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Question Paper Code : 71545

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Third Semester

Civil Engineering

CE 6302 — MECHANICS OF SOLIDS

(Common to Environmental Engineering)

(Regulations 2013)

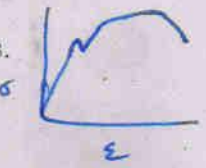
Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Hooke's law. $\sigma = E\varepsilon$

2. Draw the stress-strain diagram for mild steel and indicate the salient points.



3. Differentiate statically determinate and indeterminate beams.

4. What is point of contraflexure? Bm convert in to (+)ve (−)

5. Write the maximum value of deflection for a cantilever beam of length L, constant EI and carrying concentrated load W at the end. $WL^3/3EI$

6. State the two theorems in Moment area method. I) $\frac{d\theta}{dx} = \frac{M}{EI}$ II) $y = \frac{A\bar{x}}{EI}$

7. Write Torsional equation. $\frac{T}{J} = \frac{C\theta}{L} = \frac{\tau}{R}$

8. What are the uses of leaf springs? Truck, train & trolleys

9. What are the assumptions made in finding out the forces in a frame? Perfect frame
load carried at joint
members are pinjoined

10. What is meant by principal stress?

The planes which have no(τ) are known as P. P.
The normal stresses acting on a principal planes are known as principal stress

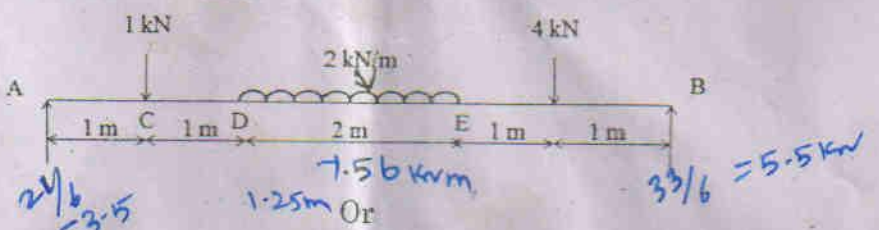
PART B — (5 × 13 = 65 marks)

11. (a) The following data relate to a bar, subjected to a tensile test : Diameter of the bar = 30 mm; Tensile Load = 54 kN; Gauge length = 300 mm; Extension of the bar = 0.112 mm; Change in diameter = 0.00366 mm. Calculate Poisson's ratio and the values of three modulii.

Or

(b) A steel tube 2.4 cm external diameter and 1.8 cm internal diameter encloses a copper rod 1.5 cm diameter to which it is rigidly connected at the two ends. If at a temperature of 10°C, there is no longitudinal stress, calculate the stresses in the rod and the steel tube, when the temperature is raised to 200°C. Take $E_s = 2.1 \times 10^5$ N/mm²; $E_c = 1 \times 10^5$ N/mm²; $\alpha_s = 1.1 \times 10^{-5}$ per °C; $\alpha_c = 1.8 \times 10^{-5}$ per °C.

12. (a) Draw the shear force and bending moment diagrams for the beam shown in figure below. Also, mark the position of the maximum bending moment and determine its value.



Or

(b) Two wooden planks 150 mm × 50 mm each are connected to form a T section of a beam. If a moment of 3.4 kNm is applied around the horizontal neutral axis, including tension below the neutral axis, find the stresses at the extreme fibres of the cross-section. Also, calculate the total tensile force on the cross-section.

13. (a) A steel girder of uniform section, 14 metres long is simply supported at the ends. It carries concentrated loads of 90 kN and 60 kN at two points 3 metres and 4.5 metres from the two ends respectively. Calculate: the deflection of the girder at the points under the two loads and the maximum deflection. Take : $E = 210 \times 10^6$ kN/m² and $I = 64 \times 10^{-4}$ m⁴.

Or

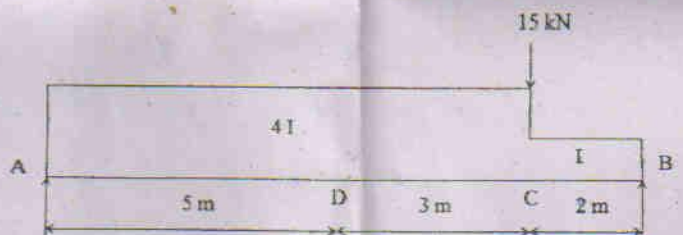
(b) For the beam shown in figure below, determine the following :

(i) Slope at end A.

(ii) Deflection at the midspan.

(iii) Maximum deflection.

Take : $E = 200 \times 10^6$ kN/m² and $I = 8 \times 10^{-5}$ m⁴.



14. (a) A solid cylindrical shaft is to transmit 300 kW at 100 r.p.m.

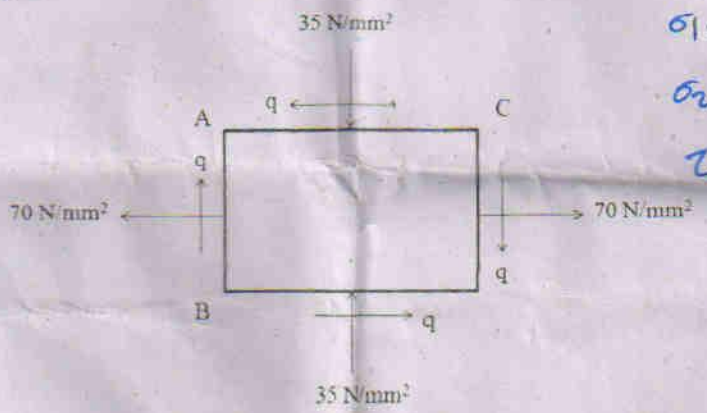
(i) If the shear stress is not to exceed 80 MN/m², find its diameter.

(ii) What percentage saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals 0.6 of the external diameter, the length, the material and maximum shear stress being the same? $D_s = 122mm$ % in weight = 29.6 %.

Or

(b) A close-coiled helical spring of 100 mm mean diameter is made of 10 mm diameter rod and has 20 turns. The spring carries an axial load of 200N. Determine the shearing stress. Taking the value of modulus of rigidity = 84 GN/m², determine the deflection when carrying this load. Also calculate the stiffness of the spring. $K = 5.25 N/mm$ $\tau = 50.93 MN/m^2$ / $\delta = 38.09 mm$

15. (a) Two planes AB and AC, which are right angles carry shear stress of intensity 17.5 N/mm² while these planes also carry a tensile stress of 70 N/mm² and a compressive stress of 35 N/mm² respectively as shown in the following figure. Determine the principal planes and the principal stresses. Also determine the maximum shear stress and planes on which it acts.



$\sigma_1 = 72.83 N/mm^2$

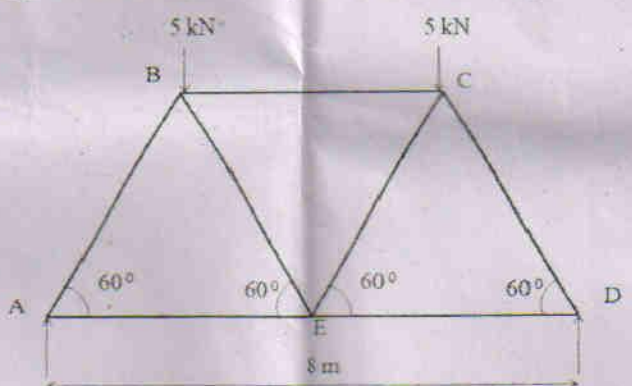
$\sigma_2 = -37.83 N/mm^2$

$\tau_m = 55 N/mm^2$

$30°$

Or

(b) The following figure shows a warren girder consisting of seven members each of 4 m length supported at its ends and loaded as shown. Determine the stresses in the members by method of joints.



AB = -5.77 kN

BC = -2.88 kN

CD = -5.77 kN

DE = 2.88 kN

W = 3.535 N/m

PART C — (1 × 15 = 15 marks)

16. (a) A steel girder of 6 m length acting as a simply supported beam carries a uniformly distributed load w N/m run throughout its length. If $I = 30 \times 10^{-6}\ m^4$ and depth 270 mm, calculate :

(i) The magnitude of w so that the maximum stress developed in the beam section does not exceed 72 MN/m².

(ii) The slope and deflection in the beam at a distance of 1.8 m from one end. Take: $E = 200$ GPa.

$\theta_c = -0.173°$

$y_c = 8.13$ mm.

Or

(b) A wagon weighing 18 kN is moving at 5 km/hr. How many springs each of 20 coils will be required in a buffer stop to absorb the energy of motion during a compression of 175 mm. The mean diameter of coils is 250 mm and the diameter of steel rod, comprising the coil is 22 mm. Take $C = 82$ GPa.

N = 15 springs

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b)

(I) $\frac{d\theta}{dx} = \frac{M}{EI}$

(II) $\delta y = \frac{A\bar{x}}{EI}$