 10.3 mm. on a length of 40 mm., while the outer diameter suffered a contraction of 2.894 × 10.4 mm. Calculate the Poisson's ratio, Young's modulus, Rigidity modulus and Bulk Modulus.

3. A solid steel is to transmit 80 kW at 200 r.p.m. The maximum torque exceeds the mean torque by 25 percent. The permissible shear stress is 70 N/mm.^{2} Find the suitable diameter of the shaft. Also find the outer diameter of a hollow shaft, the inner of which is 0.7 times the outer which can replace the solid shaft.

Or

4. Draw shear force bending moment diagrams for the cantilever beam shown in figure below.



5. A beam consists of a symmetrical rolled steel joint. The beam is simply supported at its end and carries a point at a centre of the span. If the maximum stress due to bending is 140 MPa, find the ratio of the depth of the beam section to span in order that the central deflection may not exceed 1/480 of the span.

Or

6. A horizontal girder of steel having uniform section is14 meters long and is simply supported to its ends. It carries concentrated load of 120 kN and 80 kN at two points 3 metres and 4.5 metres from the two ends respectively. Movement of inertia for the section of the girder is 16 × 108 mm.^{4} and E_s = 210 kN/mm.^{2} Calculate the deflections of the girder at points under the two loads. Find also the maximum deflection.

7. The principal tensile stresses at a point across two perpendicular planes are 80 kN/mm.^{2} and 40 kN/mm.^{2} Find the normal and tangential stresses and the resultant stresses and its obliquity on a plane at 20° with the major principal plane. Find also intensity of stress which acting alone can produce the same maximum strain. Take Poisson's ratio = 1/4.

Or

8. A column with one end hinged and other end fixed has a length of 5 m. and a hollow circular cross-section of outer diameter 100 mm. and wall thickness 10 mm. If E = 1.6 × 105 N/mm.^{2} and crushing strength f = 350 N/mm.^{2}, find the load that the column may carry with a factor of safety of 2.5 according to Euler theory and Rankine-Gordon theory. Take α = 1/4500.

(4 × 10 = 40 marks)