CBCS SCHEME

USN | | | | | | | | | | |

17CV/CT32

Third Semester B.E. Degree Examination, Jan./Feb. 2021
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. Define: (i) Young's modulus (ii) Bulk modulus (iii) Poisson's ratio. Derive a relationship between them. **(10 Marks)**

b. Two solid cylindrical rods are connected and loaded as shown in Fig.Q1(b). Determine: (i) Total deformation (ii) Deformation at point B. E_S = 200 GPa, E_b = 100 GPa.

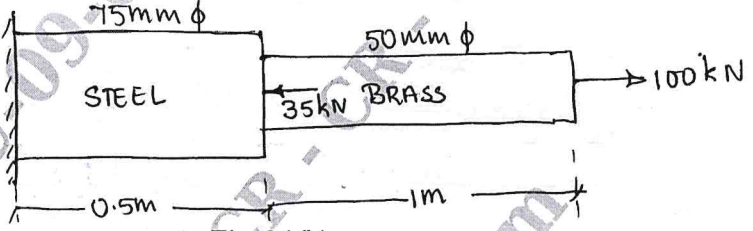

Fig.Q1(b) **(10 Marks)**

OR

2 a. A compound bar made of steel plate 60 mm wide and 10 mm thick to which a copper plate 60 mm wide and 5 mm thick are rigidly connected to each other. The length of the bar is 0.7 m. If the temperature is raised by 80°C. Determine the stress in each metal and the change in length.
E_S = 200 GPa, $\alpha_S = 12 \times 10^{-6}$/°C ; E_{cu} = 100 GPa, $\alpha_{cu} = 17 \times 10^{-6}$/°C **(12 Marks)**

b. Derive an expression for extension of the bar due to its self weight only having area 'A' and length L suspended from its top. **(04 Marks)**

c. Write a note on thermal stresses. **(04 Marks)**

Module-2

3 a. At a certain point in a strained material the stress condition shown in Fig.Q3(a) exists. Find:
(i) The normal and shear stress on the inclined plane AB
(ii) Principal stresses and principal planes
(iii) Maximum shear stresses and their planes

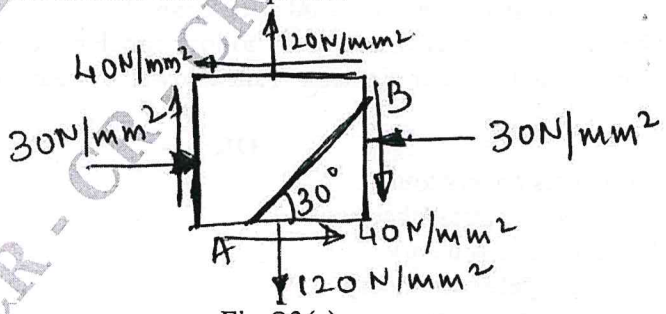

Fig.Q3(a) **(12 Marks)**

b. Derive an expressions for volumetric strain in case of a thin cylindrical shell of diameter 'd' subjected to internal pressure 'p'. **(05 Marks)**

c. Define: (i) Principal stresses (ii) Principal planes **(03 Marks)**

OR

4 a. A cylindrical shell is 3m long 1m internal diameter and is subjected to an internal pressure of 1 N/mm^2. If thickness of the shell is 12mm, find the circumferential stress and longitudinal stress. Also find maximum shear stress and the changes in the dimensions of the shell. Take E = 200 kN/mm^2 and $\mu = 0.3$. **(10 Marks)**

b. A thick metallic cylindrical shell of 150 mm, internal diameter is required to withstand an internal pressure of 8 MPa. Find the necessary thickness of cylinder, if permissible stress of the section is 20 MPa. **(10 Marks)**

Module-3

5 a. Derive relation between shear force, bending moment and load. **(06 Marks)**

b. Calculate SF and BM at salient points and draw SFD and BMD for the beam shown in Fig.Q5(b).

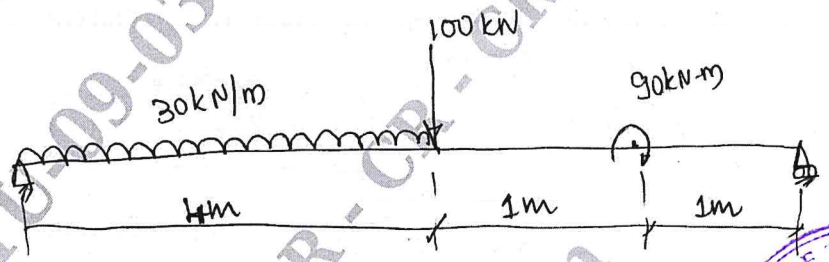

Fig.Q5(b) **(14 Marks)**

OR

6 a. Define: (i) Bending moment (ii) Shear force **(04 Marks)**

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

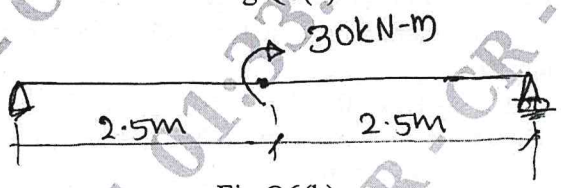

Fig.Q6(b) **(06 Marks)**

c. Draw SFD and BMD for simply supported beam of length L with point load 'P' placed at a distance 'a' from right support and 'b' from left support. **(10 Marks)**

Module-4

7 a. Define: (i) Torsional strength (ii) Torsional stiffness (iii) Torsional rigidity **(06 Marks)**

b. A shaft transmits 300 KW power at 120 rpm. Determine:

(i) The necessary diameter of solid circular shaft.

(ii) The necessary outer diameter of hollow circular section such that the inner diameter being 2/3 of the outer diameter. Take allowable shear stress as 70 N/mm^2. **(14 Marks)**

OR

8 Write short notes on any four:

a. Maximum principal stress theory

b. Maximum shear stress theory

c. Maximum principal strain theory

d. Maximum strain energy theory

e. Maximum shear strain energy theory **(20 Marks)**

Module-5

9 a. Show that for a rectangular cross section maximum shear stress is 1.5 times average shear stress. **(06 Marks)**

b. A simply supported beam of span 6 m has a cross section as shown in Fig.Q9(b). It carries 2 point loads each of 30 kN at a distance of 2m from each support. Calculate the bending stress and shear stress for maximum values of bending moment and shear force respectively. Draw neat diagram of bending stress and shear stress distribution across the cross section.

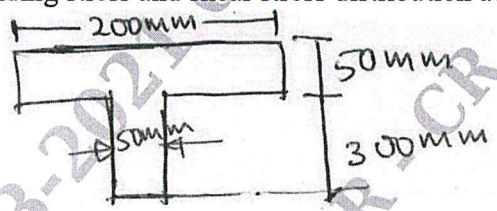

Fig.Q9(b) **(14 Marks)**

OR

10 a. Derive an expression for Euler's buckling load for long column with one end fixed and other end free. **(08 Marks)**

b. The cross section of a column is a hollow rectangular section with its external dimensions 200 mm × 150 mm. The internal dimension are 150 × 100 mm. The column is 5m long and fixed at both ends. If E = 120 GPa, calculate the critical load using Euler's formula. Compare the above load with the value obtained from Rankine's formula. The permissible compressive stress is 500 N/mm^2. The Rankine's constant is 1/6000. **(12 Marks)**

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