U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: Aerospace Engineering **Duration: 3 hrs.**

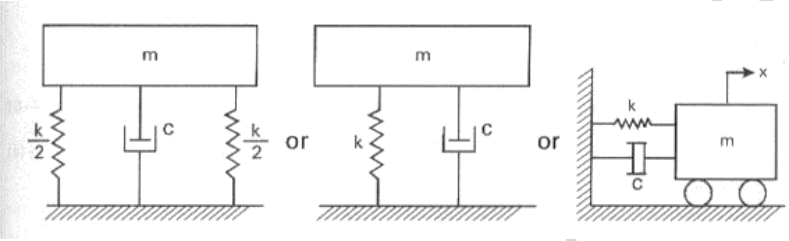
Course Code: 23AS5PCVTA / 22AS5PCVTA **Max Marks: 100**

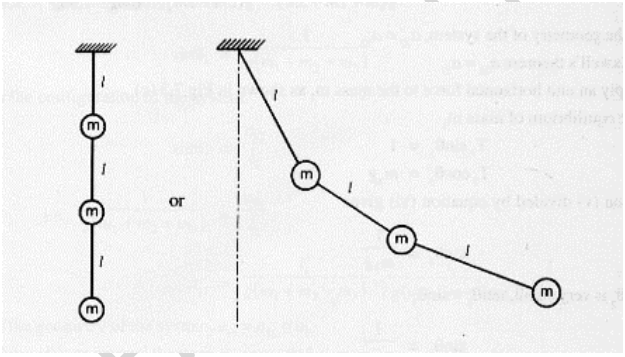
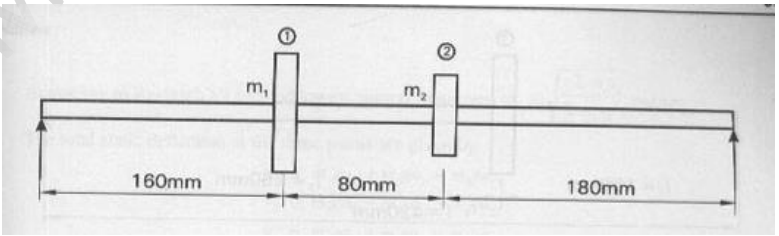
Course: Vibration Theory And Aeroelasticity

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Define i) Phase Difference ii) Degrees of Freedom iii) Simple Harmonic Motion iv) Free and Forced Vibration v) Damped and Undamped Vibrations	*CO1*	*PO1, PO2*	**10**
	b)	Derive an expression for amplitude by adding two simple harmonic motions. Also represent graphically.	*CO1*	*PO1, PO2*	**10**
		OR			
2	a)	With a neat sketch explain the beats phenomenon and obtain its resultant motion.	*CO1*	*PO1, PO2*	**10**
	b)	Add the following harmonics analytically and check the solution graphically. X_1= 2 cos (ωt+ 0.5) X_2= 5 sin (ωt+ 1.0)	*CO1*	*PO1, PO2*	**10**
		UNIT - II			
3	a)	Derive the differential equation of motion and natural frequency of vibration of a spring mass system in vertical position by i) Newton's Method ii) Energy Method	*CO2*	*PO1, PO2*	**10**
	b)	A block of mass 0.05 kg is suspended from a spring having stiffness of 25 N/m. the block is displaced downwards from its equilibrium position through a distance of 2 cm and released with an upward velocity of 3 cm/sec. Determine i) Natural Frequency ii) Period of Oscillation iii) Maximum Velocity iv) Maximum acceleration v) Phase Angle	*CO2*	*PO1, PO2*	**10**
		OR			
4	a)	Derive an expression for natural frequency of torsional vibration by newton method.	*CO2*	*PO1, PO2*	**10**

		b)	An instrument panel of natural period 0.1 seconds is excited by a step function 0.5 cm magnitude for a period of 0.075 second. Determine the response of the system.	*CO2*	*PO1, PO2*	**10**
			UNIT - III			
	5	a)	Derive the Logarithmic decrement equation by formulating the under damped system.	*CO2*	*PO1, PO2*	**10**
		b)	A machine of mass 20 kg is mounted on spring and dash pot as shown in fig.Q5b. The total spring stiffness is 10 N/mm and the total damping is 0.15 N/mm/sec. If the system is initially at rest and a velocity of 100 mm/sec is imparted to the mass, then determine i) Displacement and velocity of mass as a function of time ii) Displacement and velocity at time equal to one second  Fig.Q.5b	*CO2*	*PO1, PO2*	**10**
			OR			
	6	a)	Vibrating system consisting of a mass of 50 kg, a spring of stiffness 30 kN/m and a damper. Damping is 20% of the critical value. Determine i) Damping Factor ii) Critical Damping Coefficient iii) Logarithmic Decrement iv) Ratio of Two Consecutive Amplitudes v) Natural Frequency of Free Vibration vi) Natural Frequency of Damped Vibration.	*CO2*	*PO1, PO2*	**10**
		b)	A mass of 7.5 kg hangs from a spring and makes damped oscillations. The time for 60 oscillations is 35 secs and the ratio of first to seventh displacement is found to be 2.5. find i) Stiffness of Spring ii) Damping Resistance iii) If the oscillations were critically damped what is the damping resistance.	*CO2*	*PO1, PO2*	**10**
			UNIT - IV			
	7	a)	Define transmissibility and derive an expression for the transmissibility ratio and the phase angle for transmitted force.	*CO3*	*PO1, PO2*	**10**
		b)	A mass of 10 kg suspended from one end of helical spring, the other end is fixed. The stiffness of spring is 10 N/mm. The viscous damping causes the amplitude to decrease $1/10^{th}$ of initial value is four complete oscillations. If a periodic force of 150 Cos 50 t N at	*CO3*	*PO1, PO2*	**10**

			the mass with vertical direction. Find the amplitude of forced vibration. What is its value at resonance.			
			OR			
	8	a)	Explain briefly vibrometer and accelerometer.	*CO3*	*PO1, PO2*	**10**
		b)	A vibration picks up has a natural frequency of 7.5 Hz and a damping factor of 0.5. Determine the lowest frequency beyond which the amplitude can be measured within (i) 1% error (ii) 2% error.	*CO3*	*PO1, PO2*	**10**
			UNIT - V			
	9	a)	Derive the equation of wing divergence speed.	*CO4*	*PO1, PO2*	**10**
		b)	What is aeroelasticity? Classify. Explain collars triangle or aero elasticity tetrahedron.	*CO4*	*PO1, PO2*	**10**
			OR			
	10	a)	Determine the influence coefficients of a triple pendulum shown in the figure 10a.  Fig.10a	*CO4*	*PO1, PO2*	**10**
	10	b)	Find the lowest natural frequency of transverse vibrations of the system shown in the figure by Rayleigh's method. Take E = 196 GPa, I=10^{-6} m^4, m_1=40 kg, m_2 = 20 kg.  Fig.10b	*CO4*	*PO1, PO2*	**10**

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