B.E. (Civil) 8th Semester Examination, 2006
Subject: Advanced Structural Engineering
(C£ 803/1)

Time : 3 hours Full Marks : 100

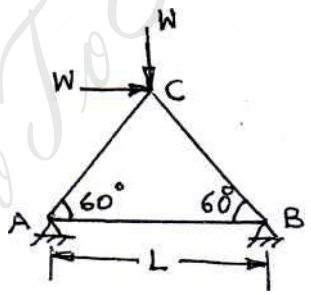
(i) Use separate Answerscript for each half (ii) The questions are of equal value (iii) Two marks reserved for neatness in each half

FIRST HALF Answer any THREE questions

1. a) What is meant by plane stress problem? b) Derive the biharmonic differential equation of elasticity problems without body force for plane strain problem.

2. a) Derive the equations of equilibrium for three dimensional elasticity problem in Cartesian co-ordinate, b) Derive the compatibility equations for strain in two dimensional elasticity comment, why it is necessary.

3. Compute the deflections of node C of the plane truss as shown in Fig. Q.3 by direct Stiffness method. AE is constant for all members.



4. Analyse the plane frame by direct stiffiiess metliod neglecting axial deformation of the member as shown in Fig. Q.4. Also draw the bending moment diagram.

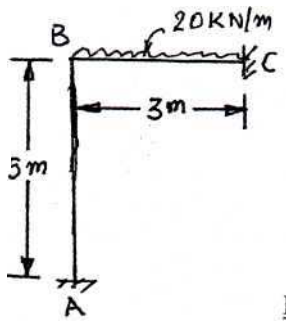


Fig. Q.4

I_{AB} = 6000 cm^4 I_{BC}- 4000cm^4 E =2X10^5N/MM^2

5. Write short notes on any **TWO** of the fallowing :

a) What is Airy's stress function? Explain its importance.

b) Derive the stiffiiess matrix for a beam element of length L due to bending only.

c) Write down the stiffiiess matrix for space truss member in member axis. Also show the transformation matrix for it, if the member is at an angle 0 with global X axis.

d) Explain temperature effect in a tall chimney. Also show its effect when combined with vertical stresses.

SECOND HALF

Answer any THREE questions

6.a) Briefly explain what is meant by the term, 'Logarithmic Decrement' & derive its relationship with the damping ratio of a structural system

b) A one-storied building is idealized as a massive girder supported by weightless columns. A free vibration test is made in which the roof system is displaced laterally by a hydraulic jack and then suddenly released. During the jacking operation a force of 90 KN is required to displace the girder by 6 mm. After the release the maximum displacement

on the first return swing is found to be 4.8 mm and the time period of vibration is 1.50 sec.

For the given system, calculate
(i) the effective mass,
(ii) the frequency of vibration
(iii) the logarithmic decrement
(iv) the damping ratio
(v) the damping coefficient and
(vi)the amplitude of displacement after 4 cycles.

7. Explain the terms 'mode shape vector' and 'modal frequency'. Prove that mode shape vectors are orthogal with respect to stiffness on mass matrix.
Briefly explain how the orthogonality of the mode shape vectors are used to decouple the equations of motion for MDOF systems.

8. A circular plate of radius 'a' is clamped throughout the edge and is subjected to a uniformly distributed load of intensity q_0. Derive the expressions for maximum deflection, bending moments at the fixed edge and bending moments at the centre, [use the plate bending equations in polar coordinates]

9. a) Derive the equations of equilibrium for an element of a cylindrical shell, considering only membrane stresses. b) A barrel vault of semicircular section is supported at the ends on "diaphragm type" supports with longitudinal edges being free. The shell carries a dead load of intensity p which is uniform over the shell surface. Derive the expressions for meridional forces.

10. Write notes on any **TWO** of the following :
a) Response Spectra
b) Corner reaction in rectangular plates
c) Membrane Theory of shells
d) Stress resultant in shells