Total No. of printed pages = 7

CE 131602

Roll No. of candidate

2018

B.Tech. 6th Semester End-Term Examination

STRUCTURAL ANALYSIS — III

Full Marks – 100   Time – Three hours

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

Answer Question No. 1 and any *six* from the rest.

1.   Fill in the blanks :   (10 × 1 = 10)

   (a)   ——————— numbers of plastic hinge are
         necessary for collapse of a structure with 'n'
         degree of indeterminacy.

   (b)   The number of independent equations to be
         satisfied for static equilibrium of a plane
         surface is ———————.

   (c)   If the frame is tall and slender, ———————
         method is more suitable than ———————
         method of frame analysis subjected to
         horizontal load.

                                        [Turn over

(d) In the plastic analysis, lower bound theorem satisfies —————— and —————— condition.

(e) The shape factor for a rectangular section of breadth 'b' and depth 'd' is ——————.

(f) The diagonal elements of a stiffness matrix are always ——————.

(g) To generate the jth column of the flexibility matrix, a unit —————— is applied at coordinate j and the —————— are calculated at all coordinates.

(h) The deflection of a spring produced by a unit load is called ——————.

(i) The collapse load is reached when —————— is formed.

(j) The absolute stiffness of a prismatic member with far end fixed having transverse displacement is ——————.

2. Answer the following questions : $(10 + 2 + 3 = 15)$

(a) Analyse the frame shown in Fig. 1 by portal frame method and draw the bending moment diagram.
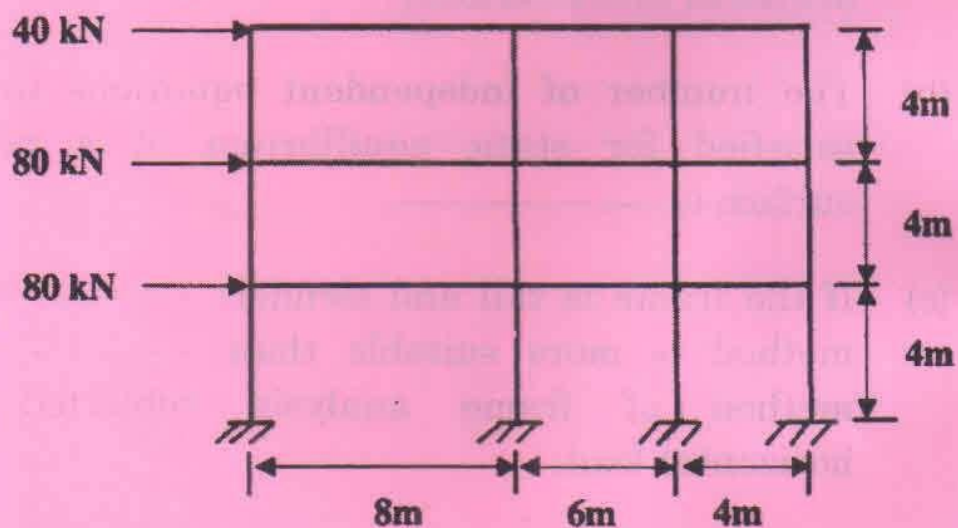
(b) Determine the flexibility matrix $[f]$ for the stiffness matrix. $[k] = \dfrac{2EI}{L}\begin{bmatrix} 2 & 1 \\ 1 & 1 \end{bmatrix}$.

(c) What is the shape factor for a square section having side 'a' placed with one of its diagonal vertical?

3. Answer the following questions. $(7 + 3 + 2 + 3 = 15)$

(a) Find the plastic section modulus and shape factor for the section shown in Fig 2. What is the full plastic moment of the section? What is the total u.d.l the beam will carry on a span of 5 meters simply supported? Take yield stress of steel as 250 N/mm²
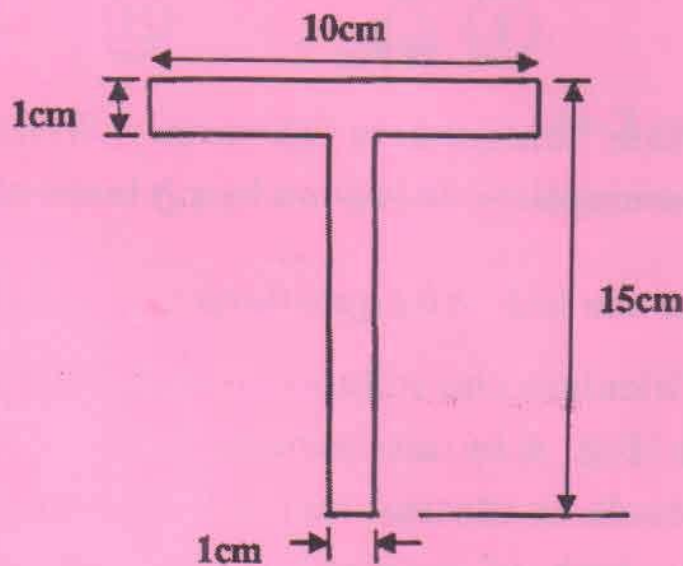

Fig. 2

(b) Draw the stress strain curve of mild steel in plastic analysis showing all necessary points.

(c) Derive the relationship between load factor and factor of safety.

(d) Show that the flexibility matrix and stiffness matrix are inverse to each other.

4. Answer the following questions. (10 + 5 = 15)

(a) Analyse the continuous beam ABC as shown Fig. 3 by using force method of analysis and thereby compute moments M_A and M_B and draw the BMD. Flexural rigidity (EI) is constant throughout the beam.
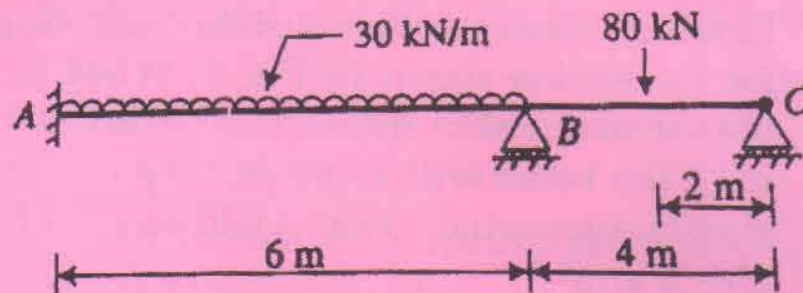

Fig. 3

(b) State uniqueness theorem. Write any five assumptions being made in plastic theory.

5. Answer the following questions : (6 + 6 + 3 = 15)

(a) Calculate the collapse load for the beam shown in Fig. 4 by mechanism method. Validate the result by statical method. Assume the beam to be both of constant section, the fully plastic moment being M_p
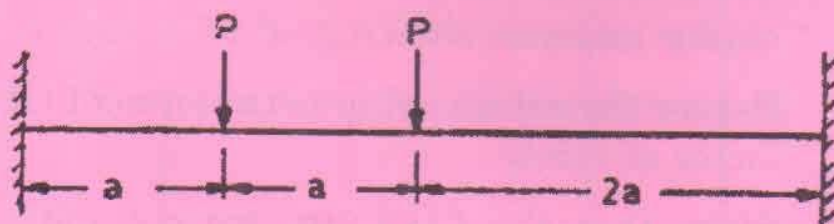

Fig. 4

CE 131602   4

(b) Derive the moment curvature relationship for a rectangular beam subjected to flexure. Hence show that it consists of two portions; linear and non-linear.

(c) Explain briefly the principle of contragradience.

6. Answer the following questions : (10 + 5 = 15)

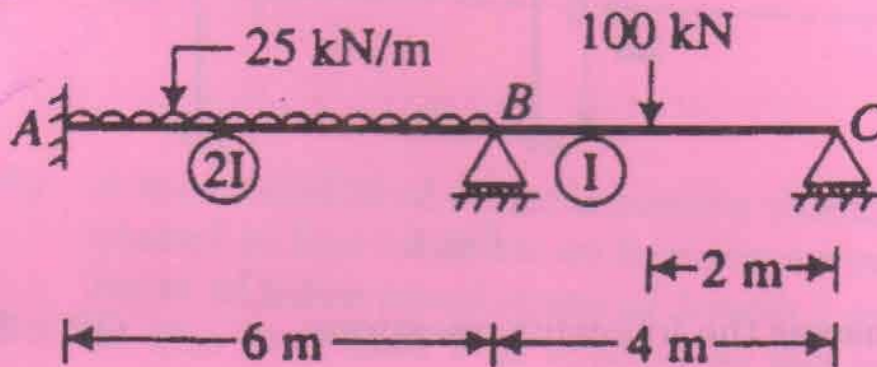(a) Analyse the continuous beam shown in the Fig. 5 by stiffness method.

Fig. 5

(b) A simply supported beam of span 'l' is subjected to a u.d.l. of w per unit run. Find the ultimate load. Is there any redistribution of moments in this beam?

7. Answer the following questions : (2 + 3 + 10 = 15)

(a) "The limit state design is to be preferred over elastic methods for many reasons". What are the different reasons referring to?

(b) State the assumptions that are being made in the portal method of frame analysis.

(c) Determine the collapse load P_u for the rectangular frame shown in Fig. 6 of uniform section with plastic moment capacity, M_p. Draw the BMD.
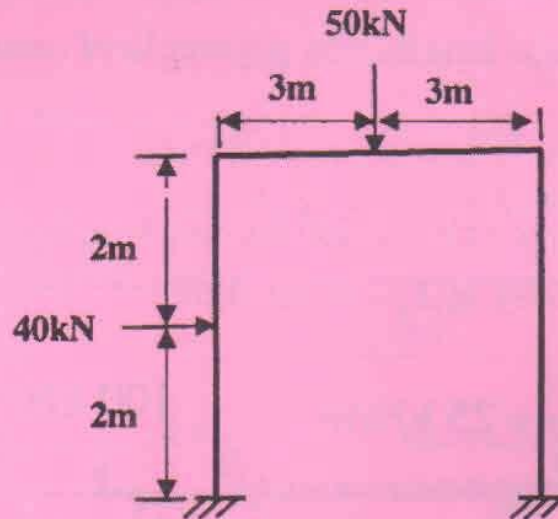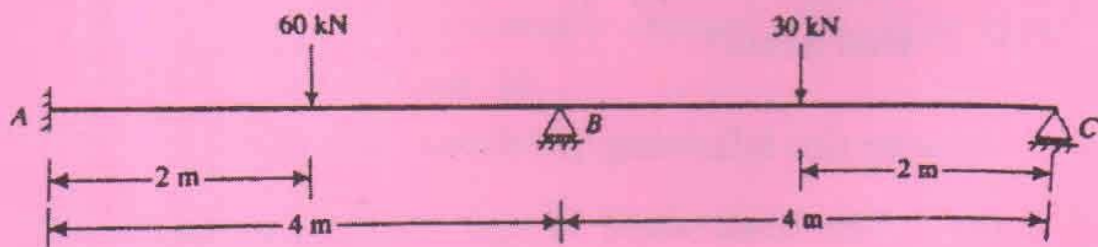

Fig. 6

8. Answer the following questions. (12 + 3 = 15)

(a) Analyse the continuous beam shown in the Fig. 7 by flexibility matrix method, if the downward settlement of support B and C are 12 mm and 6 mm respectively. Given flexural rigidity $EI = 20 \times 10^{12}$ N-mm². Draw the BMD.

(b) Obtain the length of plastic hinge for a simply supported beam subjected to a uniformly distributed load.

9. Answer the following questions.   (10 + 5 = 15)

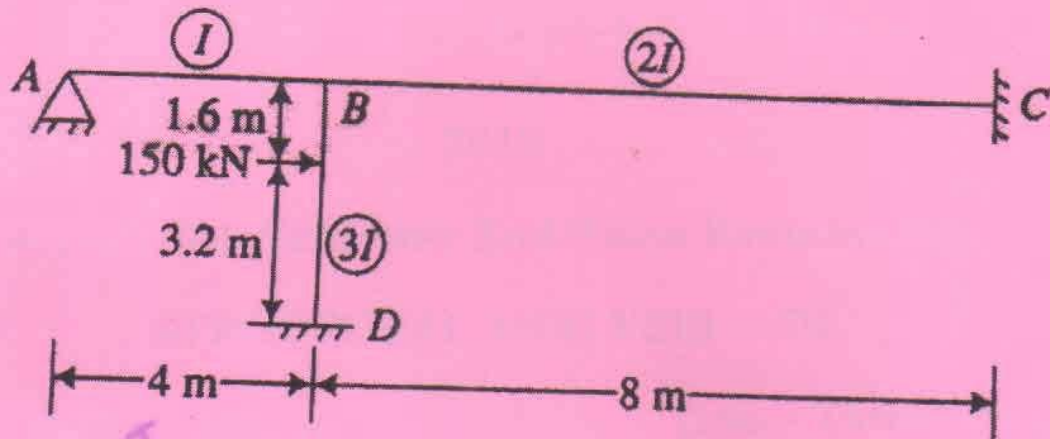(a) Analyse the frame shown in Fig. 8. Use stiffness matrix method.

Fig. 8

(b) A beam ABCD of uniform section throughout is pinned to four supports so forming a continuous beam of three equal spans of length I as shown in Fig. 9. A load P is applied at the center of each span. Find the value of P which causes collapse.
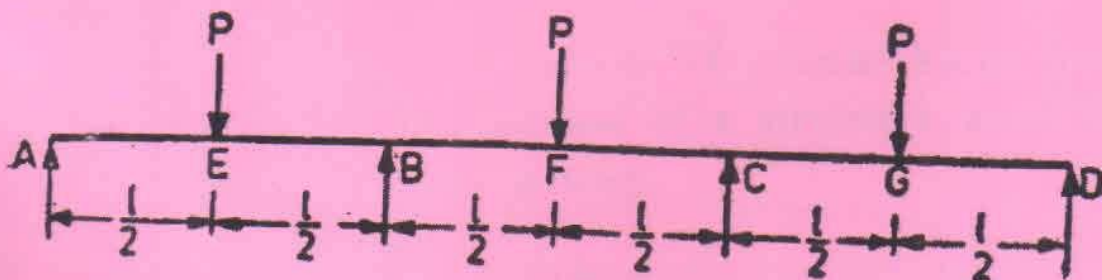

Fig. 9