

PART B (5x 2 = 10 Marks)

(Answer not more than 40 words)

11. State D'Alembert's principle. CO1 [K₁]
12. What is the difference between a vibration isolator and a vibration absorber? CO2 [K₁]
13. Consider two harmonic motions of different frequencies: $x_1(t) = 2\cos 2t$ and $x_2(t) = \cos 3t$. CO1 [K₄]
Is the sum $x_1(t) + x_2(t)$ a harmonic motion?
14. A vibrometer having the amplitude of vibration of the machine part as 4 mm and $\xi=0.2$. CO3 [K₄]
Performs harmonic motion. If the difference between the maximum and minimum recorded value is 5mm, determine the natural frequency (in rad/sec) of vibrometer, if the frequency of vibration part is 12 rad/sec.
15. What is meant by static and dynamic coupling? How can you eliminate coupling of the equations of motion? CO5 [K₁]
16. What is a semi definite system? Give two examples of physical systems that are degenerate. CO4 [K₁]
17. The equation of motion for a damped viscous vibration is $3\ddot{x} + 9\dot{x} + 27x = 0$. Find the damping factor. CO5 [K₃]
18. Write the boundary conditions for the lateral vibration of a string having (i) both ends free CO3 [K₂]
(ii) both ends fixed.
19. Draw the aeroelastic collars triangle. CO6 [K₁]
20. Define buffeting. CO6 [K₁]

Answer any Three Questions:-

PART C (5 x 14= 70 Marks)

(Answer not more than 300 words)

Q.No.21 is Compulsory

21. Derive the response of undamped system under harmonic excitation and obtain expression for magnification factor. CO1 [K₂]
22. A mass m of 10 kg traveling with the velocity $v = 50$ m/s strikes and becomes embedded in a massless board supported by a spring of stiffness $k = 6.4 \times 10^4$ N/m in parallel with a dashpot with the coefficient of viscous damping $c = 400$ N.s/m. Determine the time required for the board to reach the maximum displacement and the value of the maximum displacement. CO2 [K₃]



Figure 1

23. Two subway cars of Figure-2 has 2000 kg mass each and are connected by a coupler. The coupler can be modeled as a spring of stiffness k is 280,000 N/m. Write the equation of motion and calculate the natural frequencies and mode shapes. CO5 [K₃]

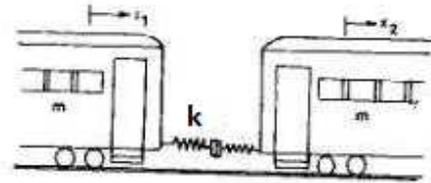


Figure-2

24. Figure-3 shows a vibrating system having two degree of freedom. Determine the two natural frequencies of vibration and the ratio of amplitude of the motion of $m_1 = 1.5$ kg and $m_2 = 0.8$ kg, $k_1 = k_2 = 40$ N/m. CO4 [K₃]

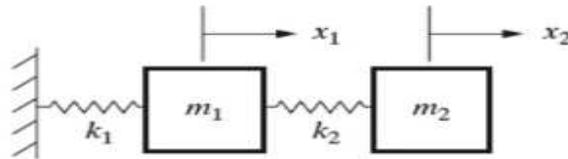


Figure-3

25. Derive the natural frequencies and mode shapes of a simply supported beam. CO3 [K₂]

26. Determine the equation of motion in matrix form, and then calculate the natural frequencies and mode shapes of the torsional system of figure-4. Assume that the torsional stiffness values provided by the shaft are equal ($K_1 = K_2$) and that disk 1 has three times the inertia as that of disk 2 ($J_1 = 3J_2$). CO4 [K₃]

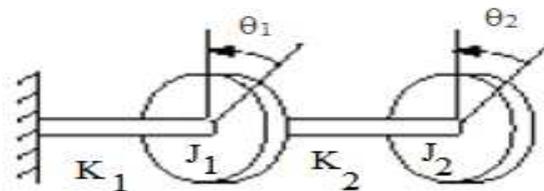


Figure 4.

27. Derive an expression for the divergence speed of a 2D wing. CO6 [K₂]
