spater

Question Paper Code : 42437

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2010.

Seventh Semester

Aeronautical Engineering

AE 1006 — VIBRATION AND AERO ELASTICITY

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Free vibrations without damping are the result of interaction between the forces of ———— and ————. (Fill in the blanks)

2. Distinguish between periodic and simple harmonic motion.

3. Derive the equivalent spring constant for 2 springs in parallel.

4. Explain D'Alembert's principle considering a simple pendulum undergoing small amplitude oscillations.

5. Define synchronous motion for a multi degree of freedom system.

6. What is the governing differential equation for a shaft undergoing free torsional vibrations?

7. What are vibration mode shapes of a structure?

8. Rayleigh's principle can be applied to (continuous systems alone/discrete systems alone/both continuous and discrete systems). Choose the correct one. Give reason.

9. Classical flutter of an aircraft wing involves interaction between ———— and ———— wing motions. (Fill in the blanks)

10. Tail plane buffeting can be avoided by ————. (Fill in the blanks)

PART B — (5 × 16 = 80 marks)

11. (a) Derive and obtain the governing differential equation for the damped free vibrations of a single degree of freedom system. Then solve the same for the following cases :

(i) overdamping and

(ii) underdamping. When is a system said to be critically damped?

Or

(b) Consider a single degree of freedom spring-mass-damper system subject to a single frequency harmonic excitation. Obtain the steady-state system response. Define the magnification factor and phase angle.

12. (a) Using the energy method, derive and obtain the governing differential equation for the systems shown in Fig. 1 and Fig. 2 and obtain the natural frequencies of the systems.

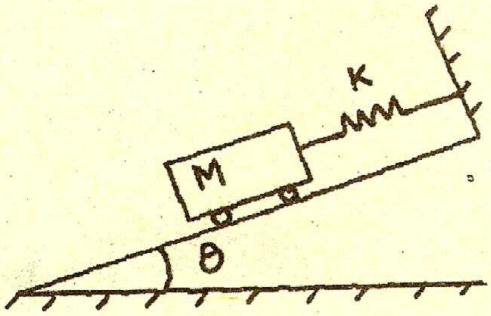

Fig. 1

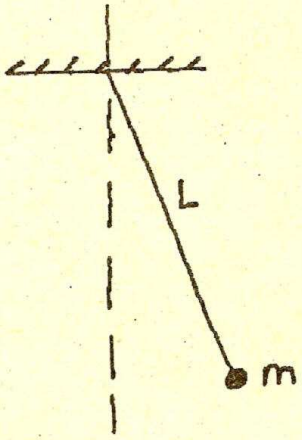

Fig. 2

Or

(b) (i) Explain the working principle of a piezo electric accelerometer. (8)

(ii) What is vibration isolation - why is it sometimes required? (8)

13. (a) Refer Fig. 3. Let $M_1 = 2\ M_2 = 2$ kg, and let $k_1 = 2k_2 = 300$ N/cm. Obtain the natural frequencies and mode shapes of the system, and locate the nodes.

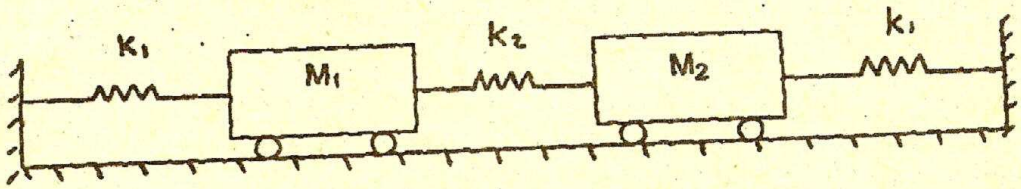

Fig. 3

Or

(b) Derive and obtain expressions for the natural frequencies and mode shapes of a simply-supported beam.

14. (a) Use Lagrange's equations and obtain the equations of motion for the system shown in Fig.3 given earlier. If M_1 alone is given an initial displacement of 1 cm to the right and then released, obtain the equation for the ensuing vibrations.

Or

(b) State Rayleigh's principle. Illustrate Rayleigh's principle using an example of your choice.

15. (a) Consider a 2-D wing with aileron attached. Derive and obtain an expression for the aileron control reversal speed.

Or

(b) Write notes on the following topics :

(i) mass balancing (6)

(ii) wing torsional divergence phenomena. (10)
