EL-MANSOURA UNIVERSITY
FACULTY OF ENGINEERING
STRUCTURAL ENG.DEPT.

8/9/2013

DYNAMIC OF STRUCTURES
MASTER DEGREE
TIME ALLOWED: 1.5 HOUR.
maximum cerdit= 50 Points

Question 1: 20 (5+4+11) points

1)Write the equation of motion for nonlinear single degree of freedom system, showing the mathematical model and free body diagram . Give a sketch for nonlinear stiffness an damping.

2)Write breifly about linear acceleration step by step method and elastoplastic behaviour.

3) For the single degree of freedom frame shown in Fig.(1-1) with elastpolastic behaviour shown in Fig.(1-2) , find the nonlinear response using linear acceleration method at times t=0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7 seconds for the loading system shown in FIG.(1-3).

Fig.(1a)

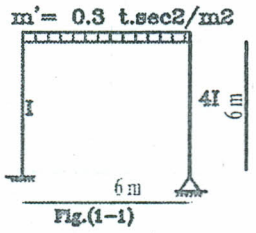

Fig.(1-1)

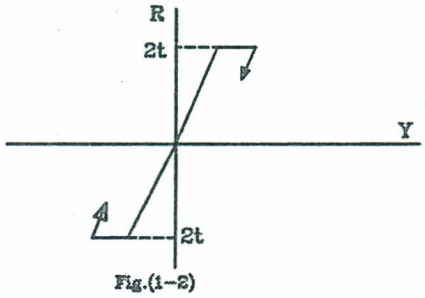

Fig.(1-2)

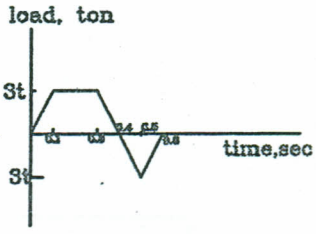

Fig.(1-3)

E= 2000 t/cm2 , I = 0.001 m4.

Question 2: 10(5+5) points

1) For random function x(t) , write about statistical properties of the fluctuating velocity component of wind.

2)A 100m tall mast , whose first and second frequencies are 1.5 Hz, 2.5 Hz, respectively is subjected to a mean wind speed of 30m/s ,at 10 m above ground level. Compute the values of the spectral density functions corresponding to the two first frequencies at 25m, 50m, 75m, and 100m along the mast height, considering the roughness length =0.3 m.

Question 3: 30(15+15) points

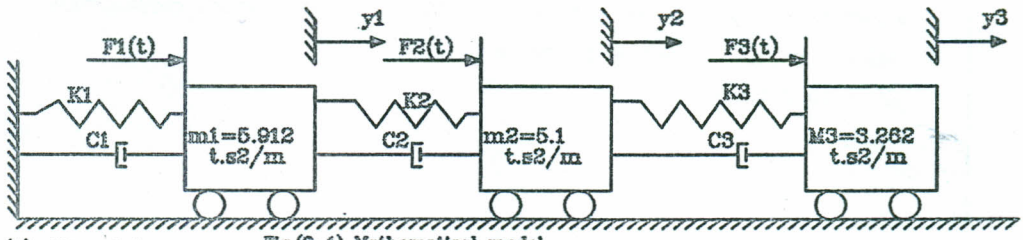

Fig.(2-1) Mathematical model

part(1) 15 points:

For Fig.(2-1) and (2-2):

K1= 2344 t/m, K2= 6222 t/m, and K3 = 1778 t/m.

F1(t)= 5 t, F2(t)= 10 t, and F3(t)= 15 t

$(DLF)_{1max}$ = 0.75 , $(DLF)_{2max}$ = 1.45 , $(DLF)_{3max}$ = 1.6

The three frequencies are 11.514, 27.186, and 51.674 rad/s.

i) Find the equation of motions.

ii) compute the maximum displacements y1max, y2max, and y3max due to triangular impulsive loads in Fig.(2-2).

iii) Write the damping matrix , considering the absolute damping coefficients for the first three modes are 5%, 10%, and 15 %, respectively.

Fig.(2-3)

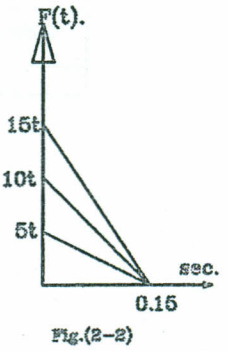

Fig.(2-2)

part(2): 15 points

For Fig.(2-3):

The mast shown in Fig.(2-3) supports two discs at 10, 20 m elevation above the ground. The diameter of each disc is 4 m, and the drag coefficient c_d = 2.0. The roughness length = 1.0 m, the wind speed = 30 m/s at 10 m, elevation above the ground level.

- Calculate the lateral response of each disk due to wind on disks only.
- Compute Kaimals power spectrum to take account of the variation of the spectral density function with height.

consider the exponential decay coefficient for the wind speed and ground roughness C_z=8 assume the damping in the first to modes is 1% and 0.5% of critical and the aerodynamic admittance factor to be 0.5 and 0.25 in first and second, respectively.

m1=6 t.s2/m , m2 = 3 t.s2/m

EI = 1000 t.m2

GOOD LUCK PROF. DR. ENG. Mohamed Naguib.