CBCS SCHEME

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18CV32

Third Semester B.E. Degree Examination, Dec.2024/Jan.2025
Strength of Materials

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain in brief St. Venant's principle. **(04 Marks)**

b. Derive an expression for the deformation of a circular bar tapering uniformly subjected to axial tensile force 'P'. **(08 Marks)**

c. Find the elongation of the bar shown in Fig.Q1(c). Take E = 210 GN/m^2.

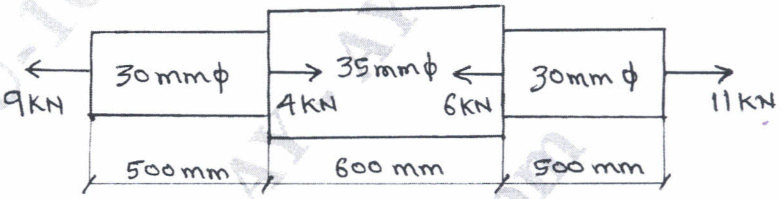

Fig.Q1(c) **(08 Marks)**

OR

2 a. Write a short note on temperature stress in simple bars. **(05 Marks)**

b. A reinforced concrete column of size 230 mm × 400 mm has 8 steel bars of 12 mm diameter distributed evenly on all sides. If the column is subjected to an axial compression of 600 KN, find the stresses developed in steel and concrete. Modular ratio = 18.67. **(07 Marks)**

c. A compound bars is made up of a central steel plate 60 mm wide and 10 mm thick to which copper plates 40 mm wide by 5 mm thick are connected rigidly on each side. The length of the bar at normal temperature is 1 metre. If the temperature is raised by 80°C, determine the stresses in each metal and change in length.
Take $E_s = 200$ GN/m^2 $\alpha_s = 12\times10^{-6}$/°C
$E_c = 100$ GN/m^2 $\alpha_c = 17\times10^{-6}$/°C **(08 Marks)**

Module-2

3 a. Discuss briefly compound stresses in beams. **(06 Marks)**

b. Explain the procedure for determining stresses in a general two dimensional stress system using Mohr's circle. **(06 Marks)**

c. The principal stresses at a certain point in a strained material are 150 N/mm^2 and 48 N/mm^2 both tensile. Find the normal and tangential stresses on a plane inclined at 20° with the major principal plane. Also determine the resultant stress, obliquity and maximum shear stress. **(08 Marks)**

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

4 a. In a thin cylinder show that the hoop stress is twice the longitudinal stresses. **(08 Marks)**

b. A thick cylinder of external and internal diameter of 300 mm and 180 mm is subjected to an internal pressure of 42 N/mm^2 and external pressure 6 N/mm^2. Determine the stresses in the material. Now if the external pressure is doubled, what internal pressure can be maintained without exceeding the previously determined maximum stress? **(12 Marks)**

Module-3

5 a. Establish the relationship between load intensity, SF and BM. **(04 Marks)**

b. Draw SFD and BMD for the beam shown in Fig.Q5(b).

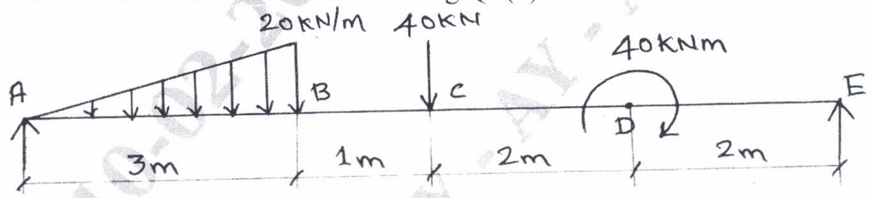

Fig.Q5(b) **(08 Marks)**

c. Draw SFD and BMD for the beam shown in Fig.Q5(c).

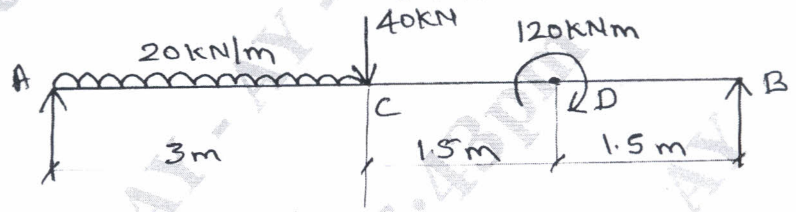

Fig.Q5(c) **(08 Marks)**

OR

6 a. Explain in brief shear force and bending moment. **(04 Marks)**

b. Draw SFD and BMD for the beam shown in Fig.Q6(b). Determine the position at which the positive BM occurs. Find also magnitude of the maximum positive and negative bending moment.

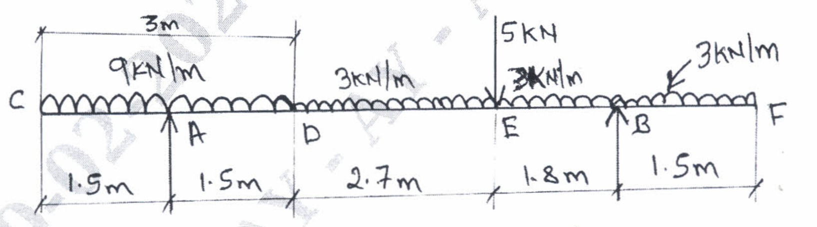

Fig.Q6(b) **(10 Marks)**

c. Draw SFD and BMD for the beam shown in Fig.Q6(c).

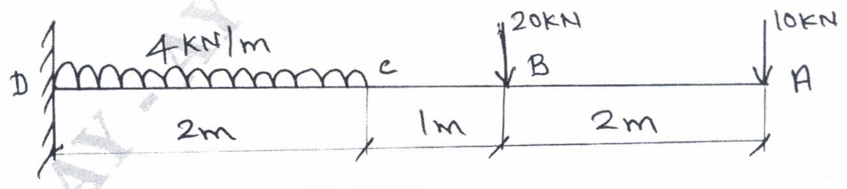

Fig.Q6(c) **(06 Marks)**

Module-4

7 a. Explain in brief the theory of simple bending. **(04 Marks)**

b. Derive the equation of pure bending with usual notations. **(10 Marks)**

c. A cantilever beam of span 1 m has rectangular c/s of size 200 mm × 400 mm. Determine the concentrated load which placed at the free end produce shear stress intensity of 1.5 N/mm^2. Hence compute maximum bending stresses in the c/s at the fixed end of cantilever. **(06 Marks)**

OR

8 a. Prove that a hollow is stronger and stiffer than the solid shaft of same material, length and weight. **(10 Marks)**

b. A shaft is required to transmit 245 KW @ 240 RPM. The maximum torque may be 1.5 times the mean torque. The shear stress in the shaft should not exceed 40 N/mm^2 and the twist 1° per metre length. Determine the diameter required if (i) Shaft is solid. (ii) Shaft is hollow with external diameter twice the internal diameter. **(10 Marks)**

Module-5

9 a. Determine the expression for slope and deflection in a simply supported beam subjected to UVL throughout, with loading intensity maximum at the left support and zero at the right support. **(08 Marks)**

b. A cantilever beam AB 2 m long is carrying a load of 20 kN at free end and 30 kN at a distance of 1 m from the free end. Find slope and deflection at the free end. Take $E = 200$ GPa and $I = 150 \times 10^6\ mm^4$. **(08 Marks)**

c. Define (i) Buckling load (ii) Slenderness ratio **(04 Marks)**

OR

10 a. Write the assumptions made in Euler's theory. **(04 Marks)**

b. Distinguish between long and short column. **(04 Marks)**

c. Determine the section of a cast iron hollow cylindrical column 3 m long with both ends firmly built in, if it carries an axial load of 800 kN. The ratio of internal to external diameter is 5/8. Use a factor of safety 4. Take $f_c = 550\ N/mm^2$ and Rankine's constant for both ends hinged case = 1/1600. **(12 Marks)**

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