

B.E. DEGREE EXAMINATIONS: NOV/DEC 2012

Seventh Semester

AERONAUTICAL ENGINEERING

AER141: Vibration and Aero Elasticity

Time: Three Hours

Maximum Marks: 100

Answer All Questions:-

PART A (10 x 1 = 10 Marks)

1. Number of cycles per unit time is called as _____
a) Time period b) frequency c) periodic motion d) amplitude
2. The resistance to the vibrating body is known as
a) continuous system b) discrete system c) damping system d) mechanical system
3. Torsional stiffness of a shaft is given by
a) $\left(\frac{G}{L}\right)\pi\left(\frac{d^4}{32}\right)$ b) $\left(\frac{L}{G}\right)\pi\left(\frac{d^4}{32}\right)$ c) $\left(\frac{L}{G}\right)\pi\left(\frac{d^4}{64}\right)$ d) $\left(\frac{G}{L}\right)\pi\left(\frac{d^4}{64}\right)$
4. Frahm Tachometer is used to measure _____
a) Amplitude b) acceleration c) frequency d) velocity
5. Vibration absorbers are used to
a) increase the amplitude b) decrease the amplitude
c) control the structural resonance d) increase the acceleration
6. The critical damping constant is given by
a) $2m\omega$ b) $4m\omega$ c) $\frac{1}{2} m\omega$ d) $\frac{1}{4} m\omega$
7. Holzer method is used to find the natural frequency of _____ system.
a) Single DOF b) Two DOF c) Multi DOF d) Multi-lumped
8. According to _____ method conservation law of energy is applied to find the natural frequency of the system.
a) Rayleigh's method b) Energy method c) Rayleigh Ritz method d) Holzer method
9. Aileron reversal occurs at
a) Very high speed b) very low speed
c) very high altitude d) very low angle of attack
10. Aileron reversal results if the aileron structure is insufficiently stiff in
a) Bending b) torsion c) both (a) and (b) d) none of the above

PART A (10 x 2= 20 marks)

11. State D'Alembert's principle.
12. Distinguish between periodic and simple harmonic motion.
13. When is a vibratory system said to be critically damped?
14. What do you understand by transient vibration and steady state response?
15. What is logarithmic decrement and how will you find the ratio of successive amplitudes?
16. Define self-excited vibration.
17. Define coordinate coupling.
18. What is meant by influence coefficients?
19. What do you mean by aeroelasticity?
20. What is the effect of flutter in aircraft design?

PART B (5x14=70 Marks)

21. a) (i) Describe simple harmonic motion. (4)
 (ii) Derive necessary expressions and obtain the natural frequency of vibration of a spring mass system (vertical position) using
 (1) Newton's law (2) Energy method (10)

(OR)

- b) (i) Obtain the expressions for the equivalent spring constants of springs when they are set in parallel and in series. (7)
 (ii) Describe about types of damping system. (7)

22. 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:
 (1) over damping (2) under damping.

(OR)

- b) (i) Explain the working principle of a piezo electric accelerometer. (7)
 (ii) What is vibration isolation? Why is it sometimes required? (7)

23. a) Refer Fig.1. Let $M_1 = 2\text{kg}$, $M_2 = 2\text{kg}$ and let $k_1 = 2k_2 = 300\text{ N/cm}$. Obtain the natural frequencies and mode shapes of the system, and locate the nodes.

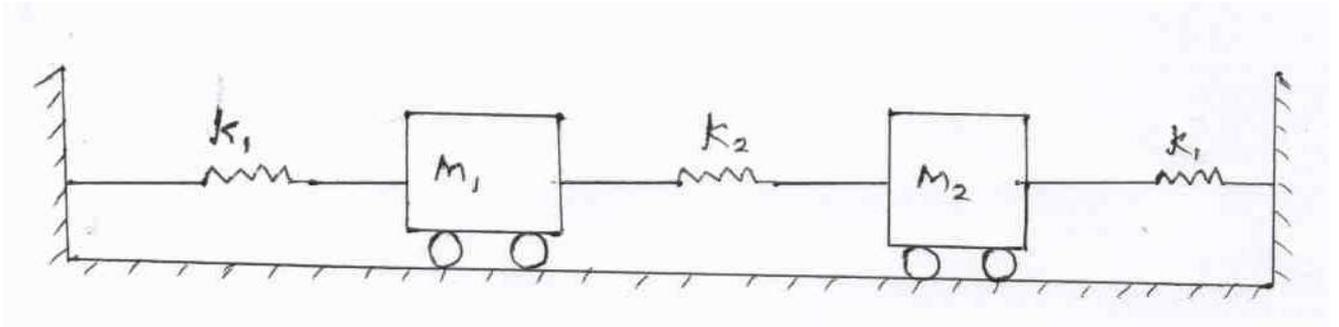


Fig.1

(OR)

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

24. a) State Rayleigh's principle. Illustrate Rayleigh's principle using an example of your choice.

(OR)

- b) Using Holzer method find the natural frequency of the system shown in Fig.2.
Assume $k=1\text{kg/cm}$ and $m=1\text{kg}$.

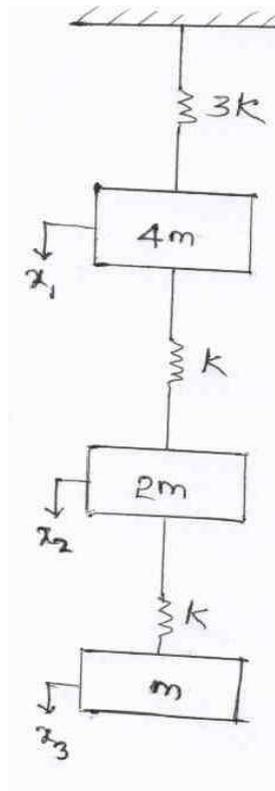


Fig.2

25. a) Write short notes on the following aeroelastic phenomena:

- (i) Loss of aileron control (6)
- (ii) Divergence of a 2d wing (4)
- (iii) Stall flutter (4)

(OR)

- b) (i) Distinguish clearly the phenomena of Resonance and flutter. (7)
- (ii) Explain flutter behaviour from the consideration of extraction of energy from airstream. (7)
