STRUCTURAL ANALYSIS – II
(CIV3101)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) The slope-deflection method of structural analysis is a
(a) Displacement method (b) Force method
(c) Hybrid method (d) None of these

(ii) A suspension bridge with two hinged stiffening girder is statically
(a) Determinate (b) Indeterminate to 1 degree
(c) Indeterminate to 2 degree (d) Indeterminate to 3 degree.

(iii) In moment distribution method, the sum of all distribution factors of all members meeting at a joint is always
(a) Zero (b) <1 (c) 1 (d) >1

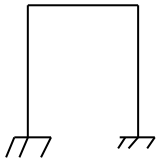
(iv) A curved beam is loaded perpendicular to its plane. The resulting bending stresses are highest at
(a) The outermost fibre (b) The innermost fibre
(c) The neutral axis (d) The centroid of the beam's cross-section

(v) The shear centre of a beam cross-section is the point
(a) Where shear stress is maximum
(b) Through which the load can be applied without twisting the beam
(c) At the centroid of the section
(d) At the neutral axis

(vi) If the displacement at co-ordinate i due to unit force at co-ordinate j is δ_{ij} and displacement at co-ordinate j due to unit force at co-ordinate i is δ_{ji}, then according to Maxwell's Reciprocal Theorm,
(a) $\delta_{ij} = \delta_{ji}$ (b) $\delta_{ij} > \delta_{ji}$ (c) $\delta_{ij} < \delta_{ji}$ (d) $\delta_{ij} \neq \delta_{ji}$

(vii) A simply supported beam of span 5m carries an udl of 20kN/m . The plastic moment capacity of the same is
(a) 47.5 kN.m (b) 62.5 kN.m
(c) 112.5 kN.m (d) 148.5 kN.m

(viii) Portals with two fixed supports, as shown in figure are statically



(a) Determinate
(b) Indeterminate
(c) Unstable
(d) None of the above

(ix) Which on is the assumption of the portal frame method?
(a) A hinge is placed at the center of each girder, since this is assumed to be a point of zero moment
(b) A hinge is placed at the center of each column, since this is assumed to be a point of zero moment
(c) At a given floor level the shear at the interior column hinges is twice that at that exterior column hinges, since the frame is considered to be a superposition of portals
(d) All of the above

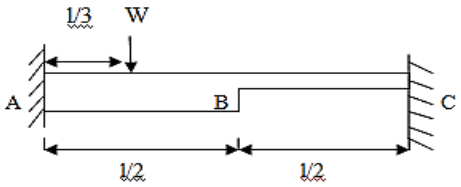
(x) In matrix structural analysis, the stiffness matrix [K] is
(a) Always symmetric and singular
(b) Symmetric and positive definite
(c) Asymmetric and non-singular
(d) Always a diagonal matrix

Fill in the blanks with the correct word

(xi) The ratio of stiffness of a member to the total stiffness at a joint is called the _____.

(xii) The ratio of plastic moment capacity to yield moment capacity is called _____.

(xiii) The fixed end shown below is subjected to a load at 1/3 rd of the span. The collapse load is _____.

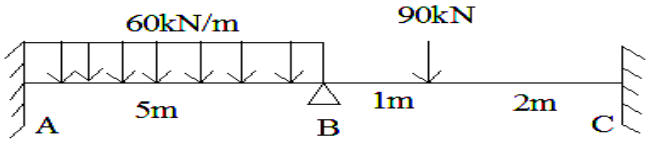


(xiv) Stiffness of the end A if the far end B is fixed is _____.

(xv) In a curved beam, the neutral axis does not pass through the _____ of the cross-section.

Group - B

2. (a) Determine the support moments and reactions for the continuous beam shown in fig. by slope deflection method. Assume EI is constant throughout.



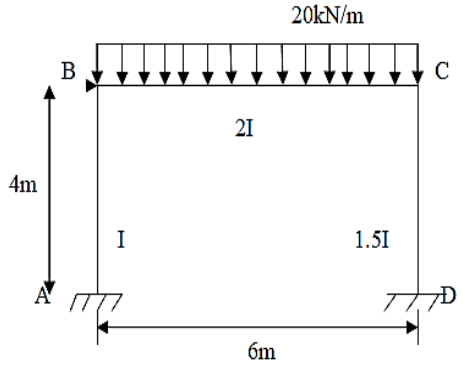
[(CO1)(Analyse/HOCQ)]

(b) The three hinged stiffened girder of a suspension bridge of span 120m is subjected to two point loads of 200kN and 320kN at a distance of 25m and 80m from left end. Find the shear force and bending moment for the girder at a

distance of 40m from left end. The supporting cable has a central dip of 8m. Find the maximum tension in cable. *[(CO2)(Evaluate/HOCQ)]*

7 + 5 = 12

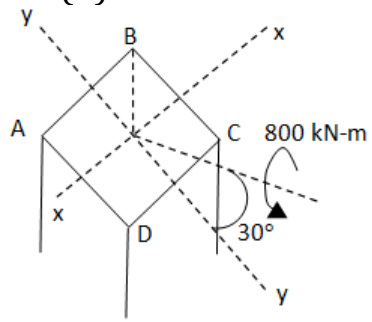
3. Analyze the rigid frame shown in fig. by Moment Distribution method. *[(CO1)(Evaluate/HOCQ)]*



12

Group - C

4. A rectangular beam is subjected to unsymmetric bending as shown in figure below. The value of the bending moment applied is 800kN-m and it is applied at angle 25^0 from *y-y* axis which is a symmetrical axis. The sides AB=CD=150mm and the sides BC= AD=140mm. Find bending stress (σ) at each corner of the beam. *[(CO3)(Analyse/HOCQ)]*



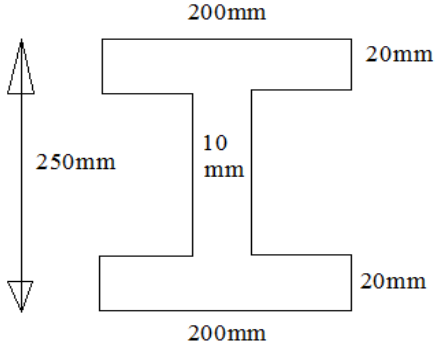
12

5. (a) Derive the expression of shear centre for a channel section. *[(CO3)(Analyse/HOCQ)]*
   (b) A channel section has flanges 12 cm × 2 cm and web 16 cm × 1 cm. Determine the shear centre of the channel. *[(CO4)(Analyze/LOCQ)]*

8 + 4 = 12

Group - D

6. (a) Find the shape factor of I section shown in fig. below



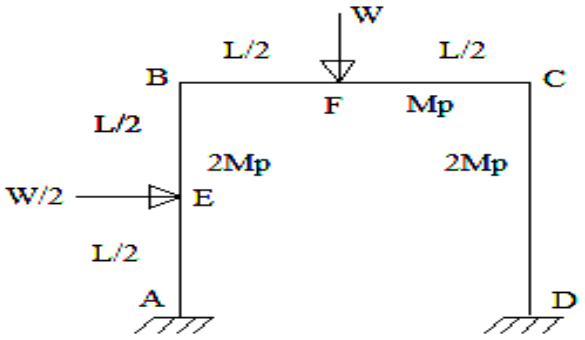
[(CO4)(Apply/IOCQ)]

(b) A two span continuous beam ABC has a span of length AB=5m and BC=5m and carries an uniformly distributed load of 30kN/m. A and C are simply supported. If the load factors 1.75 and the shape factor is 1.15 for the I section. Find the section modulus needed. *[(CO5)(Evaluate/HOCQ)]*

5 + 7 = 12

7. (a) Briefly describe the assumptions of "**Fully Plastic Moment of the Section**". *[(CO4)(Remember/LOCQ)]*

(b) Find the collapse load for the frame shown below:

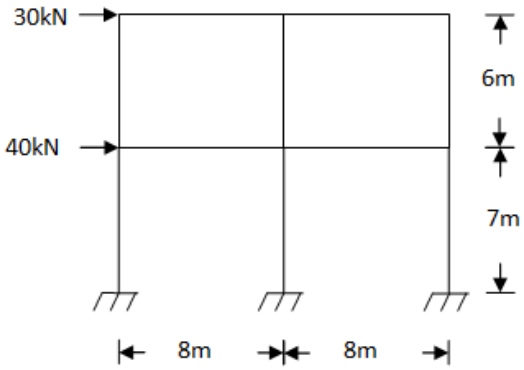


[(CO5)(Evaluate/HOCQ)]

5 + 7 = 12

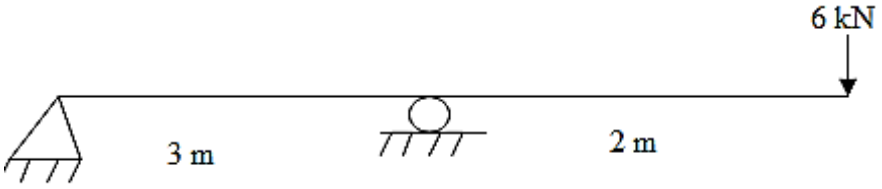
Group - E

8. Determine (approximately) the reactions at the base of the columns of the frame shown in figure below. Use the portal method of analysis. *[(CO5)(Analyse/IOCQ)]*



12

9. Determine the reactions at the supports of the beam shown in figure by using stiffness matrix method. EI is constant. *[(CO6)(Analyse/HOCQ)]*



12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	9.38	17.71	72.91