

Total No. of Questions : 8]

[Total No. of Printed Pages : 4

Roll No

MMPD-104
M.E./M.Tech., I Semester
 Examination, December 2017
Theory of Vibration

Time : Three Hours

Maximum Marks : 70

- Note :** i) Attempt any five questions.
 ii) All questions carry equal marks.
 iii) Assume suitable data, if necessary.

1. a) Show that for viscous damping, loss factor is independent of the amplitude and proportional to frequency. 7
 b) A heavy machine of mass m is mounted through a resilient system on a foundation. The resilient system comprises of a spring of stiffness k and a viscous damper with damping coefficient c , the machine produces as excitation force $F(t) = F_0 \sin \omega t$. Derive the formula for total force transmitted to the foundation and prove that the forcing frequency should be greater than $\sqrt{2}$ times the natural frequency of the system in order to achieve vibration isolation. 7
2. a) What is the difference between vibration isolator and vibration absorber? 4

- b) A double pendulum having length l is shown in figure 1. Determine natural frequency of double pendulum when $K=50\text{N/m}$, $m_1=3\text{kg}$, $m_2=5\text{kg}$, $l=200\text{mm}$ and $a=100\text{mm}$. 10

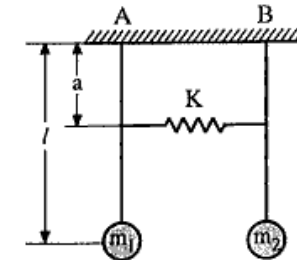


Figure 1

3. a) State and prove Maxwell's Reciprocal theorem. 4
 b) Formulate Eigen value problem for system shown in Figure 2 and then find natural frequencies and mode shapes. $K_1=2$, $K_2=3$, $K_3=4$, $K_4=10\text{N/m}$, $M_1=2$, $M_2=3$ and $M_3=10\text{kg}$ 10



Figure 2

4. a) A uniform beam fixed at one end and simply supported at the other is having transverse vibrations. Derive the suitable expression for frequency. 7
 b) Define stiffness influence coefficient. Determine the influence coefficient of the three degrees of freedom spring mass system as shown in figure 3. 7

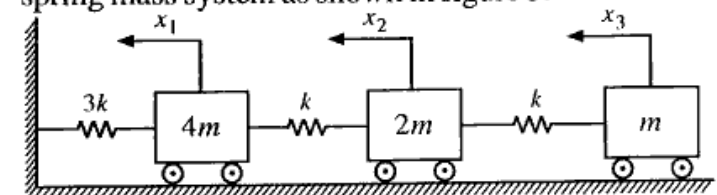


Figure 3

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5. a) Use a one element finite element model to approximate the lowest natural frequency and mode shape for a uniform fixed free beam. 7
- b) A shaft of negligible weight 6cm diameter and 5 meters long is simply supported at the ends and carries four weights 50kg each at equal distance over the length of the shaft. Find the frequency of vibration by Dunkerley's method. Take $E = 2 \times 10^6 \text{ kg/cm}^2$. 7
6. a) What are various sources of non-linearity in a vibration problem? 3
- b) Differentiate between : 4
- i) Sub harmonic and Super harmonic oscillations
- ii) Hard and soft Spring
- c) The non-dimensional form of the nonlinear equation governing the motion of a pendulum is $\ddot{\theta} + \sin \theta = 0$ 7
- i) Derive the general equation defining the phase plane for this motion
- ii) Determine the trajectory for the condition that $\dot{\theta} = 1$ when $\theta = 0$
- iii) What is the maximum angle through which the pendulum will swing?
7. a) Briefly differentiate between : 7
- i) Sample space and an ensemble
- ii) Stationary random and non stationary random process
- iii) Deterministic and non deterministic forcing functions

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- b) How are the mean square value, autocorrelation function and power spectral density function of stationary random process related? Discuss. 7
8. Write short notes on : 14
- a) Torsionally Equivalent shaft
- b) Jump Phenomenon
- c) Perturbation method

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