U.S.N.										

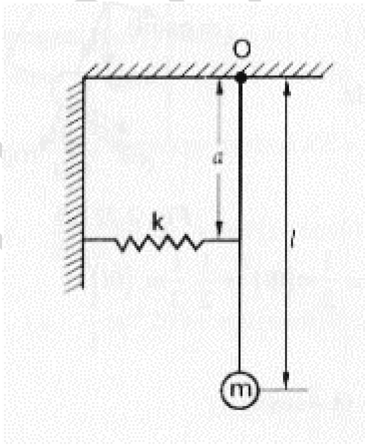
B.M.S. College of Engineering, Bengaluru-560019

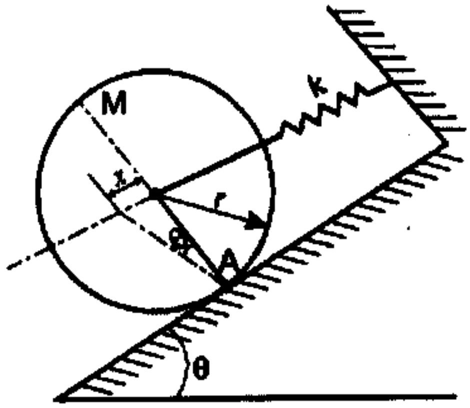
Autonomous Institute Affiliated to VTU

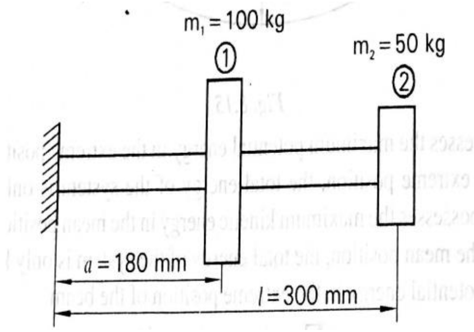
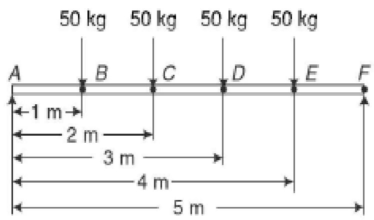
July 2024 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code: 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.

		UNIT - I	*CO*	*PO*	Marks
	a)	Add the following harmonic motions analytically and check the solution graphically. $X_1 = 4\cos(\omega t + 10^0)$; $X_2 = 6\sin(\omega t + 60^0)$	*CO1*	*PO2*	**10**
	b)	With a neat sketch explain the beats phenomenon and obtain its resultant motion.	*CO 1*	*PO 2*	**10**
		UNIT - II			
2	a)	Determine the equation of motion and natural frequency of the system shown in figure 2a below.  Figure 2a	*CO 1*	*PO2*	**05**
	b)	Analyze the vibratory system having a sphere of radius, r and mass, m rolls without slipping on aspherical surface of radius, R and arrive an expression for time period of oscillation	*CO 1*	*PO2*	**10**
	c)	A homogenous solid cylinder of mass M is linked by a spring of constant k N/m and is resting on an inclined plane as shown in figure 2c. If it rolls without slipping show the frequency of oscillation is sqrt.(2k / M) rad/sec.	*CO 1*	*PO2*	**05**

			 Figure 2c			
			UNIT - III			
	3	a)	Setup the differential equation for a spring mass damper system and obtain the complete solution for the underdamped conditions.	*CO 2*	*PO2*	**10**
		b)	A spring-mass-dashpot system is given an initial velocity of $X\omega_n$, where ω_n is the undamped natural frequency of the system. Find the equation of motion for the system when (i) $\xi = 2.5$ (ii) $\xi = 1$(iii) $\xi = 0.5$	*CO 2*	*PO3*	**10**
			UNIT - IV			
	4	a)	Define the magnification factor. With usual notations, obtain an expression for magnification factor and phase lag for spring mass damper system subjected to harmonic excitation	*CO 3*	*PO2*	**10**
		b)	A single cylinder vertical petrol engine of total mass 320kg is mounted upon steel chassis and causes a vertical static deflection of 2mm. The reciprocating parts of the engine have a mass of 24kg and move through a vertical stroke of 150mm with simple harmonic motion. A dashpot attached to the system offers a resistance of 490 N at a velocity of 0.3 m/s. Determine i) The speed of driving shaft at resonance The amplitude of steady state vibration when the driving shaft of the engine rotates at 480 rpm.	*CO 3*	*PO3*	**10**
			OR			
	5	a)	Explain the principle of “Seismic” instrument and analyze how it can be used to measure displacement and acceleration of a vibrating body	*CO 3*	*PO2*	**10**
		b)	A vibrometer gives a reading of relative displacement 0.5 mm. the natural frequency of vibration is 600 rpm and the machine runs at 200 rpm. Determine the magnitude of displacement, velocity and acceleration of the vibrating machine part.	*CO 3*	*PO3*	**10**
			UNIT - V			
	6	a)	Derive an expression for the divergence of wing assuming wing is rigid.	*CO 4*	*PO 2*	**10**

		b)	Explain the aeroelasticity with block diagram and collars triangle.	*CO 4*	*PO 1*	**10**
			OR			
	7	a)	Find the lowest natural frequency of vibration for the system shown in fig 7a by Rayleigh's method, Take $E=1.96x10^{11}$ N/m^2, $I=4x10^{-7}$ m^4  Figure 7a	*CO 4*	*PO3*	**10**
		b)	A shaft of negligible weight, 6cm diameter and 5m length, is simply supported at the ends and carries four weights of 50kg each at equal distance over the length of the shaft as shown in figure 7b. Find the frequency of vibration by using Dunkerley's method. Take E = 210 GPa.  Figure 7b	*CO 4*	*PO3*	**10**

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