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**B.E., DEGREE EXAMINATIONS MAY/JUNE 2013**

Fourth Semester

**CIVIL ENGINEERING**

CEE107: Strength of Materials

**Time: Three Hours** **Maximum Marks: 100**

**Answer ALL Questions:-**

**PART A (10x1=10 Marks)**

1. Maxwell's reciprocal theorem is valid for all
   a) statically determinate structures b) structures
   c) elastic structures d) Structures with linear force-displacement relation.
2. Castigliano's theorem is applicable
   a) when the system behaves elastically
   b) only when principle of superposition is valid
   c) when system behaves in non-linear manner
   d) None of the above.
3. The statically indeterminate structures can be solved by
   a) using equations of statics alone
   b) equations of compatibility alone
   c) ignoring all deformations and assuming the structure to be rigid
   d) Using the equations of statics and the necessary number of equations of compatibility.
4. A propped cantilever of span L is subjected to a moment M (sagging) at the propped end, the reaction at the fixed end will be
   a) $\frac{M}{2L}$ b) $\frac{3M}{2L}$ c) $\frac{M}{L}$ d) $\frac{2M}{3L}$
5. Lame's theory is associated with
   a) Thin cylindrical shells b) Thick cylindrical shells
   c) Direct and bending stresses d) None of these
6. The direct stress induced in a long column is _____ as compared to bending stress.
   a) same b) More c) less d) Negligible
7. Guest Tresca theory of failure is suitable for
   a) Brittle materials b) Ductile Materials
   c) All elastic materials d) Both brittle and ductile materials
8. Stress Invariants are
   a) Some quantities that are semi-permanent, changeable and don’t vary under different conditions
   b) Quantities that are occasional, unchangeable and vary under different conditions
   c) Quantities that are non-permanent, changeable and don’t vary under different conditions
   d) Quantities that are permanent, unchangeable and don’t vary under different conditions
9. In the case of symmetrical bending
   a) The neutral axis will coincide with the other principal axis of inertia.
   b) The neutral axis will not coincide with the other principal axis of inertia.

c) The neutral axis will be perpendicular to the other principal axis of inertia.

d) None of the above

10. In curved beams, the distribution of bending stress is

a) Linear b) Parabolic c) Hyperbolic d) Uniform

**PART B (10 x 2 = 20 Marks)**

11. Write the expression for strain energy due to (a) axial loading and (b) shear force
12. Define strain energy density.
13. State the theorem of three moments. / Write down the three moment equation for continuous beam.
14. Draw SFD and BMD for a fixed beam with a central concentrated load W.
15. What is a compound cylinder?
16. What is slenderness ratio of a column?
17. What is deviatric stress tensor?
18. Explain total strain energy theory of failure.
19. Explain the differences between symmetrical and unsymmetrical bending
20. Explain the significance of shear centre.

**PART C (5 x 14 = 70 Marks)**

21. a) (i) Derive the expression for strain energy stored in a member due to flexure. (6)

(ii) Find the slope and deflection at the free end of a cantilever beam, carrying a UDL through out the span. (8)

**(OR)**

b) (i) State and prove Castigliano's first theorem. (6)

(ii) Find the support reactions and draw the BM diagram for the portal frame beam shown below. (8)

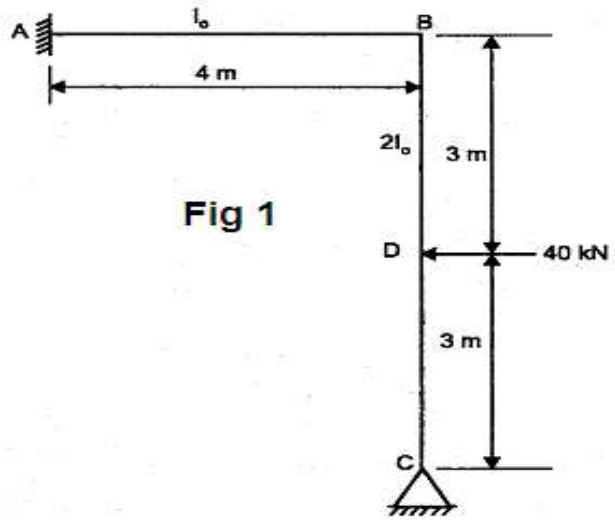


Fig 1

22. a) A continuous beam ABCD of uniform section with span AB as 8m and BC as 6m, is fixed at A and simply supported at B & C. the beam is carrying a UDL ok 1 kN/m through out the length. Find the support moments along the beam, draw the SFD & BMD.

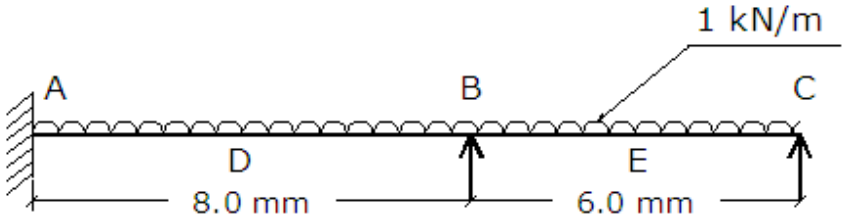


**Fig 2**

**(OR)**

b) A fixed beam of span 8 meters carries a distributed load of 6 kN/m throughout the span and a concentrated load of 5 kN at the mid span. Analyse the fixed beam, draw the SFD and BMD

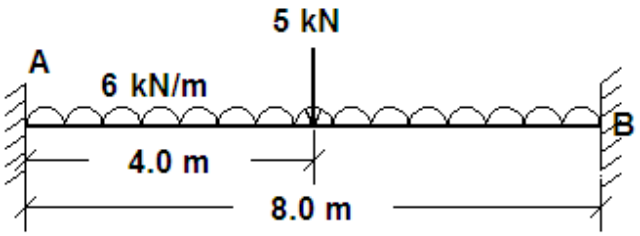


**Fig 3**

23. a) (i) Derive the expression for buckling load of a column fixed at both ends. (6)

(ii) A hollow column 200 mm external dia. and 160 mm internal dia. is used as a column of 4.5 m length. Calculate the Rankine's crippling load when the column is fixed at both ends. Take allowable stress stress as 350 MPa and Rankine's Constant 1/1600.

**(OR)**

b) A compound tube is composed of a tube 200 mm internal diameter and 20 mm thick shrunk of a tube of 200 mm external diameter and 20 mm thick. The radial pressure at the junction is 6 N/mm2. Find the variation of the hoop stress over the wall of the compound tube.

24. a) (i) Explain the concept of stresses in three dimensions. (6)

(ii) The state of stress at a point P is given by

$\sigma_x = 1, \sigma_y = -2, \sigma_z = 4, \tau_{xy} = 2, \tau_{yz} = -3, \tau_{zx} = 1$, all units in kPa. Calculate the principal stresses. (8)

**(OR)**

b) In a material, the principal stresses are 60 $MN/m^2$, 48 $MN/m^2$ and - 36 $MN/m^2$. Calculate

(i) Total strain energy.

(ii) Volumetric strain energy.

(iii) Shear strain energy.

(iv) Factor of safety on the total strain energy criterion if the material yields at 120 $MN/m^2$ Assume E = 200 $GN/m^2$, and 1/m = 0·3.

25. a) A 80 mm x 80 mm x 10 mm angle section shown below is used a simply supported beam over a span of 2.4 m. It carries a central concentrated load of 400 N along the line YG, which is the centroid of the section. Calculate the stresses at the points A, B and C of the mid section of the beam.

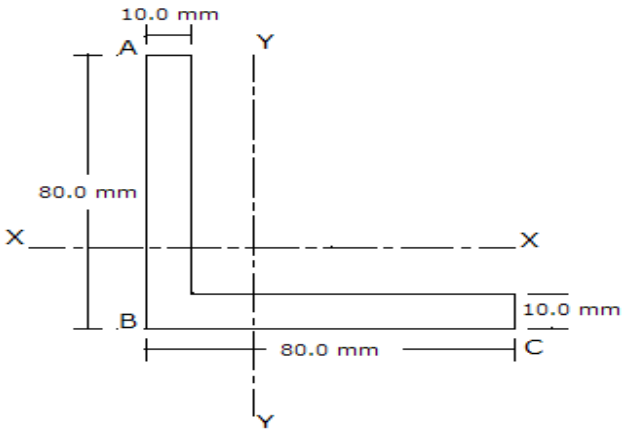


**Fig 4**

**(OR)**

b) The curved bar shown below has a solid circular cross section 0.1 m diameter. If the maximum tensile and compressive stress in the member shouldn't exceed 150 MPa and 200 MPa, determine the value of the load P that can be safely carried by the member. The radius of curvature is 0.1 m.

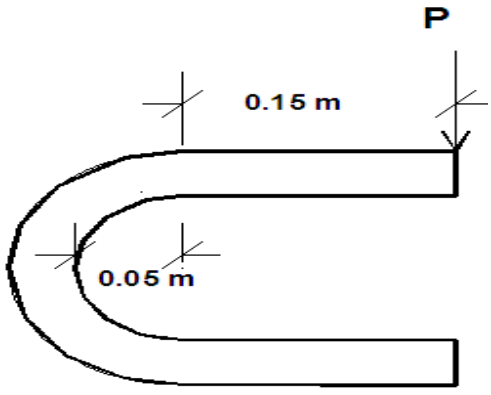


**Fig 5**

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