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Code : 011511

B.Tech. 5th Semester Exam., 2014

## STRUCTURAL ANALYSIS—I

Time : 3 hours

Full Marks : 70

## Instructions:

- (i) All questions carry equal marks.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct one (any seven) :

- (a) In a pin-jointed truss, the members may be subjected to bending, if
  - ☒ (i) the material of the truss does not obey Hooke's law
  - ☐ (ii) the truss is statically indeterminate
  - ☐ (iii) the loads are not applied at the nodes
  - ☐ (iv) there is support settlement
- (b) Point of contraflexure occurs in a structure, when
  - ☐ (i) bending moment is zero
  - ☒ (ii) bending moment changes sign
  - ☒ (iii) shear force is zero
  - ☐ (iv) All of the above

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- (c) In a vertically loaded propped cantilever, any settlement of the prop would
  - ☐ (i) reduce the hogging BM at the fixed end
  - ☐ (ii) increase the hogging BM at the fixed end
  - ☐ (iii) affect only SF and not BM values
  - ☐ (iv) affect neither BM nor SF values
- ☒ (d) A simply-supported beam of 8 m span is loaded by a u.d.l. and has maximum deflection of 16 mm. If the span is halved (i.e., 4 m) and the loading is doubled, the maximum deflection will be
  - ☐ (i) 2 mm
  - ☐ (ii) 4 mm
  - ☒ (iii) 8 mm
  - ☐ (iv) 16 mm

The fixed support in a read beam becomes  
— in the conjugate beam.

- ☐ (i) roller support
- ☐ (ii) hinged support
- ☒ (iii) free support

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(f) Castigliano's theorem for deflection, i.e.,  
 $\frac{\partial U}{\partial P} = \delta$  (deflection) is true for

- (i) linearly elastic material
- (ii) rigid material
- (iii) non-linearly elastic material
- (iv) any material, elastic or inelastic

(g) The maximum bending moment due to train of wheel loads on a simply-supported girder

- (i) always occurs at the centre of span
- (ii) always occurs under the wheel load
- (iii) Both (i) and (ii)
- (iv) occurs at the  $\frac{1}{4}$ th of any support

(h) Three-moment equation is applicable, when

- (i) the beam is prismatic
- (ii) there is no settlement of support
- (iii) there is no discontinuity within the span
- (iv) the spans are equal

(i) The theorem of three moments expresses the condition of

- (i) equilibrium of forces
- (ii) slope compatibility
- (iii) Maxwell's reciprocal theorem

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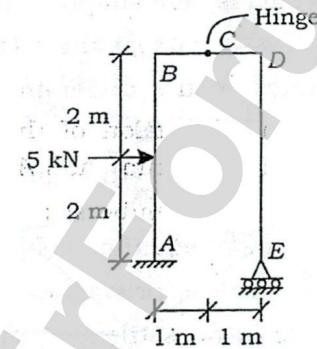
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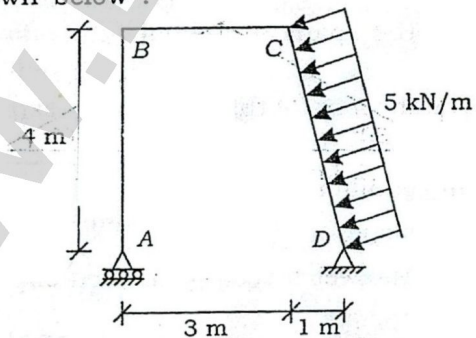
(j) The rotational stiffness of a cantilever beam at its free end is

- (i)  $EI / L$
- (ii)  $2EI / L$
- (iii)  $3EI / L$
- (iv)  $4EI / L$

2. Calculate the reactions at the supports for the frame shown below :



3. Draw the SF and BM diagrams for the frame shown below :

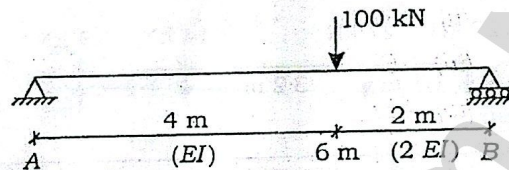


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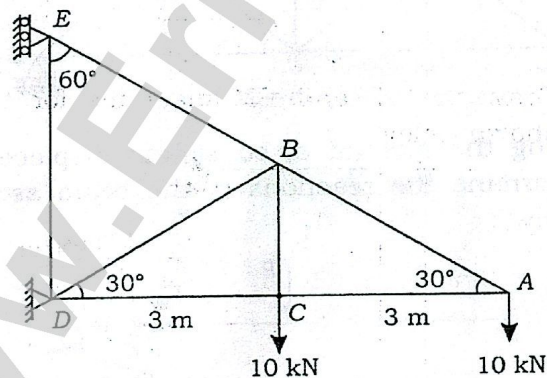
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4. Calculate the maximum deflection in the beam and its location :



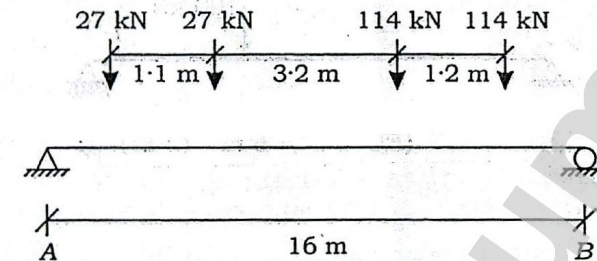
5. Determine the deflection of the point A of the truss  $E = 2 \times 10^5 \text{ N/mm}^2$  and  $A = \text{cross section} = 100 \text{ mm}^2$  (all the members) :



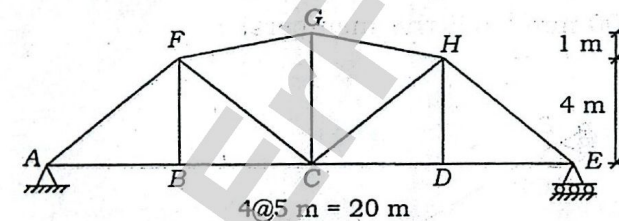
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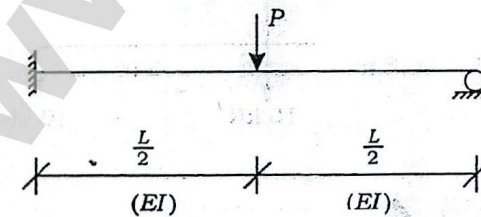
6. Determine the absolute maximum shear and moment for the beam as shown below, when a standard IRC class-A driving vehicle traverse in either direction :



7. Draw the IL for the forces in members CD, CH and GH :



8. Using the method of consistent displacements, determine the reactions of the beam as shown below :

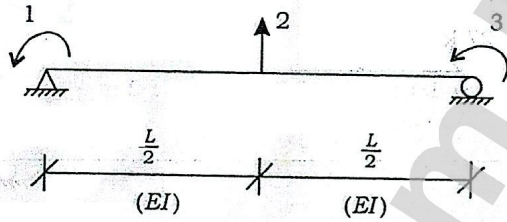


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9. Generate the flexibility matrix  $f$  for the coordinates 1, 2 and 3 of the beam as shown below :



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