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

II B. Tech I Semester Supplementary Examinations, July - 2022
MECHANICS OF SOLIDS
(Common 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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1 a) A hollow circular steel column of external diameter 300 mm and internal diameter 250 mm carries an axial load of 1500 k N. Determine the compressive stress in the column. If the initial length of the column is 3.75 m, find the decrease in length of the column. Take E = 2 x 10^5 N/mm^2. [7M]

b) A 12 mm diameter steel rod passes centrally through a copper tube 48 mm external and 36 mm internal diameter and 2.50 metres long. The tube is closed at each end by 24 mm thick steel plate which are secured by nuts. The nuts are tightened until the copper tube is reduced in length by 0.508 mm. The whole assembly is then raised in temperature by 60^0C. Calculate the stresses in copper and steel before and after the rise of temperature, assuming that the thickness of the plates remains unchanged. [7M]

Or

2 a) The principal stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60^0 to the axis of the major principal stress. Also determine the maximum intensity of shear stress in the material at the point. [7M]

b) A 12 mm diameter mild steel bar of length 1.25 metre is stressed by a weight of 150 N dropping freely through 15 mm before commencing to stretch the bar. Find the maximum instantaneous stress and the elongation produced in the bar. Take E = 2 x 10^5 N/mm^2. [7M]

3 a) Draw the shear force and bending moment diagrams for the beam shown in Fig.1. Also find the position and magnitude of the maximum bending moment. [7M]

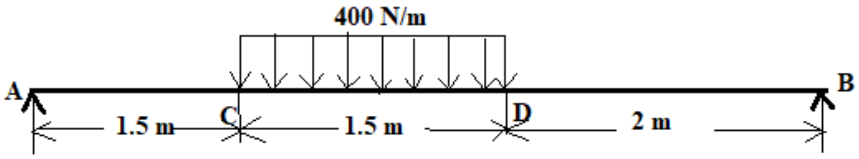

Fig.1

b) Draw B.M diagram for the cantilever ACB shown in Fig .2 [7M]

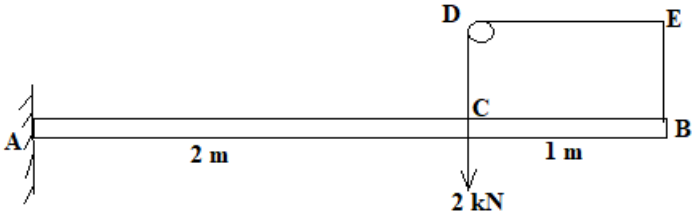

Fig.2

Or

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4 a) A beam 5 metres long, supported at the end carries point loads of 140 kN, 60 kN and 80 kN at distance 0.5 metres, 2.5 metres and 3.5 metre respectively from the left end. Find the maximum S.F and B.M. Draw S.F and B.M diagrams. [7M]

b) Fig.3 shows a compound beam ABCDE consisting of two beams AB and BE which are hinged to each other at B. The compound beam is supported at A, C and E. The beam carries a 3kN load at the mid-point of AB and a 6 kN load at the end of a bracket rigidly attached to the beam at D. Draw shear force and bending moment diagram for the compound beam. [7M]

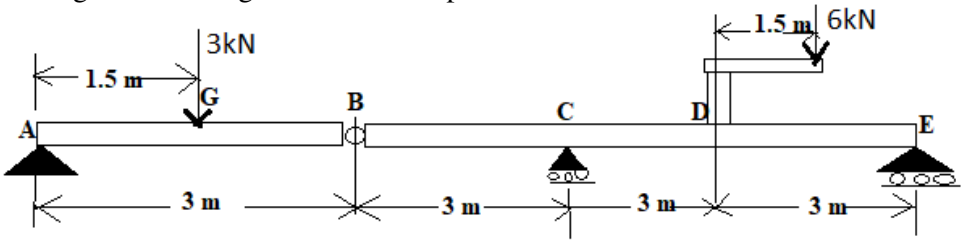

Fig.3

5 a) A steel plate is bent into a circular arc of radius 12 metres. If the plate section be 100 mm wide and 20 mm thick find the maximum stress induced and the bending moment which can produce this stress. Take E = 2 x 10^5 N/mm^2. [7M]

b) The vertical post of a crane consists of an I section 550 mm x 190 mm. When a load of 60 kN was lifted by the crane the distance of the load line from the centroid of the section is 4000 mm. Find the extreme stresses for the section. Take for the 550 mm x 190 mm. I section area of the section = 10997 mm^2, I_{xx} = 5.316 x $10^8 mm^4$. [7M]

Or

6 a) An I- section beam, shown in fig.4, is simply supported over a span of 10 metres. If the maximum permissible bending stress is 80 N/mm^2. What concentrated load can be carried at a distance of 3.50 metres from one support? [7M]

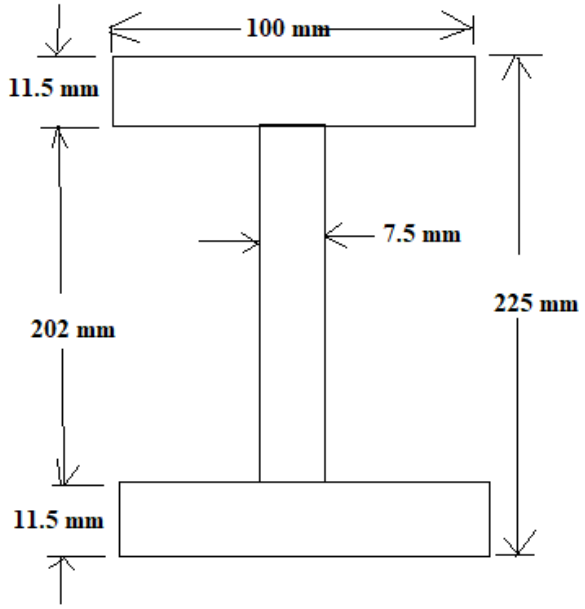

Fig.4

b) A cantilever specimen for a fatigue-testing machine, is of circular cross-section throughout its length, but in a length of 80 mm the diameter decreases from 10 mm at the fixed end to 5 mm at the free end. Calculate the maximum stress due to bending when a static load of 300 N is applied at the free end in a direction perpendicular to the length of the specimen. [7M]

7 a) Cantilever of length 'l' carrying a uniformly distributed load w per unit run over as the whole length. Derive the expression for deflection at free end B. [7M]

b) Cantilever of length l carries a concentrated load W at its mid span. If the free end be supported on a rigid prop, find the maximum deflection. [7M]

Or

8 a) A cast iron beam 40 mm wide and 80 mm deep is placed on supports 1.25 metres apart and is subjected to a central point load 30000 N. If the central deflection is found to be 6.5 mm, find the value of the Young's Modulus for the material. [7M]

b) Cantilever carrying a point load at the free end. Find deflection at free end. [7M]

9 a) A hollow cylindrical drum 600 mm in diameter has a thickness of 10 mm. If the drum is subjected to an internal air pressure of 3 N/mm^2, determine the increase in the volume of the drum. Take $E = 2 \times 10^5$ N/mm^2 and 1/m = 0.3. [7M]

b) A cylindrical shell is 400 mm internal diameter and 8 mm thickness and 1 metre long. Find the change in the internal diameter and the length, when the cylinder is charged with an internal pressure of 8 N/mm^2. Take $E = 2 \times 10^5$ N/mm^2 and poisson's ratio=0.3. [7M]

Or

10 a) A steel cylindrical plug of 125 mm diameter is forced in to a steel sleeve of 200 mm external diameter and 100 mm length. If the greatest circumferential stress in the sleeve is 90 N/mm^2,find the torque required to turn the plug in the sleeve assuming the coefficient of friction between the plug and the sleeve is 0.2. [7M]

b) Find the thickness of metal necessary for a steel cylindrical shell of internal diameter 200 mm to withstand an internal pressure of 40 N/mm^2. The maximum hoop stress in the section is not to exceed 150 N/mm^2. [7M]