**DEPARTMENT OF CIVIL ENGINEERING** iitdelhi

# MAJOR EXAM

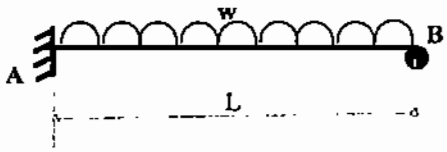
## CEL331: STRUCTURAL ANALYSIS II (2006-07)

**Time allowed:** 2hours **Date:** 02 December 2006 **Venue:** VI 301 **Max marks:** 40

**NOTE:** (a) This question paper contains two pages. (b) All questions are compulsory. (c) Assume all members as inextensible unless otherwise stated. (d) Draw neat and claar sketches wharever required.

1. Use the minimum potential energy theorem to obtain the rotation at point B for the beam shown in Fig. 1. Assume a polynomial function of appropriate degree.

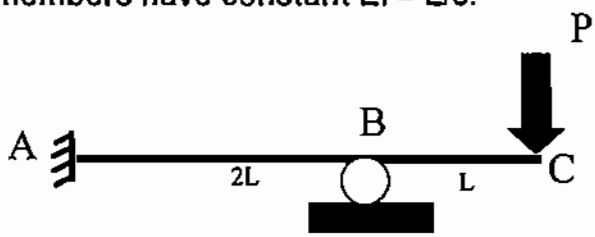
   Also determine the exact rotation using slope deflection or any other method. Find the error in prediction by the minimum potential energy theorem




**(5+3 = 8 marks)**

**Fig. 1**

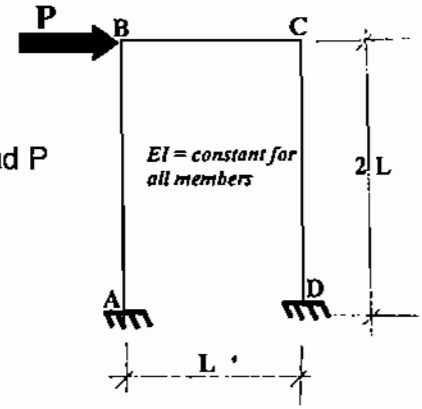
2. Derive the flexibility matrix of the structure shown in Fig. 2, such that it should enable you to determine the deflection under the load P (i.e. at C) and the rotation at B. **Assume both members have constant EI = L/6.**




**(7 marks)**

**Fig. 2**

3. For the frame shown in Fig. 3, determine the moment induced at joint A (of column AB)under the action of load P using either **moment distribution** or **slope-deflection** or **matrix stiffness** approach.




**(5 marks)**

**Fig. 3**

4. For the structure shown in Fig. 4, perform following steps. Assume constant EI =2 for beams and EI=1 for the columns.

   (a) Obtain all fixed ended moments.
   (b) Show all relative stiffness factors (k) and distribution factors at governing joints in a sketch of the structure. Modified k (if used) should be identified by an asterisk (*).
   (c) Carry out moment distribution and obtain all final moments. You may stop when the carry over moments are less than 1 kN-m.
   (d) Obtain bending moment diagram of BC, showing the end and mid span moments.
   (e) Calculate the axial force in member BE.

**(2+2+4+2+2= 12 marks)**

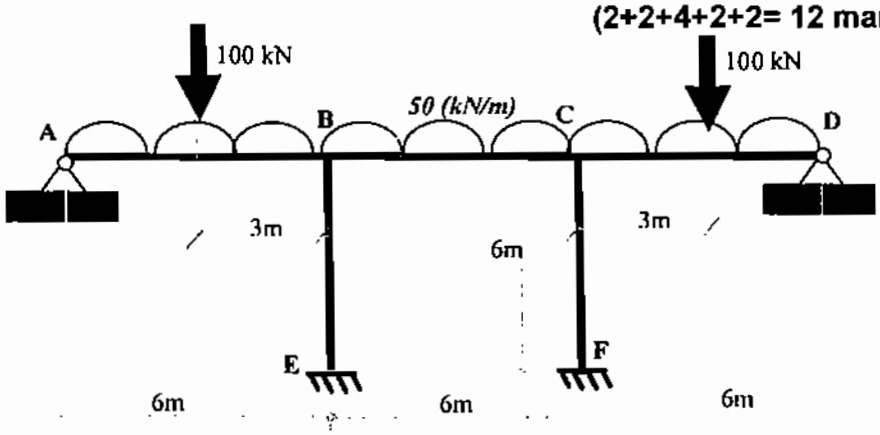



**Fig. 4**

5. For the **structure** shown in Fig. 5, which has **extensible** members, determine the size of the matrices $[K_{pp}]$, and $[K_{xx}]$. What is the size of the half band matrix? Where will be element $k_{43}$ of the local stiffness matrix of member 2 be transferred in $[K_{pp}]$ ? Finally, where will it be transferred in the half banded matrix B. The figure shows the joint numbers in circles and member numbers in squares. Assume local x axis directed upwards.

**(1+1+1+1= 4 marks)**

5. Determine the **static** and the **kinematic** indeterminacies of the structure shown in Fig. 6.

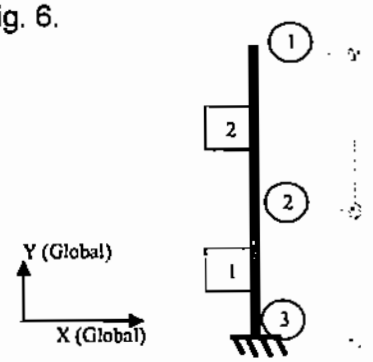



**Fig. 5**

**(2+2= 4 marks)**

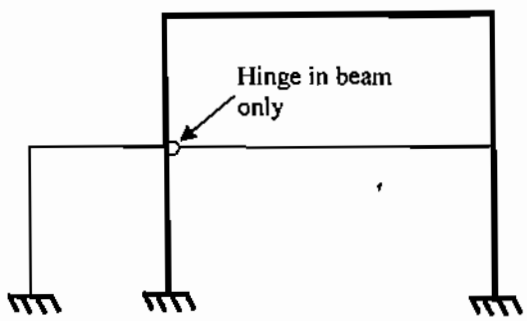



**Fig. 6**