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Question Paper Code : 71333

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Sixth Semester

Aeronautical Engineering

AE 6602 — VIBRATIONS AND ELEMENTS OF AEROELASTICITY

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define free, damped and forced vibrations.
2. In what way accelerometer is different from vibrometer?
3. What are static and dynamic couplings?
4. What are meant by orthogonal conditions of eigen vectors?
5. Distinguish between longitudinal, lateral and torsional vibrations.
6. State and explain two important differences between discrete systems and continuous systems.
7. Briefly explain the reasons for preferring Rayleigh-Ritz's method over Rayleigh's method.
8. Using Dunkerley's method find the fundamental frequency of a double pendulum with equal masses and lengths.
9. What is meant by bending torsion coupling?
10. Distinguish between aeroelastic problems and vibration problems.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Derive the expression for logarithmic decrement in terms of damping factor. (6)

(ii) Find the value of the displacement after 3 seconds of a system with parameters m = 2 kg, K = 20 N/cm, C = 4 N sec/cm when it is given an initial displacement of 2 cm and an initial velocity of 1.5 cm/sec. (10)

Or

(b) (i) Derive the expression for transmissibility and also obtain the frequency ratio at which transmissibility is maximum.

(ii) A machine of mass 750 kg is acted upon by an external force of 2000 N at a frequency of 120 rpm. The static deflection of the springs and the damping factor of the supporting systems are 2 mm and 0.2 respectively. Determine the maximum force transmitted to the ground and also the corresponding excitation frequency.

12. (a) (i) Derive the equation of motion for the system shown in Figure 12(a).

(ii) Find the natural frequencies and the normalized eigen vectors for the system shown in Figure 12(a) when $K_1 = 2$ kN/m, $K_2 = 5$ kN/m, $K_3 = 3$ kN/m, $m_1 = 15$kg and $m_2 = 10$kg.

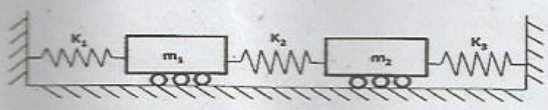

Figure 12(a)

Or

(b) (i) Derive Lagrange's equation and explain each one of the terms in detail. (8)

(ii) Using Lagrange's equation derive the equation of motion for the system shown in figure 12(b) and calculate the natural frequencies when M = 10 kg, m = 2 kg, K = 2 kN/m and I = 20 cm. (8)

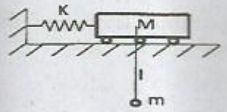

Figure 12(b)

13. (a) (i) Derive the equation of motion for the transverse vibration of beams. (8)

(ii) Using the above equation find the fundamental frequency of a cantilever beam with uniform mass and sectional properties. (8)

Or

(b) (i) Derive the equation of motion for the transverse vibration of a stretched string. (8)

(ii) A uniform weightless string of length L with large initial Tension T is attached with three masses as shown in Figure 13(b). It is displaced through a distance y_0 at its centre at t = 0. Find the equations of motion for the system. (8)

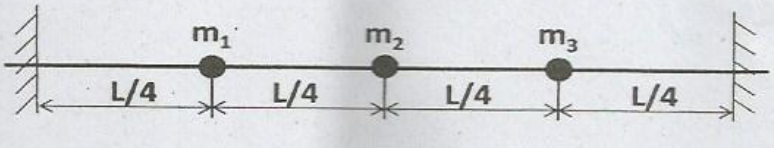

Figure 13(b)

14. (a) Using Rayleigh's method find the fundamental frequency of the simply supported beam shown in Figure 14(a). Assume L = 100 cm mass per unit length of the beam is 0.1kg/cm, E = 210 GPa and moment of inertia I = 25 cm^4.

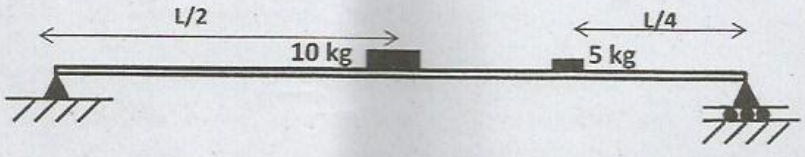

Figure 14(a)

Or

(b) Using matrix iteration find the fundamental frequency of the system shown in Figure 14(b).

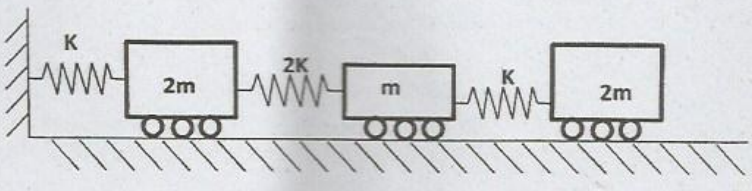

Figure 14(b)

15. (a) Using Collar's triangle explain various aeroelastic phenomena in detail.

Or

(b) Write short notes on :

(i) Support excitation,

(ii) Vibration absorber,

(iii) Hamilton's principle and

(iv) Servo elasticity.
