AU – 2494

Third Semester B. E. (Civil) (CGS) Examination

STRENGTH OF MATERIAL

Paper – 3 CE 02

(USC – 10173)

P. Pages : 5

Time : Three Hours] [Max. Marks : 80

Note : (1) Separate answer book must be used for each section in the subject Geology, Engineering material of Civil branch and separate answer book must be used for Section A and B in pharmacy and Cosmetic Tech.
(2) All questions carry marks as shown.
(3) Answer **Three** questions from Section A and **Three** questions from Section B.
(4) Due credit will be given to neatness and adequate dimensions.
(5) Assume suitable data wherever necessary.
(6) Diagrams and chemical equations should be given wherever necessary.
(7) Illustrate your answer wherever necessary with the help of neat sketches.
(8) Use pen of Blue / Black ink / refill only for writing the answer book.

SECTION A

1. (a) Define stress and strain. Determine extension, change in lateral dimention and change in volume of a steel tie bar 1.1 m long and 50 mm diameter is subjected to a tensile stress of 120 MN/m^2 . Assume that $E = 200\,GN/m^2$ and Poisson's Ratio $\nu = 0.3$ 6

(b) A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If at a temperature of $10\,^0C$ there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to $200\,^0C$. Take

$E_s = 2.1 \times 10^5\ N/mm^2$ $\quad E_{cu} = \times 10^5\ N/mm^2$

$\alpha_s = 11 \times 10^{-6}$ per ^0C $\quad \alpha_{cu} = 18 \times 10^{-6}$ per ^0C 8

OR

2. (a) Derive the expression for Elongation of a bar due to its own weight. 4

   (b) Draw and explain stress–strain diagram and their characteristics for mild – steel. 4

   (c) A reinforced concrete column of 400 mm diameter supports a load of 500 KN axially. The reinforcement consists of 8 steel rods each of 20 mm diameter. Find how mach load is carried by the rods and the concrete of if Young's modulus of steel is 18 times that of concrete. 6

3. (a) Define bending moment and shear force at any section of a beam. 4

   (b) Draw bending moment and shear force diagram for the beam shown in fig. Q. 3 (b). Also calculate maximum bending moment.

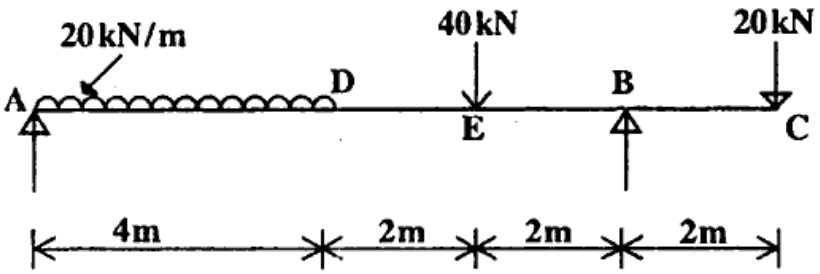

fig. Q. 3 (b) 9

OR

4. (a) Define point of contraflexure. Draw shear force and bending moment diagrams for a simply supported beam carrying a uniformly distributed load W per unit length over the entire length. 6

   (b) A cantilever 3 m long is loaded with a uniformly distributed load of 18 KN/m run over a length of a 2 m from the free end. It also carries a point load of 25 KN at a distance of 2 m from fixed end. Draw shear force and bending moment diagrams. 7

5. (a) Define Section Modulus. Find an expression for section modulus for a circular, rectangular and hollow circular sections. 6

(b) A T – section with flange 200 mm x 50 mm and web 200 mm x 50 mm is subjected to a vertical shear force of 200 KN. Calculate :—

(i) Shear stress at the junction of the flange and web.

(ii) Shear stress at the Neutral axis.

Sketch the shear stress distribution diagram. 7

OR

6. (a) Deduce a formula for shear stress at a layer in the section of a beam. 6

(b) A cast iron cantilever of length 1.5 m fails when a point load W is applied at the free end. If the section of the beam is 40 mm x 60 mm and the stress at the failure is 120 N/mm^2. Find the point load applied. 7

SECTION B

7. (a) Pressure inside a thin cylinder is 2115 N/m^2 and its diameter is 1 m. If thickness of cylinder wall is 5 mm, determine the hoop stress and longitudinal Stress induced in cylinder material. 7

(b) Determine a suitable diameter of a shaft transmitting 20 KW at 120 r. p. m. If the maximum allowable shear stress in the shaft material is not to exceed 5000 N/cm^2 and angle of twist is not exceed 1^0 in a length of twenty times the diameter of the shaft. 7

OR

8. (a) What assumption are made in the theory of pure torsion ? Derive torsion equation. 6

(b) The mean coil diameter of a close coiled spring is 15 cm and the diameter of the wire with which the spring is made is 10 mm. Number of turns of the spring is 20. The axial load carried by the spring is 2000 N.
Take $G = 8.4 \times 10^6 N/cm^2$.
Determine :—

(i) Maximum shear stress

(ii) Deflection of spring

(iii) Stiffness of spring. 8

9. (a) What do you mean by principal planes and principal stresses ? 6

(b) A point in a strained element is subjected to normal stresses 250 N/mm^2 (tensile) and 150 N/mm^2 (tensile) accompnied with a shear stress of 50 N/mm^2. Draw Mohr's stress circle and determine :

(i) The principal planes

(ii) Principal stresses

(iii) Normal stresses and shear stresses on an oblique plane inclined at 60^0 with the plane of 250 N/mm^2. 7

OR

10. (a) Derive a formula for the critical eccentricity for :

(i) Rectangular column

(ii) Circular column. 6

(b) A hollow short column has a rectangular section 1500 x 1000 mm^2 and 200 mm thick. A compressive load of 250 KN applied to the column vertically at an eccentricity of 100 mm from the C. G. of the section of the column on a line bisecting 1500 mm side. Calculate minimum and maximum stress. Draw also stress distribution diagram. 7

11. (a) Prove the relation :—

$$M = EI \frac{d^2y}{dx^2}$$

where M = Bending moment,

E = Young's modulus

I = Moment of Inertia. 5

(b) A simply supported beam of span 7 m is loaded with a point load of 5 KN at a distance 2 m from the left support. Determine the deflection under the load point and maximum deflection. Take E = 1×10^6 N/cm^2 and I = 10 cm^4. Use moment area method. 8

OR

12. (a) A simply supported beam of span 10 m carries loads as shown in fig. Q. 12 (a). Determine the deflection under each load using Macauley's method. Take $I = 12 \times 10^8$ mm^4 and $E = 2 \times 10^5$ N/mm^2.

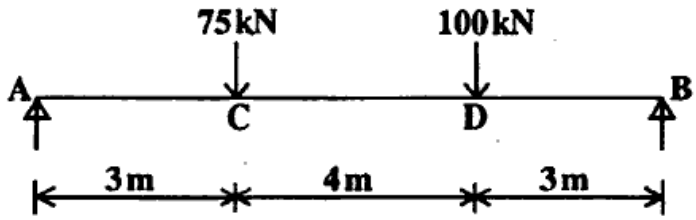

fig. Q. 12 (a) 13