B.E. DEGREE EXAMINATIONS: NOVEMBER 2009

Fourth Semester

MECHANIAL ENGINEERING

U07ME401: Strength of Materials

Time: Three hours   **Maximum Marks: 100**

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

1. If a force acts on a body, it sets up some resistance to the deformation. This resistance is known as

    (a) stress   (b) strain   (c) elasticity   (d) modulus of elasticity

2. Thermal stress is caused when the temperature of a body

    (a) is increased   (b) is decreased   (c) remains constant   (d) either a or b

3. When shear force at a point is zero, then bending moment at that point will be

    (a) zero   (b) minimum   (c) maximum   (d) infinity

4. The point of contra flexure is a point where

    (a) shear force changes sign   (b) bending moment changes sign

    (c) shear force is maximum   (d) bending moment is maximum

5. The ratio of the effective length of a column and minimum radius of gyration of its cross sectional area, is known

    (a) buckling factor   (b) slenderness ratio

    (c) crippling factor   (d) Poisson's ratio

6. The maximum slope of a cantilever carrying a point load at its free end is at the

    (a) fixed end   (b) centre of span   (c) free end

7. Match the following

List I	List II
a. Longitudinal stress	1. pd/2t
b. Hoop stress	2. $pd^2/8l$
c. Max shear stress	3. pd/4t
d. Circumferential stress	4. pd/2t

    (a) a – 1 , b – 4 , c – 3 , d – 2   (b) a – 2 , b –42 , c – 3 , d –1

    (c) a – 4 , b – 3 , c – 2 , d – 1   (d) a – 3 , b – 4 , c – 2 , d –1

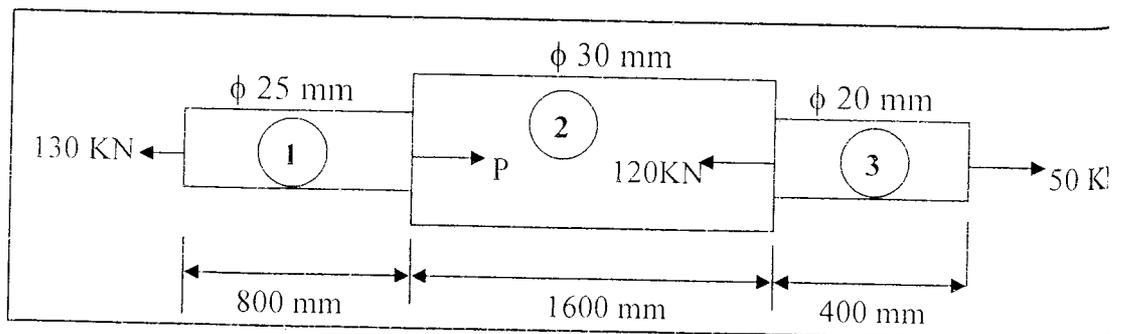8. S1:In a uni dimensional stress system, in principle plane shear stress is zero

S2: In a uni dimensional stress system, in principle plane normal stress is minimum

    (a) S1 is right S2 is wrong   (b) S2 is right S1 is wrong

    (c) Both S1 & S2 are right   (d) Both S1 & S2 are wrong

9. When a solid shaft is subjected to torsion the shear stress induced in the shaft at in cen

    (a) Zero   (b) Minimum   (c) maximum   (d) average

10. A thin cylindrical shell of diameter (d) length (l) is subjected to an internal pressu

The circumferential stress in the shell is

    (a) pd/2t   (b) pd/4t   (c) pd/ 6t   (d) pd/ 8t

PART B (10 x 2 = 20 Marks)

11. What are compressive and tensile strains?

12. What do you mean by thermal stresses?

13. What are sagging and hogging bending moments?

14. What do you mean by point of contraflexure?

15. What is the advantage of Macaulay's method?

16. What is buckling load in columns?

17. What are principal planes and principal stresses?

18. What is circumferential or hoop stress in shells?

19. Define torsional rigidity.

20. What is spring constant or spring index?

PART C (5 x 14 = 70 Marks)

21. (a) Find the value of P and the change in length of each component and the total char
length of the bar shown in figure. E=200 kN/mm².

ss is zero

ress is minimum

is wrong

are wrong

the shaft at in cent

(d) average

an internal pressu

(d) pd/ 8t

(b) The composite bar shown in figure is rigidly fixed at the ends. An axial pull of P=15 kN is applied at B at 20° C. Find the stresses in each material at 80°C. $\alpha_s = 11 \times 10^6$ per °C; $\alpha_a = 24 \times 10^{-6}$ per°C Es =210 kN/mm^2 ; Ea= 70 kN/mm^2 .
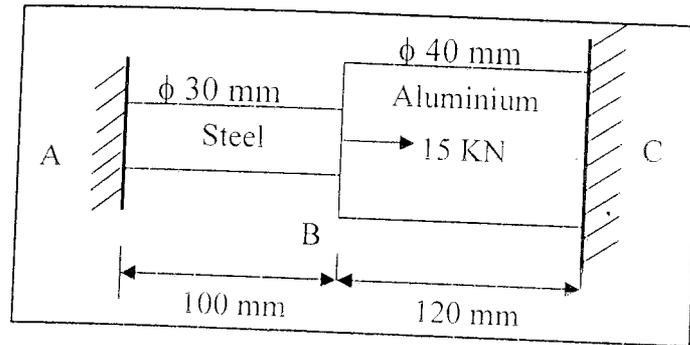

22. **(a)** A beam ABCDE is simply supported over B and E. AB=CD=DE meter, BC=3 meter. The beam is subjected to a concentrated load of 60 kN at A an U.D.L of intensity 40 kN/m over at D. Draw shear force and bending moment diagram. Locate the point of contra flexure if any.
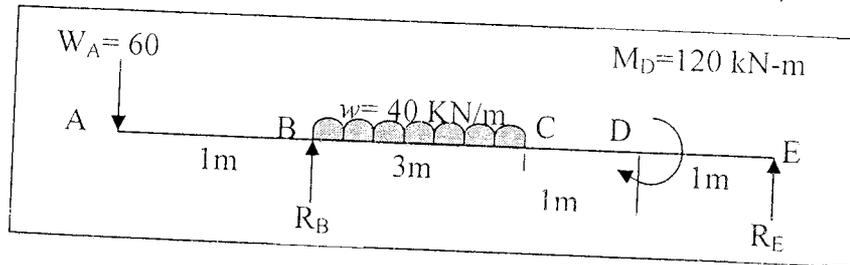
(OR)

(b) A hollow steel tube having external and internal diameter of 100 mm and 75 mm respectively is simply supported over a span of 5 m. The tube carries a concentrated load of W at a distance 2 m from one of the supports. What is the value of W if the maximum bending stress is not exceeding 100 MPa.
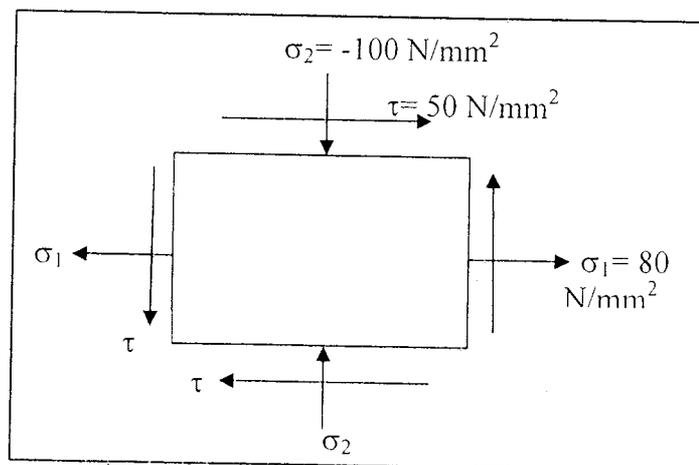
the total chan

50 KN

23. (a) A simple beam of span 5 m carries a point load of 10 KN mid span. Find the defl at mid span using Macaulay's Method.

W= 10kN

A L/2 ← → L/2 B

5m
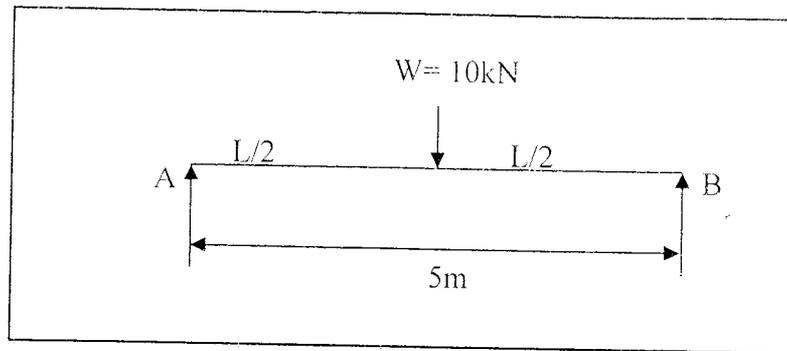
(OR)

(b) Find the Euler's load for a hollow cylindrical steel column of 40 mm external dia and 3 mm thick. Take the length of the column as 2.5 m and hinged at both ends. E=200 GPa. Also determine the crippling load by Rankine's formula using constant = 330 MPa and α =1/7500.

24. (a) A point in a strained material is subjected to a horizontal tensile stress of $80 N/mm^2$ a vertical compressive stress of $100 N/mm^2$. It is also accompanied by a shear stress $50 N/mm^2$. Determine:

(i) Principal stress

(ii) Principal planes and

(iii) Maximum shear stress and its planes.

σ_2= -100 N/mm^2

τ= 50 N/mm^2

σ_1 ← → σ_1= 80 N/mm^2

τ

τ

σ_2

(OR)

(b) A cylindrical shell 3 m long, 1m internal diameter and 10 mm thick is subjected to an internal pressure of 1.5 N/mm². Calculate the changes in length, diameter and volume of the cylinder. E=200 kN/mm², Poisson's ratio =0.3.

25. (a) A solid circular shaft transmits 75 kW power at 200 rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1° in 2 m length of shaft and shear stress is limited to 50 N/mm². Take G=1x 10⁵ N/mm².

(OR)

(b) A Railway wagon weighing 20 kN is moving at 10 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 300 mm and the diameter of steel rod comprising the coil is 25 mm. Take G=80 GPa.

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