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 / VI**

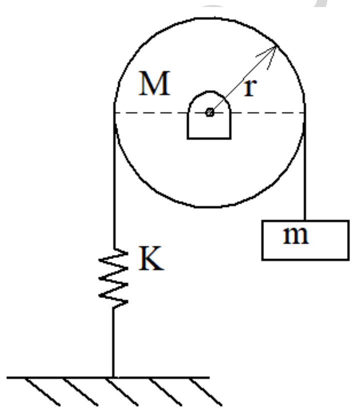
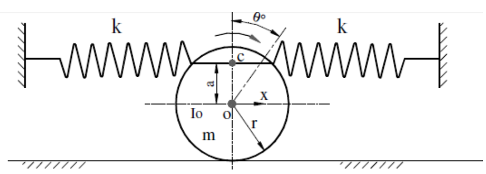
Branch: Mechanical Engineering **Duration: 3 hrs.**

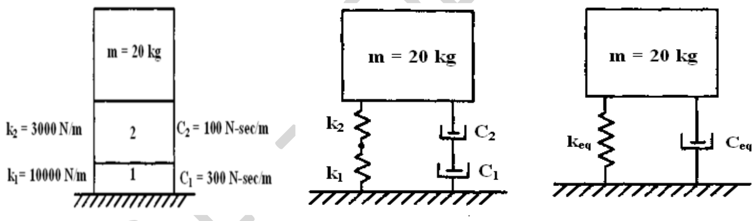
Course Code: 23ME5PCMEV /22ME6PCMEV/ 20ME6DCMEV **Max Marks: 100**

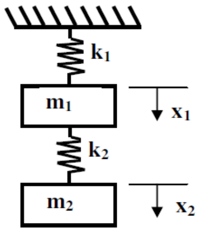
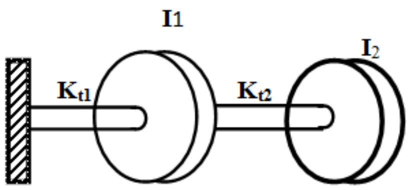
Course: Mechanical Vibrations

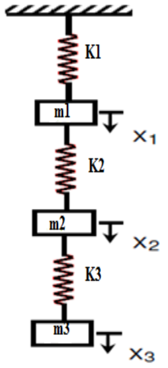
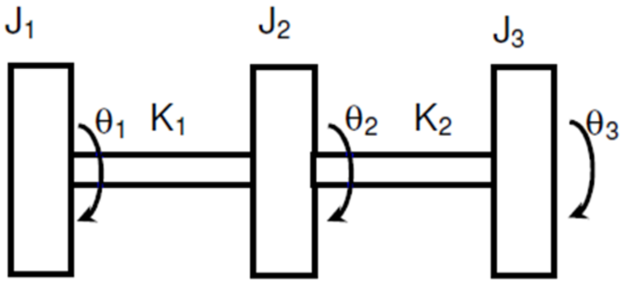
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

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 the following i) Simple harmonic Function ii) Resonance iii) Degrees of Freedom iv) Natural frequency v) Damping	CO1	PO1	**10**
	b)	Determine the natural frequency of the system shown in figure 1b.  Figure 1(b)	CO1	PO2	**10**
		OR			
2	a)	What are the causes and effects of vibration	CO1	PO1	**08**
	b)	A cylinder of mass *m* and mass moment of inertia is free to roll without slipping but is restrained by two springs of stiffness K, as shown in Fig.2(b). Find its natural frequency of vibration.  Fig2(b)	CO1	PO2	**12**

			UNIT - II			
	3	a)	Define a logarithmic decrement and show that it can be expressed as $\delta = 1/n \log[x_0/x_n]$, where ‘n’ is the number of cycles, x_0 is the initial amplitude and x_n is the amplitude after ‘n’ cycle.	*CO2*	*PO1*	**08**
		b)	A horizontal shaft is fixed at both ends and carries a flywheel at the middle. The shaft is 1 m long either side of the flywheel and is 10 mm diameter. The flywheel has a moment of inertia of 1.9 kg-m^2. The system has proportional damping and it is observed that the amplitude reduces by 60% after one oscillation. The shaft material has a modulus of rigidity of 90 GPa Calculate the following. i. The damping ratio. ii. The natural frequency. iii. The damped natural frequency. iv. The spring stiffness. v. The critical damping coefficient. vi. The damping coefficient	*CO2*	*PO2*	**12**
			OR			
	4	a)	A mass of 20kg is supported on two isolators as shown in fig.4(a). Determine the undamped and damped natural frequencies of the system, neglecting the mass of the isolators.  Fig4(a)	*CO2*	*PO2*	**08**
		b)	A gun barrel of mass 500kg has a recoil spring of stiffness 3,00,000 N/m. If the barrel recoils 1.2 meters on firing, determine. (a) initial velocity of the barrel (b) critical damping coefficient of the dashpot which is engaged at the end of the recoil stroke (c) time required for the barrel to return to a position 50mm from the initial position.	*CO2*	*PO2*	**12**
			UNIT - III			
	5	a)	Derive an expression for transmissibility ratio as applicable to force excited system.	*CO3*	*PO2*	**10**
		b)	A 75 kg machine is mounted on springs of stiffness k=11.76×106 N/m with a damping factor of 0.2. A 2 kg piston within the machine has a reciprocating motion with a stroke of 0.08 m and a speed of 3000cpm. Assuming the motion of the piston to be harmonic, determine the amplitude of vibration of machine and the vibratory force transmitted to the foundation.	*CO3*	*PO2*	**10**

			OR			
	6	a)	Derive an equation for magnification factor for SDOF spring-damper-mass system using graphical method.	*CO3*	*PO2*	**10**
		b)	A machine part of mass 4 kg vibrates in a viscous medium. A harmonic exciting force of 40 N acts on the machine and causes a resonant amplitude of 15 mm with a period of 0.2 second. Determine the damping coefficient. If the system is excited by a harmonic force of frequency 4 Hz. What will be the percentage increase in the amplitude of forced vibration when damper is removed.	*CO3*	*PO2*	**10**
			UNIT - IV			
	7	a)	Write a note on: i. Semi definite system ii. Normal mode of vibration	*CO4*	*PO1*	**06**
		b)	Obtain the frequency equation for the system shown in Figure 7(b). Also determine the natural frequencies and mode shapes when $k_1 = 2k$, $k_2 = k$, $m_1 = m$ and $m_2 = 2m$.  Fig7(b)	*CO4*	*PO2*	**14**
			OR			
	8	a)	Explain the principle of dynamic vibration absorber. What is the disadvantage of such an absorber?	*CO4*	*PO1*	**08**
		b)	Determine the natural frequencies and mode shapes of the torsional system shown in figure. Take $I_1 = I$, $I_2 = 2I$ and $K_{t1} = K_{t2} = K$  Fig8(b)	*CO4*	*PO2*	**12**
			UNIT - V			
	9	a)	Derive the Maxwell reciprocal theorem of multi DOF System	*CO5*	*PO1*	**08**
		b)	Estimate the approximate fundamental natural frequency of the system shown in Fig.9(b)using Rayleigh's method. Take: m=1kg and K=1000 N/m., K_1=2k, k_2=k, K_3=K M1=2m, m2=2m, m3=m	*CO5*	*PO2*	**12**

			 Fig9(b)			
			OR			
	10		For the system shown in the Fig.10(b) obtain natural frequencies using Holzer’s method  Fig10(b)	*CO5*	*PO2*	**20**

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