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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Second Semester, M. Tech - Mechanical Engineering (MMDN)

Make - up Examination; July - 2016

Advanced Theory of Vibrations

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Assume suitable missing data if any.

UNIT - I

1. A single degree of freedom spring-mass-damper system with m = 0.1 kg, k = 1000 N/m and $C = 10\ ^{N-s}/_{m}$ is subjected to excitation force which varies as shown in Fig. Q(1). Obtain the response equation of the system by considering the first three harmonics of the forcing function. 20

2 a. One cycle of the forcing function shown in Fig. Q 2(a) is split into twelve divisions and the magnitudes of force at different instants of time are shown in Table Q 2(a). Obtain the first three harmonic components of the forcing functions. 10

b. Use convolution integral to determine the response of an undamped single degree of freedom system due to triangular pulse shown in Fig. Q 2(b). 10

UNIT - II

3 a. Discuss about coordinate coupling and existence of different types of coupling in a system. 6

b. Obtain flexibility and stiffness matrix for the system shown in Fig. Q 3(b) and show that they are inverse to each other. 14

4. For the system shown in Fig. Q (4), obtain the natural frequencies and mode shapes. 20

UNIT - III

5. Obtain the response equation for the free vibration of a string with both ends fixed. 20

6. Find the natural frequencies and free vibration (longitudinal) solution of a bar fixed at one end and free at the other. 20

UNIT - IV

7 a. Derive the expression for ratio of absolute amplitudes of a single degree of freedom spring-mass-damper system subjected to base excitation. 10

b. With necessary sketches and equation explain the working principle of an accelerometer. 10

8 a. With necessary sketches explain frequency measuring instruments. 8

b. Sketch and explain two types of mechanical vibration exciters. 12

Contd…2

UNIT - V

9 a. Write any four differences between linear and non-linear vibrating systems. 4

b. With necessary sketches and equations discuss about two non-linear systems. 8

c. Discuss method of isoclines for constructing trajectory of a linear system. 8

10 a. Discuss about phase plane trajectories for a linear system. 8

b. A system with dry friction damping has its differential equation of motion given by $\ddot{x}+\phi(\dot{x})+x=0$, where $\phi(x)$ = F where $\dot{x}$ is positive and $\phi\left(\dot{x}\right)=-F$ where $\dot{x}$ is negative. 12

Obtain trajectory of motion when the system is given an initial displacement and released.

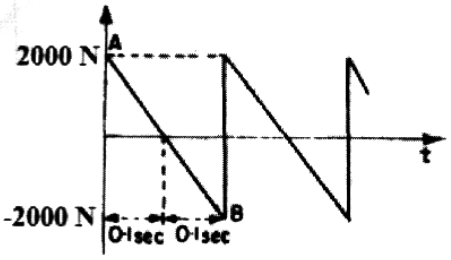

Fig.Q (1)

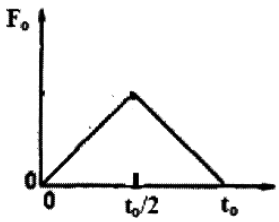

Fig.Q 2(b)

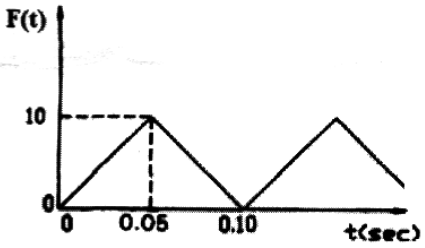

Fig.Q 2(a)

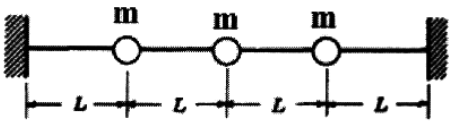

Fig.Q 3(b)

i	$F(t)_i$
1	1.67
2	3.33
3	5.00
4	6.67
5	8.33
6	10.00
7	8.33
8	6.67
9	5.00
10	3.33
11	1.67
12	0.00

Table Q 2(a)

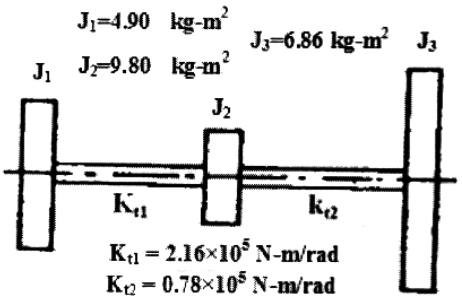

Fig.Q (4)

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