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

(An Autonomous Institution affiliated to VTU, Belgaum)

Sixth Semester, B.E. - Mechanical Engineering

Semester End Examination; June - 2016

Mechanical Vibrations

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data (if any) may be suitably assumed.

UNIT - I

1 a. Define the following: 6
(i) Periodic motion (ii) Simple harmonic motion (iii) Natural Frequency

b. Obtain the natural frequency for a spring mass system for free vibration by, 8
(i) Newton's method (ii) Energy Method

c. Determine the natural frequency for the free vibrating body shown in Fig.1. 6

2 a. Derive an expression for logarithmic decrement for '*n*' number of cycles. 4

b. The disc of a torsional pendulum has a moment of Inertia of 0.06 kgm^2 and is immersed in a viscous fluid. The brass shaft attached to it is of 100 mm diameter and 400 mm long. When the pendulum is vibrating, the amplitude on the same side for the successive cycles is 9º, 6º and 4º. Determine; 12
(i) Logarithmic decrement (ii) Damping torque at unit velocity
(iii) Periodic time of vibration. Assume G = 4.4x10^{10} N/m^2, what would be the frequency if Disc is removed from the viscous fluid?

c. A torsional pendulum when it is put to vibration in Vacuum without damping has a natural frequency of 100 Hz. But when it is immersed in oil its natural frequency was 50 Hz. Determine the damping factor of oil. 4

UNIT - II

3 a. Derive an expression from magnification factors for a spring mass damper system subjected to forced vibration. 8

b. A mass of 10 kg suspended from one end of helical spring, other end is fixed. The stiffness of spring is 10 N/mm. The vicious damping causes the amplitude to decrease 1/10th of initial value in four complete oscillations. If periodic force of 150cos 50t N is applied at the mass with vertical direction. Find the amplitude of forced vibration. What is its value at resonance? 12

4 a. Explain the terms vibrations isolation and transmissibility ratio. 6

b. A machine of mass one tone is acted upon by an external force of 2450 N at a frequency of 1500 rpm. To reduce the effect of vibration, isolator of rubber having a static deflection of 2 mm under the machine load and an estimated damping factor of 0.2 are used. Determine; 14

Contd…2

i) Force transmitted to the foundation

ii)Amplitude of vibration of the machine

iii) Phase lag of transmitted force with respect to external force.

UNIT - III

5 a. Discuss seismic instrument as a vibrator and an accelerometer. 8

b. A vibration pick up has a natural frequency of 7.5 Hz and a damping factor of 0.5. Determine the lowest frequency beyond which the amplitude can be measured within, 12

(i) 1% error

(ii) 2% error

6 a. Derive an expression for whiling of shaft without air damping. 8

b. A rotor of mass 12 kg mounted midway on a 25 mm diameter horizontal shaft supported at the ends of two bearings. The span between the bearings is 900 mm. Because of some manufacturing defect the cg of the rotor is 0.02 mm away from geometric center of rotor. If the system rotates at 3000 rpm, determine the amplitude of steady state vibrations and the dynamic force on the bearings. Take; E = 200 GPa. 12

UNIT - IV

7. Fig. 2 shows a spring mass system. Determine; 20

(i) Equation of motion

(ii) Frequency equation and natural frequencies of the system

(iii) Modal vectors and mode shapes.

8 a. Explain Dynamic vibration absorber. 6

b. Obtain all the influence coefficients for the triple pendulum shown in Fig. 3. 14

UNIT - V

9. Determine the fundamental natural frequency for the system shown in Fig. 4 using matrix iterations method. 20

10. Determine the natural frequencies of the system shown in Fig. 5 using Holzers method. Given $J_1 = J_2 = J_3 = 1\ kgm^2$, $Kt_1 = Kt_2 = 1$ Nm/rad. 20

Contd…3

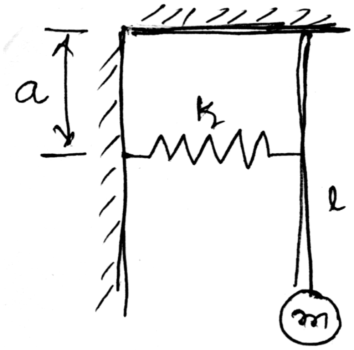

Figure 1
Q. 1 (c)

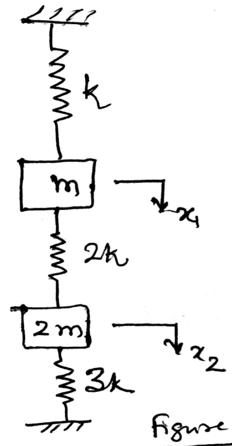

Figure 2 Q. 7

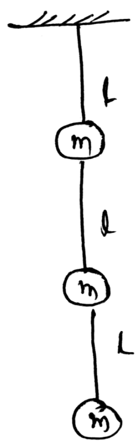

Figure 3 Q 8

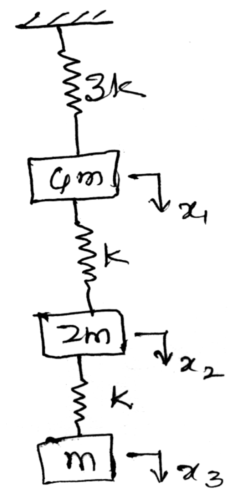

Figure 4
Q. 9

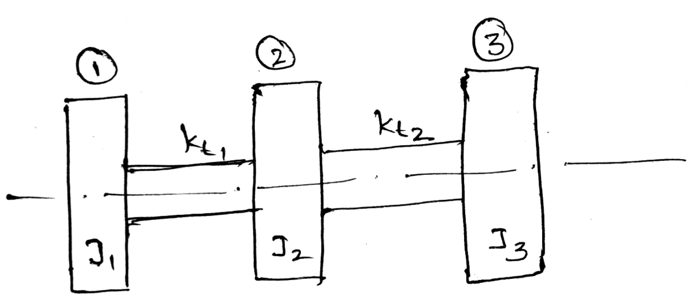

Figure 5 Q. 10

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