Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech(CE/OLD)/SEM-6/CE-604/2013

2013
STRUCTURAL ANALYSIS III

Time Allotted : 3 Hours *Full Marks :* 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) The rotational stiffness of a beam when far end is hinged

a) $\frac{3EI}{L}$ b) $\frac{2EI}{L}$

c) $\frac{4EI}{L}$ d) None of these.

ii) If ξ = 6% then the logarithmic decrement is

a) 0·377 b) 0·378

c) 0·375 d) 0·376.

iii) According to Muller Breslau principle for any reaction or stress component of a beam is obtained as a

a) S.F. diagram for the beam

b) B. M. diagram for the beam

c) Deflection diagram for the beam

d) None of these.

iv) In the horizontal load analysis the point of contra flexure lies at ..... point of the beam in the framed structure

a) Middle

b) end

c) one third

d) none of these.

v) A system is said to have under damped condition when

a) $c > c_{cr}$

b) $c = c_{cr}$

c) $c < c_{cr}$

d) all of these.

vi) Flexibility and stiffness matrices for the system are

a) equal b) inverse

c) not related d) direct.

vii) The displacement function in case of truss element in finite element approach is

a) $a_1 + a_2 x$ b) $a_1 x + a_2 x^2$

c) $a_1 + a_2$ d) none of these.

viii) Influence line for B. M. at left hand support of a fixed beam is given by the equation, measuring x distance from left hand support

a) $\frac{x(l-x)^2}{l^2}$ b) $\frac{x(l+x)^2}{l^2}$

c) $\frac{x^2(l-x)^2}{l^2}$ d) none of these.

ix) The degree of relative isolation is

a) Transmissibility b) Resonance

c) Damping d) Vibration.

x) The stage when forcing frequency equals natural frequency of the system is known as

a) Resonance b) Steady state

c) Transient response d) None of these.

xi) Direct stresses in columns are proportional to their distances from the C.G. of the frame is the assumption in

a) Cantilever method b) Portal method

c) Factor method d) None of these.

xii) The shape of the displacement associated with degrees of freedom is called

a) Interpolation function

b) Displacement function

c) Shape function

d) None of these.

xiii) Structural analysis technique which involves discretization and numerical approximation is called

a) Finite difference method

b) Finite element method

c) Finite strip method

d) All of these.

xiv) A vibrating system consisting of a weight of W = 10 N and a spring with stiffness k = 20 N/m. The angular natural frequency of the system is

a) 4·43 b) 5·4

c) 2·5 d) 3·25.

xv) Numerical approach where the differential equations are converted to ordinary algebraic equations is

a) Finite difference method

b) Finite element method

c) Newmark's method

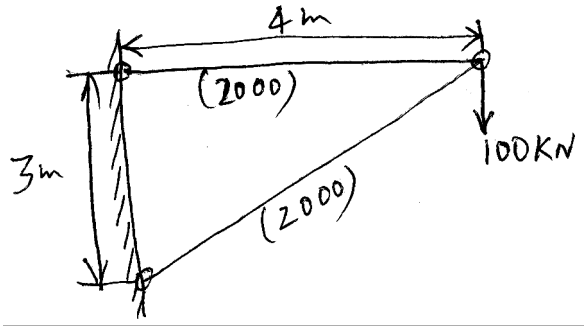
d) All of these.

GROUP – B

(Short Answer Type Questions)

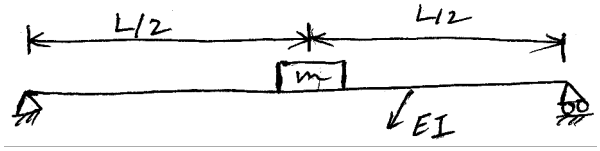
Answer any *three* of the following. 3 × 5 = 15

2. Develop the stiffness matrix for the pin jointed truss as shown in the Fig. The cross sectional area of each member is 2000 mm^2. The E = 200 KN/mm^2.

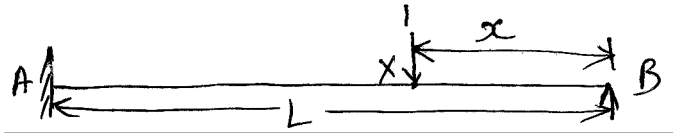


3. Derive 4th order derivatives in finite difference technique.

4. A mass m is attached to the midpoint of a beam of length L as shown in the Fig. the mass of the beam is small in comparison to m. Determine the spring constant and the frequency of the free vibration of the beam in the vertical direction. The beam has a uniform flexural rigidity EI.



5. Draw the influence line diagram for the reaction at B.



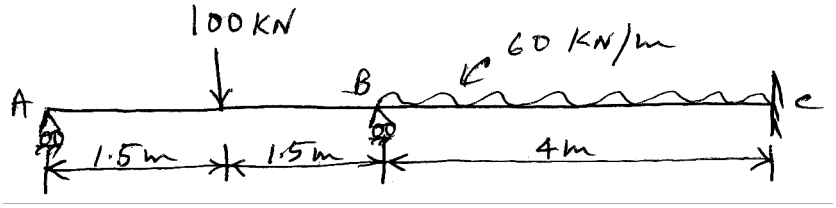
6. Write short notes on the following :

   a) System stiffness matrix

   b) Shape functions

   c) Critically damped system.

7. Develop the flexibility matrix for the continuous beam as shown in the Fig.

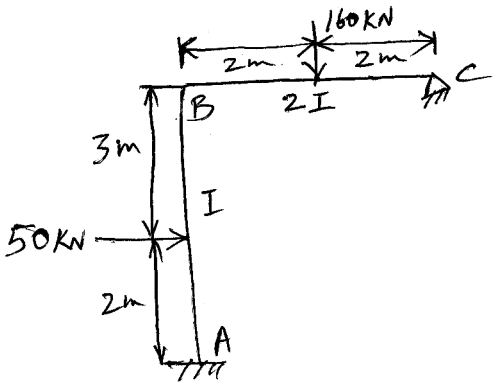


GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

8. Analyse the structure by matrix method as shown in the Fig.



9. The steel rigid frame supports a rotating machine which exerts a horizontal force at the girder level of 50000 sin 11t N. Assuming 4 percent critical damping, 5000 kg mass acting at beam level and columns mass less. Determine :

   (i) Steady state amplitude of vibration

   (ii) Transmissibility of the motion to the girder

   (iii) The max. Shearing force in the supporting columns

   (iv) Damped natural frequency

   (v) Logarithmic decrement

   (vi) Dynamic magnification factor

   (vii) Max. bending moment

   (viii) Max. shearing stress in the columns

(ix) Max. relative displacement

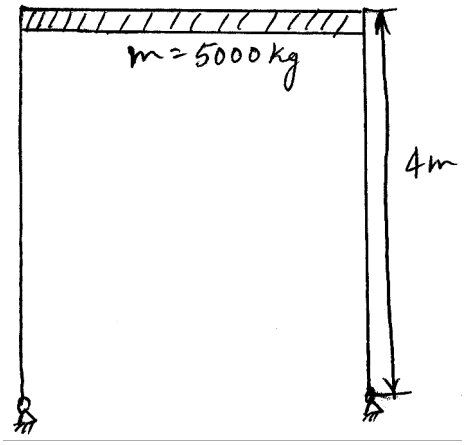
(x) Time interval between consecutive max. amplitudes.

Take length of the beam = 4m

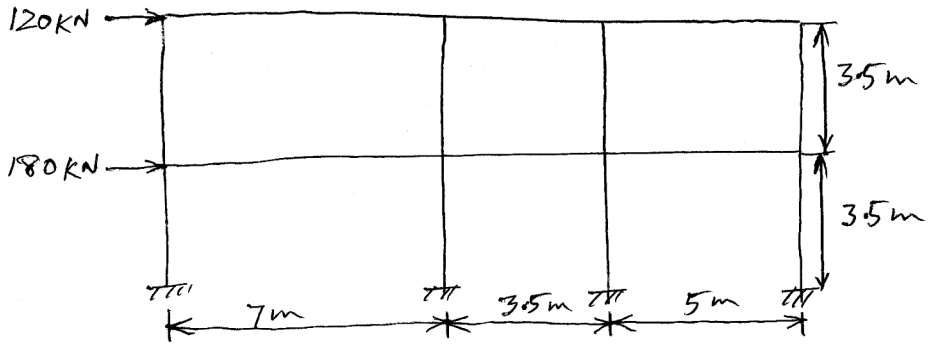
Length of the columns = 4 m

$E = 2{\cdot}1 \times 10^{11} N/m^2$

1 for columns $= 1500 \times 10^{-7}\ m^4$



10. Analyse the frame as shown in the Fig. by portal or cantilever method. Assume const. *EI* for all beams and columns. Draw the relevant BMD and SFD.



11. A simply supported beam of span 1 carries *udl* of intensity w over the entire span. Determine the bending moments and the deflections at quarter span, mid span and three quarter span. Also determine the actual *BM* and the deflection at these points and calculate the percentage the percentage of error by finite difference method or relaxation technique. Take EI = const.

12. Derive the stiffness matrix for a beam element using finite element method. Neglect the axial deformation.