

4. Match the following for a system with $m = 1$, $k = 1000 \text{ N/m}$ & $C = 40 \text{ N-sec/m}$ CO1 [K₃]

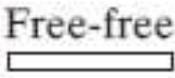
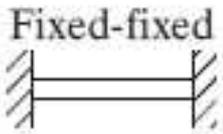
List I	List II
A. Natural frequency	i. 0.63
B. linear frequency	ii. 63.24
C. critical damping constant	iii. 5.03
D. damping ratio	iv. 31.62

- | | A | B | C | D |
|----|-----|-----|-----|----|
| a) | iv | iii | ii | i |
| b) | iii | ii | i | iv |
| c) | ii | iii | iv | i |
| d) | iv | ii | iii | i |

5. The fundamental natural frequency of a system is CO3 [K₂]

- | | |
|----------------------|-----------------------|
| a) The largest value | b) The smallest value |
| c) Any value | d) one |

6. Match the items in the two columns below regarding boundary conditions for uniform shafts subjected to torsional vibration: CO4 [K₂]

End conditions of shaft	Boundary conditions
 <p>A.</p>	(i) $\theta(0, t) = 0$ $\theta(l, t) = 0$
 <p>B.</p>	(ii) $\theta(0, t) = 0$ $\frac{\partial \theta}{\partial x}(l, t) = 0$
 <p>C.</p>	(iii) $\frac{\partial \theta}{\partial x}(0, t) = 0$ $\frac{\partial \theta}{\partial x}(l, t) = 0$

- | | A | B | C |
|----|-----|-----|-----|
| a) | iii | i | ii |
| b) | ii | i | iii |
| c) | ii | iii | i |
| d) | i | iii | ii |

7. Assertion (A): One of the natural frequencies is equal to zero in semi definite system. CO2 [K₂]
Reason (R): The moves as a whole without any relative motion between the two masses.

- | | |
|--|--|
| a) Both A and R are true and R is the correct explanation of A | b) Both A and R are true and R is not the correct explanation of A |
| c) A is true but R is false | d) A is false but R is true |

8. The number of natural frequencies of a continuous system is CO4 [K₂]

- | | |
|----------------|-----------|
| a) Infinite | b) One |
| c) Even number | d) Finite |

9. Which of the following statements are correct? CO5 [K₂]

1. A seismometer is also known as a vibrometer.
2. A spectrum analyzer is a device that analyzes a signal in the frequency domain.
3. Modal analysis is used find natural frequencies.

- | | |
|------------|---------------|
| a) 1 and 2 | b) 2 and 3 |
| c) 3 and 1 | d) 1, 2 and 3 |

10. When a transducer is used in conjunction with another device to measure vibration, it is called a CO5 [K₂]
 a) Vibration sensor b) Vibration pickup
 c) Vibration actuator d) Exciter

PART B (10 x 2 = 20 Marks)

11. A free vibration has a frequency of 10 Hz and its maximum velocity is 4.57 m/s. Find its amplitude, period and maximum acceleration. CO1 [K₃]
12. Define damping ratio and frequency ratio CO1 [K₂]
13. A torsional pendulum has a natural frequency of 200 Hz when vibrating in vacuum having no damping. It is then immersed in oil and its damped natural frequency is found to be 180 Hz. Determine the damping ratio. CO2 [K₂]
14. What is meant by semi definite system? CO2 [K₂]
15. What is a mode shape? How is it computed? CO3 [K₂]
16. State Lagrange s equations. CO3 [K₂]
17. Differentiate the initial conditions from boundary conditions CO4 [K₂]
18. How does continuous system differ from a discrete system in the nature of its equation of motion? CO4 [K₂]
19. Distinguish between the time domain signal and frequency domain signals CO5 [K₂]
20. What are the main specifications of the electro dynamic exciters? CO5 [K₂]

PART C (6 x 5 = 30 Marks)

21. The damped vibration record of a spring – mass - dashpot system shows the following data: CO1 [K₃]
 Amplitude on second cycle = 1.2 cm
 Amplitude on third cycle = 1.05 cm
 Spring constant $k = 8 \text{ kg/cm}$
 Weight on the spring $W = 2 \text{ kg}$
 Determine the damping constant, assuming the viscous damping.
22. Describe the coordinate coupling and principal coordinates CO2 [K₂]
23. Discuss procedure to reduce the undesirable effects of vibration by isolation CO2 [K₂]
24. Explain about the Dunkerley's and Rayleigh's method to find out the fundamental frequency CO3 [K₂]
25. Write down the frequency equation of beam and state the boundary conditions to be specified at the end of the simply supported, free end and fixed end of a beam. CO4 [K₂]

26. Discuss about the vibrometer and accelerometer that how it is useful in vibration measurement CO5 [K₂]

PART D (4 x 10 = 40 Marks)

Answer any FOUR Questions

27. A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kNm has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0.3, determine (a) amplitude caused by the unbalance and its phase angle (b) the transmissibility and (c) the actual force transmitted and its phase angle. CO1 [K₃]
28. Obtain the natural frequencies of the string system shown in the Fig.1. For simplicity take $m_1=m_2=m$ and $l_1=l_2=l_3=l$ CO2 [K₄]

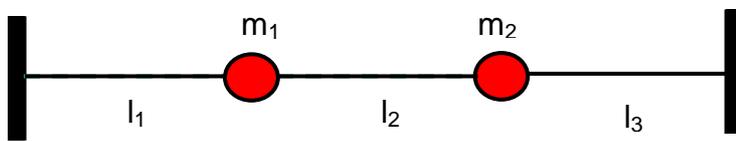


Fig.1 String system

29. Determine the lowest natural frequency and the corresponding mode vibration of the spring mass system shown in Fig.2 using method of matrix iteration. CO3 [K₄]
- Where $k_1 = k$, $k_2 = 2k$, $k_3 = 3k$ and $m_1 = m$, $m_2 = 2m$, $m_3 = 3m$

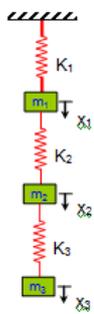


Fig.2

30. Derive the one dimensional wave equation for torsional vibration of a uniform shaft. CO4 [K₄]
Also obtain the general solution of the equation.
31. An accelerometer has a suspended mass of 0.01 kg with a damped natural frequency of vibration of 150 Hz. When mounted on an engine undergoing an acceleration of 1g at an operating speed of 6000 rpm, the acceleration is recorded as 9.5 m/s² by the instrument. Find the damping constant and the spring stiffness of the accelerometer. CO5 [K₄]
