G 6070

M.E. DEGREE EXAMINATION, MAY/JUNE 2007.

Second Semester

CAD–CAM/Engineering Design/Computer Aided Design/Product Design and Development

CD 1651 — MECHANICAL VIBRATIONS

(Regulation 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Discrete and Continuous Systems.

2. What is meant by equivalent spring stiffness?

3. Define magnification factor of a damped forced vibrating system

4. "There is no relative motion between m_1 and m_2 for a Semi definite system" — Substantiate the statement.

5. List out the demerits of centrifugal vibration absorber.

6. What is the importance of influence coefficients in multi DOF systems?

7. What is the basic difference between Holzer's method and Stodola's method for solving a vibration problem?

8. Differentiate natural boundary condition from geometric boundary condition.

9. What is a contrary to a Deterministic vibrating system?

10. What is the function of an accelerometer?

PART B — (5 × 16 = 80 marks)

11. (a) (i) The characteristic of the dashpot of the following system as shown in Fig. Q. 11(a) (i) is such that when a constant force of 49N is applied to the piston, its velocity is found to be 0.12m/sec. Determine the value of damping factor of the system. Would you expect the complete system to be periodic or aperiodic? (8)

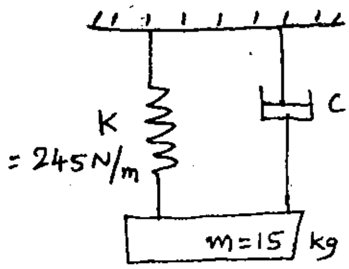

Fig. Q. 11 (a) (i)

(ii) Write the equation of motion and determine the natural frequency of the following system as shown in Fig. Q. 11(a) (ii), if a mass of 10 kg is attached to one end of a weightless rod having a stiffness of 1 kN/m. (8)

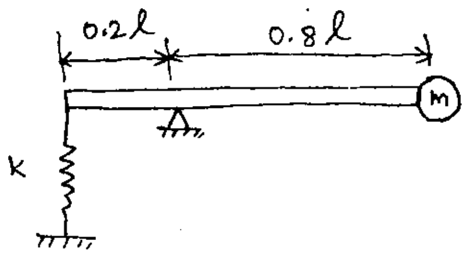

Fig. Q. 11 (a) (ii)

Or

(b) A machine of mass 10 kN is acted upon by an external force of 2450 N at a frequency of 1500 rpm. Effects of vibration is reduced with the help of a rubber isolator having a static deflection of 2 mm under the machine load with an estimated damping of $\varepsilon = 0.2$ are used. Determine

(i) force transmitted to the foundation

(ii) amplitude of vibration and

(iii) the phase lag.

12. (a) (i) Determine the natural frequencies and mode shapes for the following system as shown in Fig. Q. 12 (a) (i), when the string is stretched with an initial tension of T. (10)

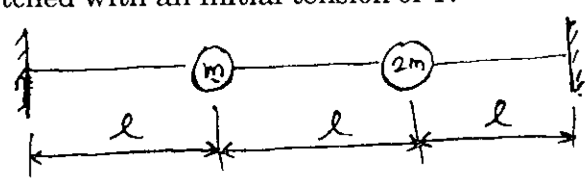

Fig. Q. 12 (a) (i)

(ii) Explain the concept of co-ordinate coupling (6)

Or

(b) (i) Derive the natural frequencies of a semi definite system. (6)

(ii) Determine the equation of motion of the following two DOF system as shown in Fig. Q. 12 (b)(ii) using Lagrange's equation. (10)

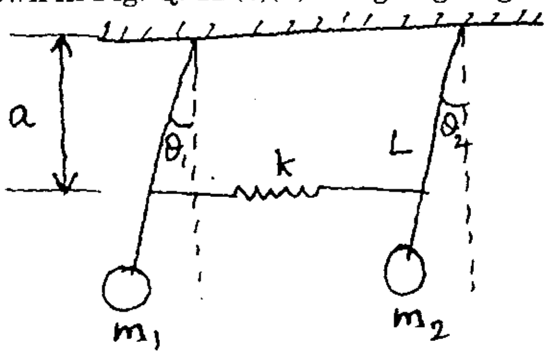

Fig. Q. 12 (b) (ii)

13. (a) (i) Determine the influence coefficients of the system shown in Fig. Q. 13 (a) (i). (8)

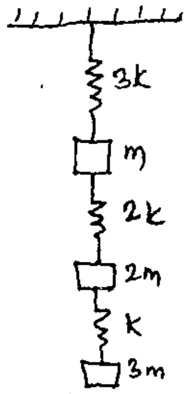

Fig. Q. 13 (a) (i)

(ii) Determine the lower natural frequency of vibration for the following system as shown in Fig. Q. 13 (a) (ii) using Rayleigh's method. (8)

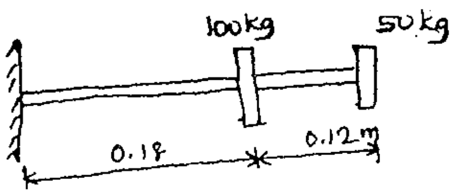

Fig. Q. 13 (a) (ii)

Or

(b) Using matrix method, determine the natural frequency of a standard 3 mass 3 spring vibrating system.

Assume $m_1 = 4$ m; $m_2 = 2$ m; m_3 = m; $k_1 = 3$ k; $k_2 = k_3$ = k.

14. (a) (i) Determine the steady state vibration of a simply supported beam of length L acted upon by a concentrated forcing function $F_0 \sin \omega t$ as shown below in Fig. Q. 14 (a) (i). (8)

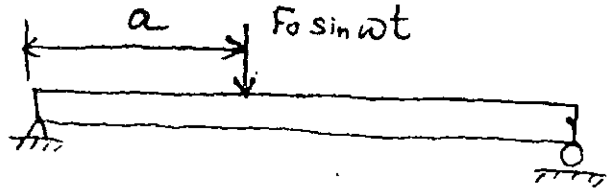

Fig. Q. 14 (a) (i)

(ii) From the basic principles, derive the general solution for lateral vibration of a string. (8)

Or

(b) Using any one of the Numerical iteration procedures, determine the natural frequency of the following vibrating system shown in Fig. Q. 14 (b).

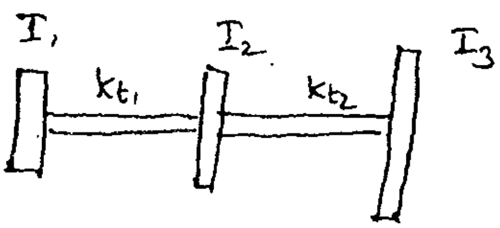

Fig. Q. 14 (b)

15. (a) (i) Explain the role of any two types of vibration exciters in the field of seismic studies. (8)

(ii) With the aid of neat sketches, explain how vibration balancing is done on the air craft wings. (8)

Or

(b) The arrangement of the compressor — Turbine and Generator in a power plant is as shown in Fig. Q. 15 (b). Determine the natural frequencies and mode shape of the system. Stiffness, K_{t1} = 6 MN-m/rad; K_{t2} = 3 MN-m/rad; MI of the compressor, Ic = 18 kg-m^2 MI of the Turbine, It = 14 kg-m^2 MI of the Generator, I_G = 9 kg-m^2. (MI – Moment of inertia)

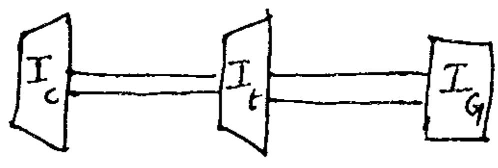

Fig. Q. 15 (b)
