Code No: R2021031 **R20** SET - 1

II B. Tech I Semester Supplementary Examinations, July - 2023
MECHANICS OF SOLIDS
(Com to ME, AME)

Time: 3 hours Max. Marks: 70

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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UNIT-I

1 a) A rectangular bar of steel is 4 m long 12 mm thick. The rod is subjected to an axial tensile load of 40 kN. The width of the rod varies from 75 mm to 25 mm at the other. Find the extension of the rod if $E = 2 \times 10^5\ N/mm^2$ [7M]

b) A rectangular body is subjected to direct stresses in two mutually perpendicular directions accompanied by a shear stress. Prove that the normal stress and shear stress on an oblique plane inclined at an angle θ with the plane of major direct stress, are given by [7M]

$$\sigma_n = \frac{\sigma_1 + \sigma_2}{2} + \frac{\sigma_1 - \sigma_2}{2} cos2\theta$$

And $\sigma_t = \frac{\sigma_1 - \sigma_2}{2} sin2\theta$

OR

2 a) The principal stresses at a point across two mutually perpendicular planes are $100\ N/mm^2$ and $50N/mm^2$. Determine the normal, tangential and resultant stresses on a plane inclined at 20℃ to the axis of the minor principal stress. [7M]

b) State and explain the terms : Elasticity, elastic limit, young's modulus and modulus rigidity. [7M]

UNIT-II

3 a) A cantilever beam of length 6 m carries point loads of 1 kN, 3 kN and 3.5 kN load at 1, 3 and 6 m from the fixed end. Draw the shear force and B.M diagrams for the cantilever. [7M]

b) What are the different types of beams? Differentiate : [7M]
(i) Cantilever and simply supported beam,
(ii) Point load and uniformly distributed load.

OR

4 a) Draw the S.F and B.M diagrams for a simply supported beam carrying a uniformly varying load from zero at each end to w per unit length at the centre. [7M]

b) A cantilever 4 m long is loaded with a uniformly distributed load of 4 kN/m run over a length of 1.5 m from the free end. It also carries a point load of 4kN at a distance of 0.8 m from the free end. Draw the shear force and B.M diagrams. [7M]

UNIT-III

5 a) A *T* section beam having flange 3 cm × 12 cm and web 12 cm × 3 cm is simply supported over a span of 8 m. It carries a U.D.L. of 4 kN/m run including its own weight over its entire span; together with a load of 3 kN at mid span. Find the maximum tensile and compressive occurring in the beam section. [7M]
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b) A cast iron pipe of external diameter 80 mm, internal diameter of 60 mm and of length 6 m is supported at its ends. Calculate maximum bending stress induced in the pipe if it carries point load of 120 N at its centre. [7M]

OR

6 a) Show that for a rectangular section of the maximum shear is 1.5 times the average stress. [7M]

b) A beam of span *l* meters simply supported at the ends, carries a central load *W*. the beam section has an overall depth of 30 cm, with horizontal flanges 10 cm × 1 cm and a vertical web 20 cm × 1 cm. If the maximum shear stress is to be 40 MN/m^2 when maximum bending stress is 100 MN/m^2, calculate the value of the centrally applied point load *W* and the span *l*. [7M]

UNIT-IV

7 a) A gun metal sleeve(D) is fixed securely to a steel shaft(d) and the compound shaft is subjected to a torque. If the torque on the sleeve is twice the torque on the shaft, find the ratio of the external diameter of sleeve to a diameter of the shaft. Given : $C_{steel} = 2.5\ C_{gun\ metal}$ [7M]

b) Prove that the deflection at the centre of simply supported beam, carrying point load at the centre is given by $y_c = \frac{WL^3}{48EI}$ where *W* =point load, *L* = length of the beam. [7M]

OR

8 a) A beam of 10 m and of uniform flexural rigidity *EI* = 50 MN-m^2, is simply supported at its ends. It carries a uniformly distributed load of 20 kN/m run over the entire span. It is also subjected to a clockwise moment of 150 kNm at a distance of 4 m from the left support. Calculate the slope of the beam at the point of application of the moment. [7M]

b) Compare solid and hollow shafts. [7M]

UNIT-V

9 a) A cylindrical vessel whose ends are closed by means of rigid flange plates, is made of steel plate 5 mm thick. The length and the internal diameter of the vessel are 60 cm and 30 cm respectively. Determine the longitudinal and hoop stresses in the cylindrical shell due to an internal fluid pressure of 5 N/mm^2. Also calculate the increase in length, diameter and volume of the vessel. Take $E = 2 \times 10^5$ N/mm^2 and $\mu = 0.3$. [7M]

b) Derive an expression for the radial pressure and hoop stress for a thick spherical shell. [7M]

OR

10 a) Show that in thin cylinder shells subjected to internal fluid pressure, the circumferential stress is twice the longitudinal stress. [7M]

b) Find the ratio of thickness to internal diameter for a tube subjected internal pressure when the pressure is 5/8 of the value of the maximum permissible circumferential stress. Find the increase in internal diameter of such a tube 140 mm internal diameter when the internal pressure is 100 MN/mm^2. Also find change in wall thickness. Take *E* = 205 GN/mm^2 and $\frac{1}{m} = 0.3$. [7M]