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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.

**Instructions :**

1. All questions of PART-A are compulsory.
2. Answer all questions from PART-B.

**PART – A**

Marks – 25

1. Fill in the blanks : 1×10=10

(a) Limiting values of Poisson's ratio are

\_\_\_\_\_.

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(b) Structural steel forms neck before it breaks.  
Neck formation starts \_\_\_\_\_.

(c) The term 'flexural rigidity' can be expressed as \_\_\_\_\_.

(d) Fixed beam is an example of statically \_\_\_\_\_ structure.

(e) The type of load that is applied to a beam through knife edge is \_\_\_\_\_.

(f) In the slope deflection equations, the deformations are considered to be caused by \_\_\_\_\_.

(g) A single rolling load of 8 kN rolls along a girder of 15m span. The absolute maximum bending moment will be \_\_\_\_\_.

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

(i) \_\_\_\_\_ support develops support moment.

(j) Moving train is an example of \_\_\_\_\_ load.



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2. Write true or false :  $1 \times 10 = 10$

(a) For most metals, Poisson's ratio is approximately 3.

(b) A principal plane is a plane of zero shear stress.

(c) Second theorem of moment area method helps in finding deflection in a beam.

(d) Conjugate beam is an imaginary beam made out of original beam.

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

(f) Fixed end in an original beam is a free end in conjugate beam.

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

(h) Point of Contraflexure is where the bending moment changes sign.



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(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 parabolic then BMD line will also be parabolic curve.

3. Choose the correct answer :  $1 \times 5 = 5$

(a) For a static equilibrium case maximum number(s) of known equations are limited to

- (i) 1
- (ii) 2
- (iii) 3
- (iv) 4

(b) For a propped cantilever beam, degree of indeterminacy is

- (i) 1
- (ii) 2
- (iii) 3
- (iv) 4

(c) A pin-jointed plane frame is unstable if

- (i)  $(m + r) < 2j$
- (ii)  $(m + r) = 2j$
- (iii)  $(m + r) > 2j$
- (iv) None of the above

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(4)

(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 circular arch hinged at the springing and crown points has a span of 40m and a central rise of 8m. It carries a uniformly distributed load 20 kN/m over the left half of the span together with a concentrated load of 100 kN

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(5)

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at the right quarter span point. Find the reactions at the supports, normal thrust and shear at a section 10m from the left support. 11

5. A simply supported beam has a span of 16m. Uniformly distributed load of 40 kN/m and 4 m long crosses the girder from left to right. Draw the influence line diagram for shear force and bending moment at a section 7m 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 five 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 15 kN is acting perpendicular to the direction of AC at B (midspan of AC) and a vertical downward load of 25 kN is acting at D (midspan of CE). If the length of AC = 6m, length of CE = 4m, 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 = 2m, AB = 3m), with a total span of 3m is fixed supported at A and free at B. The beam is loaded with a point load of 15 kN at C and a point load of 10 kN at point B. Find the rotation and deflection at the free end B of the cantilever beam. 6

8. A simple supported beam AB, supported at A and B is loaded with a point load of 60 kN at the midspan C. Length of the beam AB is 9m and I (moment of Inertia) for portion BC is twice that of portion AC. Determine the rotations at A, B and deflection at C for the beam. 6

