Total No. of printed pages = 9

CT-401/SA/4th Sem/2018/M

STRUCTURAL ANALYSIS

Full Marks – 70

Time – Three hours

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

Note : (i) Answer *all* the questions of section – 1

(ii) Section-1 contains MCQ's (Q1-Q19). (Q1-Q13) carries 1 mark each and (Q14-Q19) carries 2 marks each.

SECTION – 1

1. In a 2D case, how many constraints are there in a fixed support ?

(A) 2 (B) 3

(C) 6 (D) Can't say

[Turn over

2. Moment at a hinge will be

(A) Infinity

(B) Zero

(C) Depends upon acting forces

(D) Can't say

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

(A) Stable and statically determinate

(B) Stable and statically indeterminate

(C) Unstable

(D) None of the above

4. Which of the following methods of structural analysis is a force method ?

(A) Slope deflection method

(B) Column analogy method

(C) Moment distribution method

(D) None of the above

5. How many equilibrium equations do we need to solve generally on each joint of a truss ?

(A) 1 (B) 2

(C) 3 (D) 4

6. The deflection at any point of a perfect frame can be obtained by applying a unit load at the joint in

(A) Vertical direction

(B) Horizontal direction

(C) Inclined direction

(D) The direction in which the deflection is required.

7. When a uniformly distributed load, shorter than the span of the girder, moves from left to right, then the conditions for maximum bending moment at a section is that

(A) The head of the load reaches the section

(B) The tail of the load reaches the section

(C) The load position should be such that the section divides it equally on both sides

(D) The load position should be such that the section divides the load in the same ratio as it divides the span.

8. The number of independent displacement components at each joint of a rigid-jointed space frame is

(A) 1 (B) 2

(C) 3 (D) 6

9. The degree of kinematic indeterminacy of a pin-jointed space frame is

(A) $2j - r$ (B) $3j - r$

(C) $j - 2r$ (D) $j - 3r$

Where j is number of joints and r is reaction components.

10. Number of unknown internal forces in each member of a rigid jointed plane frame is

(A) 1 (B) 2

(C) 3 (D) 6

11. The number of independent equations to be satisfied for static equilibrium in a space structure is

(A) 2 (B) 3

(C) 4 (D) 6

12. The deformation of a spring produced by a unit load is called

(A) Stiffness

(B) Flexibility

(C) Influence coefficient

(D) Unit strain

13. Which of the following is not the displacement method ?

(A) Equilibrium method

(B) Column analogy method

(C) Moment distribution method

(D) Kani's method

14. A single rolling load of 8 kN rolls along a girder of 15m span. The absolute maximum bending moment will be

(A) 8 kN.m

(B) 15 kN.m

(C) 30 kN.m

(D) 60 kN.m

15. In the slope deflection equations, the deformations are considered to be caused by

(i) Bending moment

(ii) Shear force

(iii) Axial force

The correct answer is —

(A) Only (i)

(B) (i) and (ii)

(C) (ii) and (iii)

(D) (i), (ii) and (iii)

16. Point of contraflexure is where

(A) Bending moment changes sign

(B) Shear force changes sign

(C) Bending moment is maximum

(D) Shear force is maximum

17. Study the following statements.

(i) The displacement method is more useful when degree of kinematic indeterminacy is greater than the degree of static indeterminacy.

(ii) The displacement method is more useful when degree of kinematic indeterminacy is less than the degree of static indeterminacy.

(iii) The force method is more useful when degree of static indeterminacy is greater than the degree of kinematic indeterminacy.

(iv) The force method is more useful when degree of static indeterminacy is less than the degree of kinematic indeterminacy.

The correct answer is —

(A) (i) and (iii)

(B) (ii) and (iii)

(C) (i) and (iv)

(D) (ii) and (iv)

18. If in a rigid-jointed space frame, $(6m + r) < 6j$, then the frame is

(A) Unstable

(B) Stable and statically determinate

(C) Stable and statically indeterminate

(D) None of the above

19. A pin-jointed plane frame is unstable if

(A) $(m + r) < 2j$ (B) $(m + r) = 2j$

(C) $(m + r) > 2j$ (D) None of the above

Where m is number of members, r is reaction components and j is number of joints

SECTION – 2

20. 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

21. 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

22. 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

23. (a) 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

(b) A simple 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