U.S.N

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

(An Autonomous Institution affiliated to VTU, Belgaum)

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

Semester End Examination; June - 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. In the study of vibrations of valves used in hydraulic control systems, the valve and its elastic stem are modeled as a damped spring-mass system as shown in Fig. Q1(a). In addition to the spring force and damping force, there is a fluid pressure force on the valve that changes with the amount of opening or closing of the valve. Find the steady-state response of the valve when the pressure in the chamber varies as indicated in Fig.Q1b. Assume; K = 2500 N/m, C =10 N-s/m and m = 0.25 kg. 20

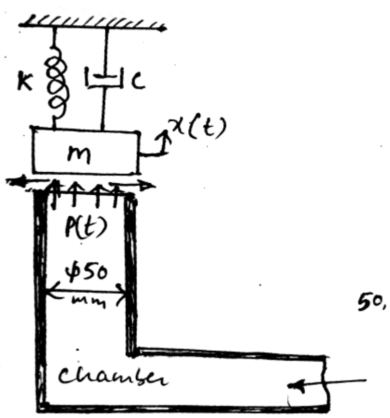


Fig. Q1a

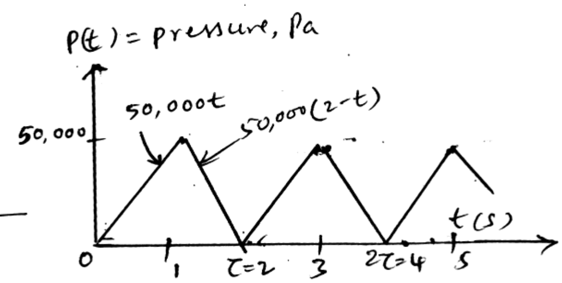


Fig Q1b.

2. A building frame is modeled as an undamped single degree of freedom system (Fig. Q2a). Find the response of the frame if it is subjected to a blast loading represented by the triangular pulse shown in Fig. Q2b. 20

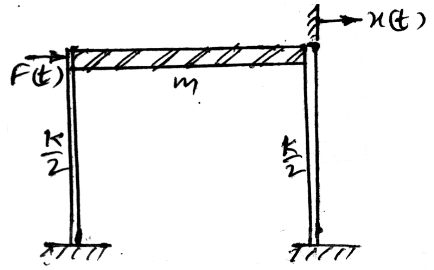


Fig Q2a.

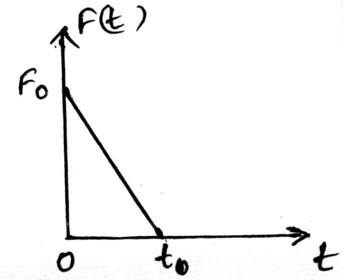


Fig Q2b.

UNIT - II

3. A string is stretched with a large tension T between two points and has three point masses fixed along its length as shown in Fig. Q3. The masses can vibrate freely in the lateral direction.

   (i) Determine the flexibility matrix and write the differential equation of motion in matrix form in terms of flexibility matrix.

   (ii) Determine the stiffness matrix and write the differential equation of motion in matrix form in terms of stiffness matrix. 20

   (iii) Show that flexibility matrix and the stiffness matrix are inverse of each other.

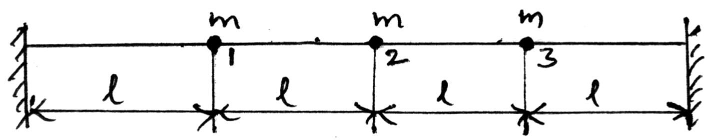


Fig. Q3

4. For the undamped two degree of freedom system shown in Fig. Q4 with the generalized coordinates x_1, x_2 determine; (i) the principle co-ordinates (ii) the ensuing vibrations of the system for the initial conditions. Take; $m_1 = m_2 = m$ and $k_1 = k_2 = k$.

$$\left(x_1\right)_{t=0} = 1, \quad \left\{\dot{x}_1\right\}_{t=0} = 0, \quad \left(x_2\right)_{t=0} = 2, \quad \left(\ddot{x}_2\right)_{t=0} = 0$$ 20

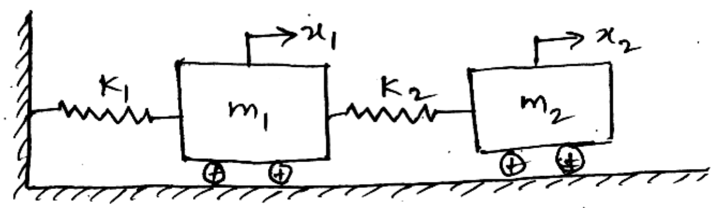


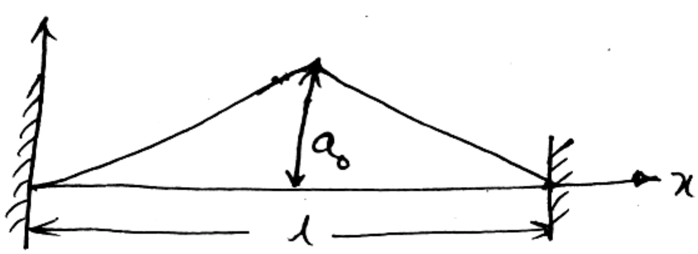
Fig Q4.

UNIT - III

5. Obtain the solution for differential equation of motion for the lateral vibration of a beam. 20

6. A uniform string of length ‘l’ and a large initial tension S, stretched between two supports, is displaced laterally through a distance, ‘a_0’ at the centre as shown in Fig. Q6, and is released at t = 0. Find the equation of motion for the string.

Fig. Q6.



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UNIT - IV

7 a. Sketch and explain working of the following : 12

(i) Piezoelectric accelerometer

(ii) LVDT transducer.

b. Sketch and explain working of Fullarton tachometer and Frahm Tachometer. 8

8 a. Design a vibrometer if the maximum error is to be limited to 1 percent of the true velocity. The natural frequency of the vibrometer is to be 80 Hz and the suspended mass is to be 0.05 kg. 10

b. Sketch and explain working of an electro dynamic shaker. 10

UNIT - V

9. For the system shown in Fig. Q9, find the time period per cycle as a function of amplitude of vibration shown this is the form of a graph. 20

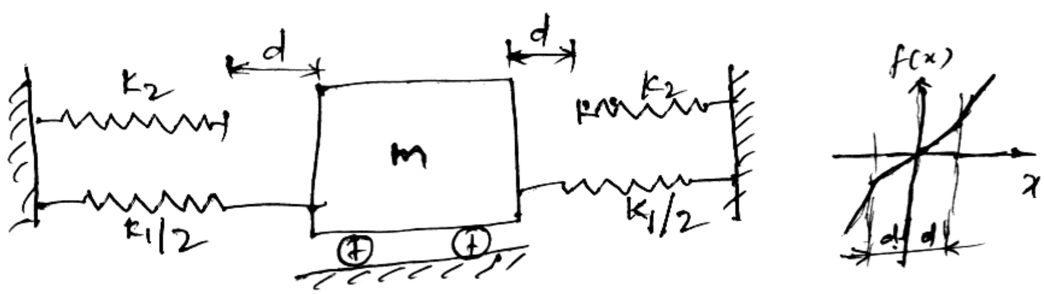

Fig Q 9.

10. Consider the system to be represented by the differential equation $\ddot{x} + w_0^2 x + \beta x^3 = 0$, where w_0 is the natural frequency of the linear system. Obtain the solution for the above equation by using perturbation method. 20

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