Code : 011511

B.Tech 5th Semester Examination, 2016

Structural Analysis-I

Time : 3 hours *Full Marks : 70*

Instructions :

(i) The marks are indicated in the right-hand margin.

(ii) There are Nine questions in this paper.

(iii) Attempt five questions in all.

*(iii) **Question No. 1 is Compulsory.***

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1. Choose the correct option (any seven): 7×2=14

(a) The principle of superposition is applicable for:

(i) A linear beam / frame structure

(ii) A linear truss structure

(iii) Any linear structure

(iv) The material of the structure is linearly elastic

(b) The loading for a conjugate beam is given by the

(i) Loading of the original beam

(ii) Shear force diagram of the original beam

(iii) Bending moment diagram of the original beam

(iv) Curvature diagram of the original beam

(i) $\frac{1}{2}\frac{EI}{L}$

(ii) $\frac{EI}{L}$

(iii) $\frac{2EI}{L}$

(iv) $\frac{6EI}{L}$

(g) A closed rectangular frame with an internal hinge, is statically:

(i) Determinate

(ii) Indeterminate of order one

(iii) Indeterminate or order two

(iv) Indeterminate of order three

(h) If the length of a simply supported beam is doubled, the flexural rigidity of the beam will be :

(i) Halved

(ii) Doubled

(iii) Increased by four times

(iv) Remain same

(i) The ordinates of influence line diagram for bending moment always have the dimensions of

(i) Force

(c) The Castigliano's second theorem can be used to calculate deflections:

(i) At any point in a statically determinate structures only

(ii) At any point of any structure

(iii) at the point under the load in statically determinate structures only

(iv) at the point under the load of any structure

(d) The Betti's theorem of reciprocal work is valid for:

(i) Only beams

(ii) Beams and Frames

(iii) Beams, Frames and Trusses

(iv) Any linear structure, satisfying principle of superposition

(e) A three hinged arch is :

(i) Externally unstable

(ii) Externally & Internally unstable

(iii) Internally unstable

(iv) Externally & Internally stable

(f) When a unit rotation is given at the free end of a cantilever beam of flexural rigidity **EI** and length L, the moment produced at the fixed end will be

4. For the cantilever beam shown in Figure-3, obtain the Influence Line Diagrams (ILD) for the: (i) moment at A (ii) shear force at a distance of 3 m from A and (iii) bending moment at a distance of 5.5 m from A. Also determine the magnitude for these quantities, for the loading condition shown in the figure. 9+5=14

5. (i) What do you understand by a 'Funicular Arch'? Show that a three hinged symmetric parabolic arch of span l and rise h, *carrying* a uniformly distributed load per unit length of its span, may be considered to be a 'Funicular Arch'. (ii) A three-hinged semicircular arch of radius R carries a uniformly distributed load of w per unit run of the horizontal span. Find the horizontal thrust at each support as well as the location and magnitude of the maximum bending moment induced in the arch. Draw the bending moment diagram for the arch. 2+5+5+2=14

6. Analyze and obtain the axial force diagram (AFD), shear force diagram (SFD) and the bending moment diagram (BMD) for the frame shown in Figure-4. Also obtain the qualitative displacement curve for the frame. 12+2=14

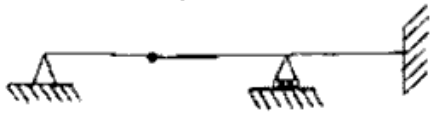
7. State and Prove Betti's Theorem of reciprocal work. Then show that Maxwell's Theorem of reciprocal displacements can be obtained from Bettis theorem, as a special case. Explain and prove Eddy's theorem for an Arch. 6+3+5=14

(ii) Length

(iii) force × length

(iv) force/length

(j) What is degree of static indeterminacy of the structure shown below:



(i) 1 (ii) 2 (iii) 3 (iv) 0

2. Determine the Internal, External and Total static Indeterminacy as well as stability for the structures shown in Figures [1-A) to (1-C)] . Also determine the Kinematic indeterminacy of the last two. 12+2+14

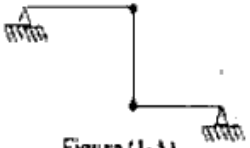


Figure (1-A)

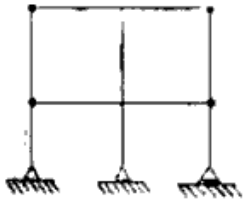


Figure (1-B)

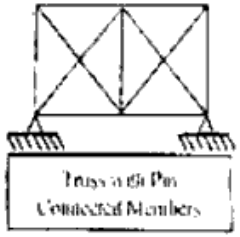


Figure (1-C)

3. Determine the member forces in the Truss shown in Figure-2, assuming the outer and the inner triangular panels (ABC & DEF) to be equilateral triangles of side lengths 5 m and 2 m, respectively and being placed concurrently. Also calculate the horizontal displacement of the joint B, by any method.

8+6=14

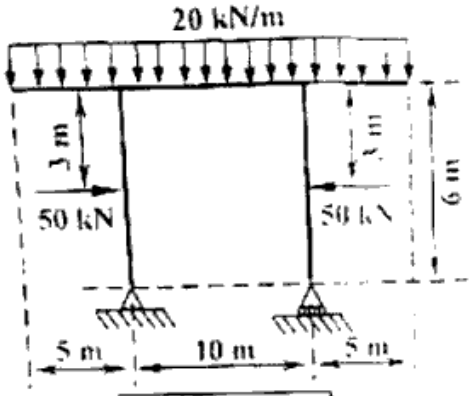


Figure-4

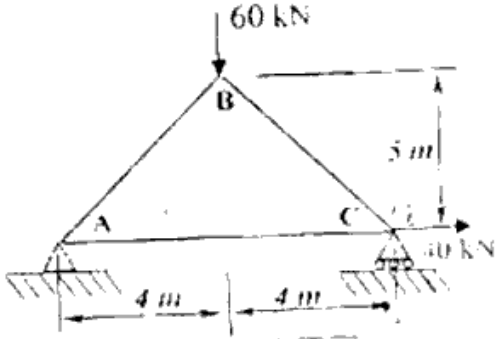


Figure-5

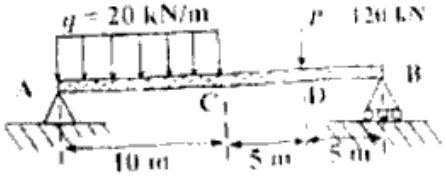


Figure-6

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8. For the simply supported plane truss shown in Figure-5. calculate the joint displacements in X and Y directions (horizontal & vertical), using *Matrix method of analysis*. Also obtain the forces induced in the members of the truss. Assume cross sectional area A = 500 mm^2 and Modulus of Elasticity E = 200 GPa, for all members of the truss. 9+5=14

9. Find the slopes at the supports of the simply supported beam shown in Figure-6, using the moment area method.

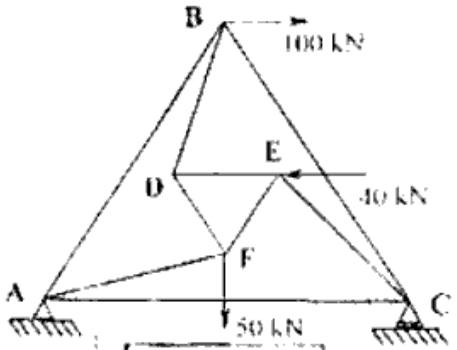

Figure-2

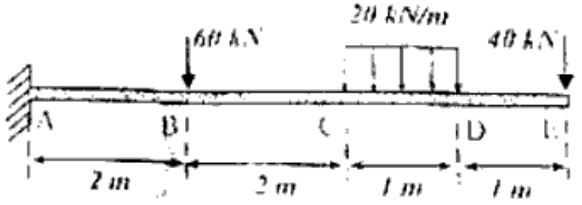

Figure-3