B.TECH SEM - III (2007 COURSE) (CIVIL ENGG.) : WINTER - 2017

SUBJECT : MECHANICS OF MATERIALS

Day : **Wednesday** Time : **10.00 AM TO 01.00 PM**
Date : **17/01/2018** **W-2017-2359** Max. Marks : 80

N.B.:

1) **Q.No.1** and **Q.No.5** are **COMPULSORY**. Out of the remaining questions attempt **ANY TWO** questions from each section.
2) Answers to both the sections should be written in the **SEPARATE** answer books.
3) Draw neat and labeled diagrams **WHEREVER** necessary.
4) Figures to the right indicate **FULL** marks.
5) Assume suitable data if necessary.

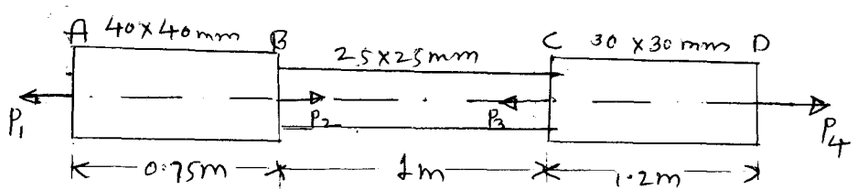
SECTION – I

Q.1 **a)** Write short note on temperature stress and hoop stress. **[04]**

b) What is equivalent length for different end condition? **[04]**

c) Write note on: **[06]**
i) Gradually applied load
ii) Suddenly applied load
iii) Impact load

Q.2 **a)** A member ABCD is subjected to point loads P_1, P_2, P_3 and P_4 as shown in figure. Calculate the forces P_3 necessary for equilibrium if P_1 = 122 kN, P_2 = 219kN and P_4 = 150kN. Determine also net change in length of the member. Take E = 2×10^5 N/mm^2. **[07]**



b) A 15mm diameter steel rod passes centrally through a copper tube 50mm external diameter and 40 mm internal diameter. The tube is closed at each and by rigid plates of negligible thickness. The nuts are tightened tightly home on the projecting parts of the rod. If the temperature of the assembly is raised by 60^0C, calculate the stresses developed in copper and steel. **[06]**
Take: $E_s = 2.10 \times 10^5$N/mm^2, $E_c = 1.05 \times 10^5$ n/mm^2
$\alpha_s = 12 \times 10^{-6}$ per ^{0}C, $\alpha_c = 17.5 \times 10^{-6}$ per ^{0}C.

Q.3 **a)** A solid circular compression member 50mm in diameter is to be replaced by a hollow circular section of the same material. Find the size of the hollow section if the internal diameter is 0.8 times the external diameter. **[07]**

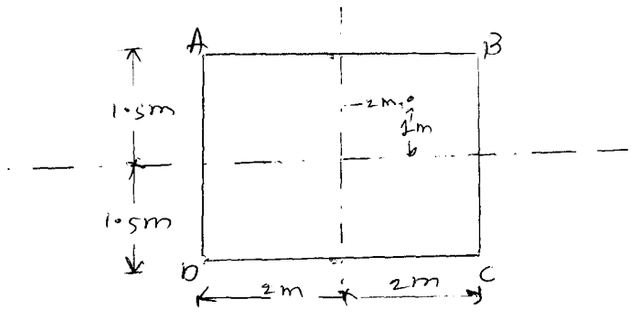
P.T.O.

b) A masonry pier 3m × 4m supports a vertical load of 600kN at a point shown in figure: **[06]**

i) Find the stresses at the corners of the pier. **[06]**

ii) What additional load should be applied at the center of the pier so that there is no tension anywhere in the pier section?

iii) What are the stresses at the four corners with the additional load at the centre?



Q.4 a) A rectangular block of materials subjected to a tensile stress of 100N/mm^2 on a plane and a tensile of 50N/mm^2 on a plane at right angles, together with shear stresses of 60N/mm^2 on the same plane. Find: **[07]**

i) The direction of the principal plane. **[06]**

ii) The magnitude of the principal stress.

iii) The magnitude of the greatest shear stress.

b) A steel bar 15mm in diameter is pulled axially by a force of 10kN. If the bar is 250mm long. Calculate the strain energy stored per unit volume of the bar and the total strain energy stored by the bar. Take E = 2 × 10^{5}N/mm^2. **[06]**

SECTION – II

Q.5 a) A cantilever beam AB 2m long carries a udl of 1.5 kN/m over a length of 1.6m from the free end. Draw SFD and BMD. **[05]**

b) Show the shear stress variation in the following sections: **[05]**
i) Rectangle **ii)** Hollow circle **iii)** I section **iv)** Triangle.

c) Determine from first principles the deflection at any point of a simply supported beam subjected to central point load W. **[04]**

Q.6 a) A beam AB 10m long has supports at its ends A and B. It carries a point load of 5kN at 3m from A and a point load of 5kN at 7m from A and udl of 1kN/m between the point loads. Draw SF and BM diagram for the beam. **[07]**

b) A CI beam of I section with top flange 15 cm × 1cm, bottom flange 20 × 2cm web 27 × 1cm is supported over a span of 6m. If permissible stress 10 MPa. In compression and 25MPa in tension. What udl can be safely applied on beam? **[06]**

Q.7 a) The beam of a square section is placed in a such manner that its one diagonal is horizontal. The beam is subjected to a shear force of 20kN at a section. Find the maximum section in the cross section of the beam and draw the profile for shear stress distribution for the section. **[07]**

b) A solid circular shaft of 30cm in diameter is subjected to a torque of 0.25 kN/m causing an angle of twist of 3.74^0 in a 2m length. Determine the modulus of rigidity for the shaft material. **[06]**

Q.8 a) A tube of 50mm out diameter and 5mm thick and 2m long is simply supported at 100mm from each end. Compute the maximum deflection in terms of E and I. **[07]**

b) A thick spherical shell 80mm diameter is required to withstand an internal pressure of 30N/mm^2. Determine necessary thickness of the shell, if the maximum permissible tensile stress is 80N/mm^2. **[06]**

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