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END SEMESTER EXAMINATION – 2019

Semester : 4th

Subject Code : CT-401

STRUCTURAL ANALYSIS

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Instruction :

- Questions for both PART – A and PART – B are compulsory.

PART – A

Marks – 25

1. Fill in the blanks : $1 \times 10 = 10$

   (a) In a 2D case, there are ——— constraints in a fixed support.

   (b) Moment at a hinge will be ———.

   (c) If in a pin-jointed plane frame $(m + r) > 2j$, then the frame is ———.

[Turn over

(d) ——— method of structural analysis is a force method.

(e) Generally we need ——— number of equations to solve each joint of a truss.

(f) The rate of change of ——— is equal to intensity of loading.

(g) A cantilever beam subjected to point load at its free end, the maximum bending moment develops at the ——— of beam.

(h) Positive bending moment is known as ——— moment.

(i) ——— support develops support moment.

(j) Moving train is an example of ——— load.

2. Write true or false : 1×10=10

(a) The deflection at any point of a perfect frame can be obtained by applying a unit load at the joint in the direction in which the deflection is required.

(b) The number of independent displacement components at each joint of a rigid-jointed space frame is 6.

(c) The degree of kinematic indeterminacy of a pin-jointed space frame is 2j – r

(d) Number of unknown internal forces in each member of a rigid-jointed plane frame is 6.

(e) The number of independent equations to be satisfied for static equilibrium in a space structure is 4.

(f) The deformation of a spring produced by a unit load is called flexibility.

(g) Moment distribution method is not a displacement method.

(h) Point of contraflexure is where shear force changes sign.

(i) If force is applied in the direction of length, then the strain in the direction of length is also called as secondary or lateral strain.

(j) If SFD line is linear then BMD line will be parabolic curve.

3. Choose the correct answer : 1×5=5

(a) For an isotropic elastic material the number of independent elastic constant is

(i) 1 (ii) 2

(iii) 3 (iv) 4

(b) In case of a loaded cantilever, maximum B.M occurs at the point where

(i) S.F is zero

(ii) S.F is maximum

(iii) Cantilever beam

(iv) None of the above

(c) The body will regain its previous shape and size only when the deformation caused by the external forces, is within a certain limit. What is that limit ?

(i) Plastic limit

(ii) Elastic limit

(iii) Deformation limit

(iv) None of the above.

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(d) The shear force in a beam subjected to pure positive bending is

(i) Positive (ii) Negative

(iii) Zero (iv) Can't determine.

(e) In SFD, vertical lines are for

(i) Point load

(ii) UDL

(iii) UVL

(iv) None of the above.

PART – B

Marks – 45

4. A three hinged symmetric circular arch has a span of 36m and a rise of 6m. Determine the bending moment, normal thrust and radial shear at 9m from the left support, if the arch is subjected to a uniformly distributed load of intensity 30 kN/m over the left half portion and a concentrated load of 60 kN at 27m from the left springing. 11

5. A simply supported beam has a span of 15m. Uniformly distributed load of 40 kN/m and 5m long crosses the girder from left to right. Draw the influence line diagram for shear force and bending moment at a section 6m from left end. Use these diagrams to calculate the maximum shear force and bending moment at this section. 11

6. A portal frame is consisting of three points A, B, C, D and E. The portion AC is vertically placed to the horizontal plane fixed at point A, portion CE is bent at right angle to AC which is jointed at C, and point E is free. In the portion AC a load of 10 kN is acting perpendicular to the direction of AC at B (midspan of AC) and a vertical downward load of 20 kN is acting at D (midspan of CE). If the length of AC= 4m, length of CE=3m, determine the vertical and the horizontal deflection at the free end E. Assume constant EI throughout. 11

7. A cantilever beam AB consisting of three points A, C and B (AC= 1.5m, AB= 2.5m), with a total span of 2.5m is fixed supported at A and free at B. The beam is loaded with a point load of 10 kN at C and a point load of 5 kN at point B. Find the rotation and deflection at the free end B of the cantilever beam. 6

8. A simply supported beam AB, supported at A and B is loaded with a point load of 80 kN at the midspan C. Length of the beam AB is 8m and I (moment of inertia) for portion BC is thrice that of portion AC. Determine the rotations at A, B and deflection at C for the beam. 6

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