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320354(20)

B. E. (Third Semester) Examination, April-May 2020

(New Scheme)

(Civil Engg. Branch)

MECHANICS of SOLIDS

Time Allowed : Three hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note *: Attempt all questions. Part (a) is compulsory. Attempt any two from (b), (c) and (d). Assume the data, if missing.*

Unit-I

1. (a) Define elastic constants. 2

(b) A mild steel rod of 20 mm diameter and 300 mm long is enclosed centrally inside a hollow copper tube of external diameter 30 mm and internal diameter 25 mm. The ends of the rod and tube are brazed together and the composite bar is subjected to an axial pull of 50 kN. If E for steel and copper is 200 GN/m^2 and 100 GN/m^2 respectively, find the stresses developed in the rod the tube. Also find the extension of the rod. 7

(c) A bar 30 mm in diameter was subjected to a tensile load of 54 kN and the measured extension on 300 mm gauge length was 0·112 mm and change in diameter was 0·00366 mm. Calculate Poisson's ratio and values of three moduli. 7

(d) A seamles spherical shell is of 0·8 m internal diameter and 4 mm thickness. It is filled with fluid water pressure until its volume increases by 50 cm^3. Determine the fluid pressure, taking E = 2×10^5 N/mm^2 and Poisson's ratio = 0·3. 7

Unit-II

2. (a) Explain principle stresses and principle planes. 2

(b) At a point in an elastic material a direct tensile stress of 75 N/mm^2 and a direct compressive stress of 60 N/mm^2 are applied on planes at right angles to each other. If the maximum principal stress in the material is limited to 80 N/mm^2, find out the shear stress that may be allowed on the planes. Also determine the magnitude and direction of the minimum principal stress and the maximum shear stress. 7

(c) At a point in a bracket the stresses on two mutually perpendicular planes are 100 N/mm^2 (tensile) and 50 N/mm^2 (tensile). The shear stress across these planes is 25 N/mm^2. Find using Mohr's circle, the magnitude and direction of the resultant stress on a plane making an angle of 30° with the plane of the first stress. Find also the normal and tangential stresses on this plane. 7

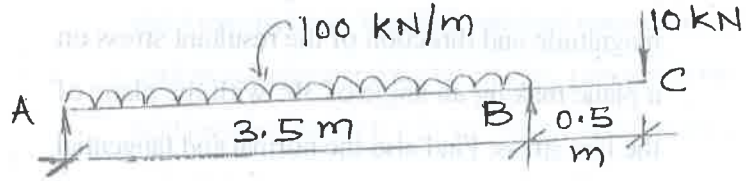
(d) A flat brass plate was stretched by tensile forces

acting in direction x and y at right angle. Strain gauges show that strains in x-direction was 0·00108 and in y-direction 0·00024. Find stress acting in x and y distances. Take E = 80 kN/mm^2 and $\mu = 0{\cdot}3$. 7

Unit-III

3. (a) What is neutral axis? 2

(b) Draw shear force diagram and bending moment diagram for a beam ABC 4·0 m long and it is supported at A and B. The part BC is overhanging. AB is 3·5 m and BC is 0·5. The part AB is subjected to udl of 100 kN/m and a point load of 10 kN at the free and '*C*'. Also locate point of zero shear force if any. 7



(c) Write the equation and assumption in the simple theory of bending. 7

(d) A wooden beam supports U.D.L. of 50 kN/m sum over a simply supported span of 5 m. It is of rectangular cross-section, 250 mm wide and 500 mm deep. Sketch the shear stress distribution and determine (i) maximum shear stress (ii) average shear stress. 7

Unit-IV

4. (a) Write the equation for the Euler's load for conditions : 2

(i) both ends of the column fixed.

(ii) One end of column fixed, other hinged.

(b) A circular rod of 20 mm diameter carries a pull along a line which is parallel to the centroidal axis, if the maximum stress is 25% greater than the mean stress on a section normal to the axis. 7

(c) Determine the section of a cast-iron hollow cylindrical column 5 m long with ends firmly built in if it carries an axial head of 300 kN. The ratio of the internal to external diameter is 3/4. Use a

factor of safety of 8. Take $f_c = 567$ N/mm^2 and Rankine's constant $\alpha = 1/1000$. 7

(d) A masonary dam 6 m high is 1·5 m wide at the top and 4·5 m wide at the bottom with vertical water face. Determine the normal stresses at the toe and heal for reservoir empty condition. Take specific gravity 'ϱ' of masonary as 2·4. 7

Unit-V

5. (a) Define 'Shear Centre'. 2

(b) 450 kN of power has to be transmitted at 100 r.p.m. Find (i) the necessary diameter of a solid circular shaft (ii) the necessary diameter of hollow circular section, the inside diameter being 3/4 of external diameter. Take allowable shear stress as 75 N/mm^2. 7

(c) A weight of 200 N is dropped on to a helical compression spring made of 15 mm steel wire closely coiled to a mean diameter of 150 mm with 24 coils. If the instantaneous compression is 100

mm. Calculate the height of the drop. Take N = $0·9 \times 10^5$ N/mm^2. 7

(d) Explain the function of spring. 7