U.S.N.										

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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

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

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

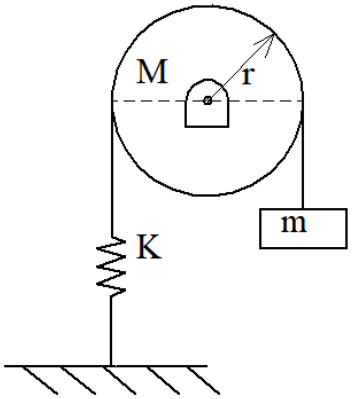
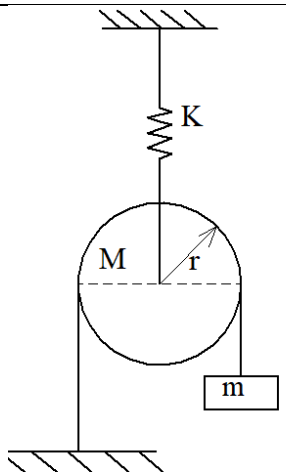
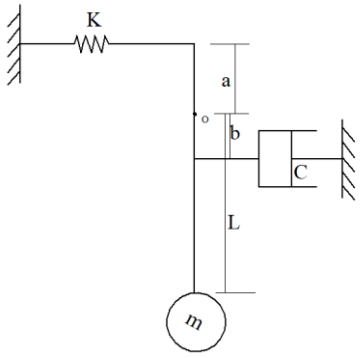
Course Code: 23AS5PCVTA / 22AS5PCVTA / 20AE5DCVTA **Max Marks: 100**

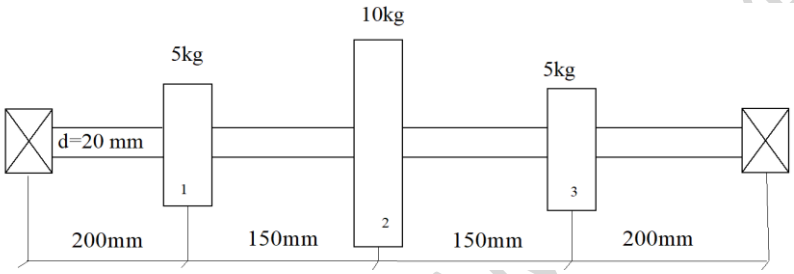
Course: Vibration Theory and Aeroelasticity

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)	With a neat sketch explain the beats phenomenon and obtain its resultant motion.	*CO1*	*PO1*	**10**
	b)	Add the following harmonics analytically and check the solution graphically. $X_1 = 2\cos(\omega t + 0.5)$ $X_2 = 5\sin(\omega t + 1.0)$	*CO1*	*PO2*	**10**
		OR			
2	a)	Describe the various types of vibrations with suitable examples? Also, discuss the role of damping and stiffness in managing the vibrations of mechanical systems.	*CO1*	*PO1*	**10**
	b)	Add the following harmonics analytically and check the solution graphically. $x_1 = 3\sin(\omega t + 30^o)$ $x_2 = 4\cos(\omega t + 10^o)$	*CO1*	*PO2*	**10**
		UNIT - II			
3	a)	Determine natural frequency of simple pendulum system i) neglecting mass of the rod ii) considering mass of the rod.	*CO2*	*PO1*	**10**
	b)	The sphere of mass M and radius r rolls without slip on a circular or cylindrical surface of radius R. Determine the natural frequency of oscillation when the cylinder is displaced slightly from its equilibrium position.	*CO2*	*PO2*	**10**
		OR			
4	a)	Determine natural frequency for the system shown in Figure 4a.	*CO2*	*PO2*	**10**
	b)	Obtain the equation for natural frequency for the system shown in Figure 4b.	*CO2*	*PO2*	**10**

			 Figure 4a	 Figure 4b		
			UNIT - III			
5	a)	Obtain the response equation for Under damped case of damped free vibrations system.	*CO3*	*PO2*	**10**
	b)	A gun barrel having mass 900 kg is designed with the following data; Initial recoil velocity 25 m/sec, recoil distance on firing 1.5m. Calculate (a) spring constant (b) damping coefficient and (c) time required for the barrel to return to a position 0.15 m from its initial position, if the time for recoil is 1/4th of time period.	*CO3*	*PO2*	**10**
		OR			
6	a)	Derive response equation for over damping case of SDOF MSD system.	*CO3*	*PO2*	**10**
	b)	Obtain the damped natural frequency of the system shown in the Figure 6b.  Figure 6b	*CO3*	*PO2*	**10**
		UNIT - IV			
7	a)	Define transmissibility. With usual notations, obtain expression for motion transmissibility and phase lag for system with base excitation. With the help of response curve, recommend the condition for vibration isolation.	*CO4*	*PO2*	**10**

		b)	A machine of total mass 17 kg is mounted on springs having stiffness k=11,000 N/cm. A piston within the machine has a mass of 2 kg has a reciprocating motion with stroke 7.5 cm and speed 6000 rpm. Assume the motion to S.H.M determine Amplitude of the machine ii) Transmissibility iii) Force transmitted to the ground. Take ξ=0.2.	*CO4*	*PO2*	**10**
			OR			
	8	a)	With the help of amplitude ratio vs frequency ratio response curve, write short note on vibrometer and accelerometer.	*CO4*	*PO2*	**10**
		b)	Explain with the neat sketches of frahm and fullarton tachometer.	*CO4*	*PO1*	**10**
			UNIT - V			
	9		Determine the natural frequency of 3 rotor system shown in Figure 9 using Rayleigh's method. Assume E= 210GPa.  Figure 9	*CO4*	*PO2*	**20**
			OR			
	10	a)	What is aeroelasticity? Classify. Explain collars triangle or aero elasticity tetrahedron.	*CO4*	*PO1*	**10**
		b)	Write a short note on i) Fluttering ii) Servo elasticity	*CO4*	*PO2*	**10**

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