Q 8043

M.E. DEGREE EXAMINATION, MAY/JUNE 2006.

Second Semester

Computer Aided Design

CD 1651 — MECHANICAL VIBRATIONS

(Common to M.E. – CAD/CAM and M.E. Engineering Design)

(Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Distinguish between continuous and discrete systems.

2. What are the applications of Duhamel's integral?

3. Differentiate between close coupled and far coupled systems.

4. Define flexural rigidity of a beam.

5. Write the orthogonality principle for a 3 DOF system.

6. What is dynamic matrix?

7. For which type of systems Euler–Bernoulli analysis is adopted?

8. Write the frequency equation in transverse vibration for a uniform beam of length l having one end fixed and other end simply supported.

9. What is passive type dynamic vibration absorber?

10. A vibration pick up has a natural frequency of 4.5 Hz and a damping factor of 0.63. Estimate the lowest frequency that can be measured by this instrument with 2% error.

PART B — (5 × 16 = 80 marks)

11. (i) A sensitive instrument with mass 113 kg is to be installed at a location where the acceleration is 15.24 cm/sec^2 at a frequency of 20 Hz. It is proposed to mount the instrument on a rubber pad with the following properties k = 2803 N/cm and $\zeta = 0.10$. Determine the magnitude of acceleration which is transmitted to the instrument.

(ii) Derive the equation of motion for the system shown in Fig. Q. 11. (ii) determine the following :

(1) Natural frequency of damped oscillation

(2) Critical damping coefficient.

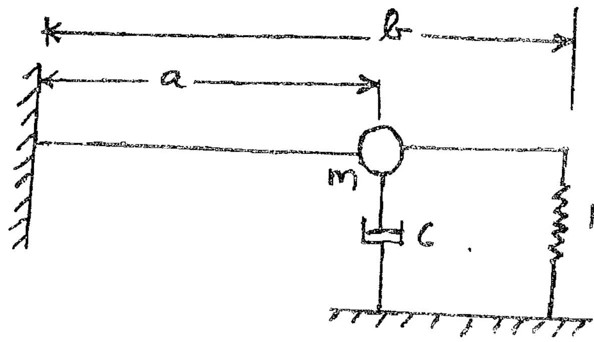

Fig. Q. 11. (ii)

12. (a) Determine the natural frequency of oscillation of the double pendulum as shown in Fig. Q. 12. (a) for the following data $m_1 = m_2 = 5$ kg, $l_1 = l_2 = 250$ mm.

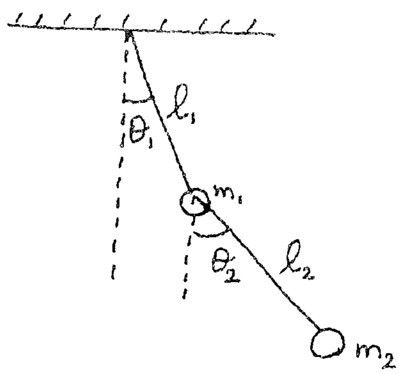

Fig. Q. 12. (a)

Or

(b) A machine of mass 68 kg is mounted on springs of stiffness. 1.1 kN/mm with a damping factor of 0.2. A piston within the machine of mass 2 kg had a reciprocating motion with a stroke of 75 mm and a speed of 3000 rpm. The motion of piston can be taken as SHM. Determine :

(i) amplitude of the machine

(ii) phase angle with respect to the exciting force

(iii) transmissibility

(iv) phase angle of the transmitted force with respect to the exciting force.

13. (a) Estimate the natural frequencies of the following spring–mass system as shown in Fig. 13. (a).

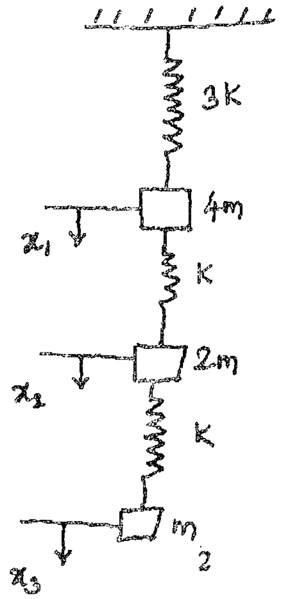

Fig. 13. (a)

Or

(b) A 3 – DOF system is represented by the following equation.

$$m\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}\begin{pmatrix}\ddot{x}_1\\ \ddot{x}_2\\ \ddot{x}_3\end{pmatrix}+k\begin{bmatrix}2 & -1 & 0\\ -1 & 2 & 1\\ 0 & -1 & 1\end{bmatrix}\begin{pmatrix}x_1\\ x_2\\ x_3\end{pmatrix}=0,$$

The three eigen value are $0.44\sqrt{\frac{k}{m}}$, $1.24\sqrt{\frac{k}{m}}$ and $1.8\sqrt{\frac{k}{m}}$ rad/sec.

(i) Determine the modal matrix and modal vectors

(ii) Prove that modal vectors are orthogonal with respect to mass matrix.

14. (a) The tension T in the string with three equal masses attached to it can be assumed to remain constant for small angles of oscillation. If the masses are placed at equal distances apart as shown in Fig. 14. (a)., determine the natural frequencies and the principle modes of vibration of the system.

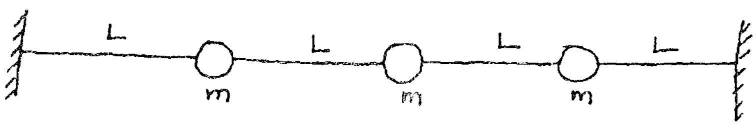

Fig. 14. (a)

Or

(b) (i) Derive the differential equation of motion for the longitudinal vibration of uniform bars. (8)

(ii) Determine the normal modes of transverse vibration of a simply supported beam of length l and uniform cross section as shown in Fig. 14. (b) (ii). (8)

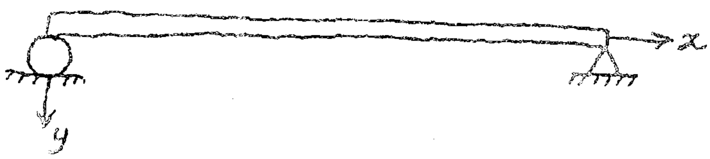

Fig. Q. 14. (b) (ii)

15. (a) Derive the one dimensional wave equation for torsional vibration of a uniform shaft. Also obtain the general solution of the equation.

Or

(b) (i) Explain the various types of vibration transducers and bring out their applications. (8)

(ii) Sketch and explain the construction of a piezo electric accelerometer. (8)
