Model Question Paper-1 with effect from 2020-21 (CBCS Scheme)

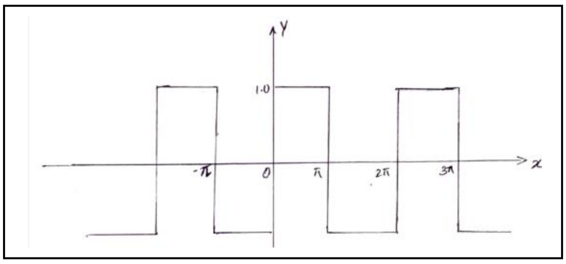
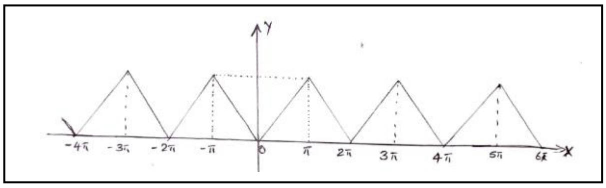
USN

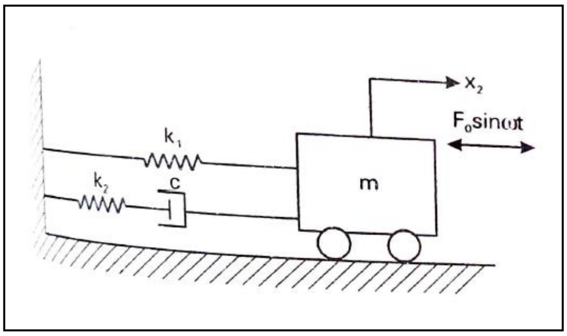
Fifth Semester B.E. Degree Examination

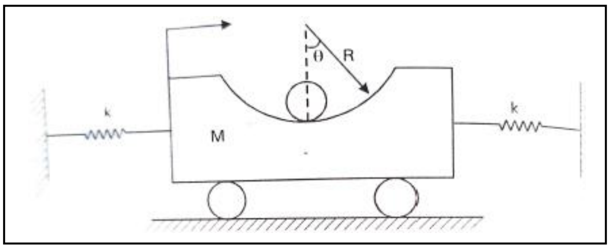
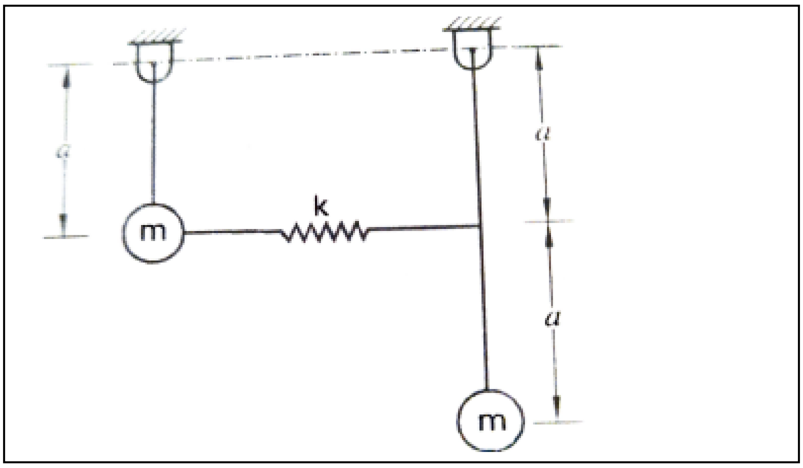
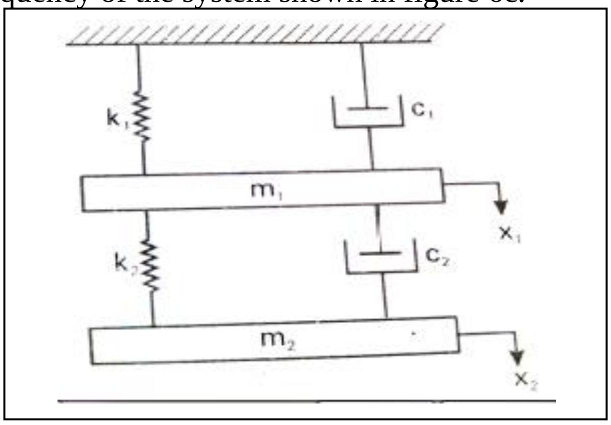
Theory of vibrations

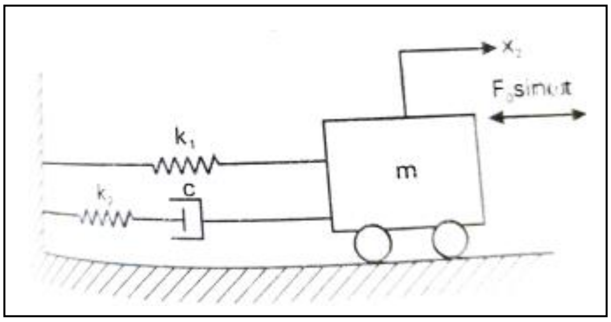
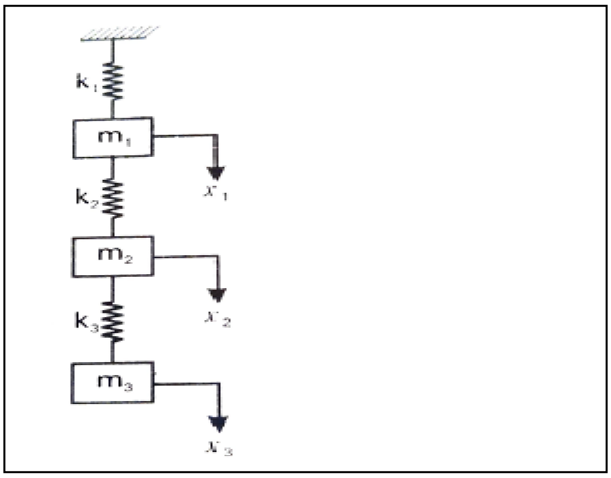
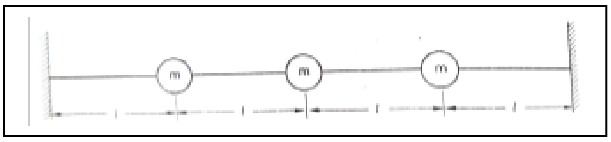
TIME: 03 Hours **Max. Marks: 100**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

		Module –1	**Marks**
Q.1	**(a)**	Add the following harmonic motions analytically and check the solution graphically, X1=4cos(wt+20) X2=7sin(wt+45)	10
	(b)	Find the Fourier series expansion for the shown figure 1b.  figure 1b	10
	(c)	Define and explain following terms: i) Natural frequency ii) Degree of freedom iii) SHM iv) resonance v) phase difference	10
		OR	
Q.2	**(a)**	Split the harmonic motion X=5cos(wt+π/4) into two harmonic motions one having phase of zero and the other of 60degree.	10
	(b)	Find the Fourier series for the saw-tooth curve as shown in figure2a.  figure 2a	10
	(c)	Determine the natural frequency of a compound pendulum.	10
		Module – 2	
Q.3	**(a)**	Define logarithmic decrement and show that it can be expressed as δ=1/nlog(x 0 /x 1), where 'n' cycles, x 0 is the initial amplitude and x n is the amplitude after 'n' cycles.	10
	(b)	A mass of 8kg hanged from a spring and makes damped oscillations. The time for 70 oscillations is 40secs and the ratio of 1 st to 8 th displacement is found to be 3. Find i)stiffness of spring ii) damping resistance iii) if oscillation were critically damped	10

		what is the damping resistance.	
	(c)	Determine the natural frequency of a spring mass system, where the mass of the spring is taken into account.	10
OR			
Q.4	**(a)**	Determine the natural frequency of a simple pendulum i) Neglecting the mass of rod ii) Considering the mass of rod	10
	(b)	A spring mass damper system has m=3.5kg, K= 100N/m, c=3N-s/m. determine i) damping factor, ii) natural frequency of damped vibration, iii) logarithmic decrement, iv) the ratio of 2-successive amplitudes.	10
	(c)	Determine the natural frequency of a spring mass system, where the mass of the spring is taken into account.	10
Module – 3			
Q.5	**(a)**	Find the response of the system of figure 5a to a sinusoidal excitation as shown in the figure.  figure 5a	10

	(b)	Explain the basic working principle of dynamic vibration absorber.	10
	(c)	Derive the equation of motion of the system shown in figure5c. The circular cylinder has a mass 'M', radius r, and rolls without slipping inside the circular groove of the radius R. Use Lagrange's equation.  figure 5c	10
OR			
Q.6	(a)	Explain with a sketch vibration absorber.	10
	(b)	Derive the differential equation of motion for small oscillation of the pendulum as shown in figure 6b .Assume rods are rigid and of negligible mass.  figure 6b	10
	(c)	Find the natural frequency of the system shown in figure 6c.  figure 6c	10
Module – 4			
Q.7	(a)	What do you understand by critical speed of shafts? Derive the necessary relations and thus, explain what is happening in the system carrying a shaft carrying an unbalanced disc at its centre is operated above and below its critical speed.	10
	(b)	A horizontal shaft 15mm diameter and 1m long is held on simply supported bearings.	10

		The weight of the disk at the mid span is 15kg, the eccentricity of the center of gravity of the disk from the center of rotor is 0.3mm. the Young's modulus of shaft is 200MPa. Find the critical speed of the shaft.	
	(c)	Find the response of the system of figure 7c to a sinusoidal excitation as shown in figure 7c.  figure 7c	10
OR			
Q.8	**(a)**	A rotor having a mass of 5kg is mounted mid-way on 1cm dia shaft supported at the ends by two bearings. The bearing span is 40cm. because of certain manufacturing in accuracy, the C.G of the disc is 0.02mm away from the geometric centre of the rotor. If the system rotates at 3000RPM, find the amplitude of steady state vibrations and the dynamic force transmitted to the bearings. Neglect damping and the weight of the shaft material. Assume E= 1.96*10^11N/m^2 for shaft material.	10
	(b)	Discuss general theory of seismic instruments and obtain the condition for using it as a vibrometer.	10
	(c)	Explain the term whirling or critical speed of a shaft. Prove that the whirling speed for a rotating mass is same as the frequency of natural transverse vibration.	10
Module – 5			
Q.9	**(a)**	State and proof Maxwell reciprocal theorem. Explain Dunkerley's method.	10
	(b)	Figure 9b shown a system subjected to vibration. Find an expression for the natural Frequency, locate the mode and draw mode shapes.  Figure 9b	10
	(c)	Determine the natural frequency of the system shown in figure 9c using stodola's method.  figure 9c	10
OR			

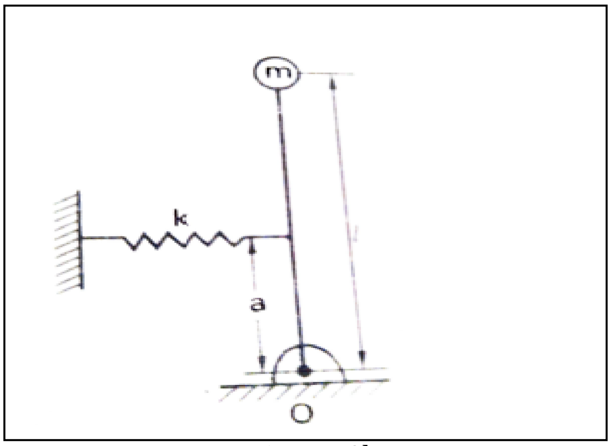
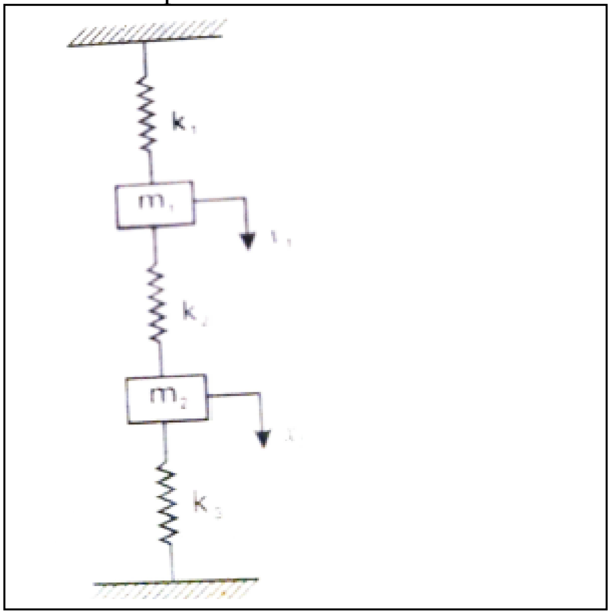
Q.10	(a)	Explain the following: i) Co-ordinate coupling ii)Orthoganality principle and iii)Influence co-efficients.	10
	(b)	Figure10b shows a pendulum. Determine the natural Frequencies of the system, assuming the spring is unstreched and the pendulums are vertical in the equilibrium position.  Figure10b	10
	(c)	Figure 10c shows a spring mass system. Determine i) equation of motion, ii) frequencies equation and natural frequencies of the system, iii) modal vectors and mode shapes.  Figure 10c	10

Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome				
Question		**Bloom's Taxonomy Level attached**	**Course Outcome**	**Programme Outcome**
Q.1	(a)	L_1	CO1	PO1
	(b)	L_1	CO1	PO1
	(c)	L_1	CO1	PO1
Q.2	(a)	L_1	CO1	PO1
	(b)	L_1	CO1	PO1
	(c)	L_2	CO1	PO1
Q.3	(a)	L_2	CO1	PO1
	(b)	L_2	CO1	PO1
	(c)	L_2	CO1	PO1
Q.4	(a)	L_2	CO2	PO8
	(b)	L_2	CO2	PO8
	(c)	L_2	CO2	PO8
Q.5	(a)	L_3	CO2	PO8
	(b)	L_3	CO2	PO8
	(c)	L_2	CO2	PO2
Q.6	(a)	L_2	CO2	PO2
	(b)	L_2	CO2	PO2
	(c)	L_3	CO2	PO2
Q.7	(a)	L_3	CO3	PO2
	(b)	L_3	CO3	PO2
	(c)	L_3	CO3	PO2
Q.8	(a)	L_3	CO3	PO2
	(b)	L_3	CO3	PO2
	(c)	L_3	CO3	PO2
Q.9	(a)	L_4	CO3	PO8
	(b)	L_4	CO3	PO8
	(c)	L_4	CO3	PO8
Q.10	(a)	L_4	CO3	PO8
	(b)	L_4	CO3	PO8
	(c)	L_4	CO3	PO8

Bloom's Taxonomy Levels	**Lower order thinking skills**		
	Remembering(knowledge):L_1	Understanding Comprehension): L_2	Applying (Application): L_3
	Higher order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6

Model Question Paper-1 with effect from 2020-21 (CBCS Scheme)

USN | | | | | | | | | |

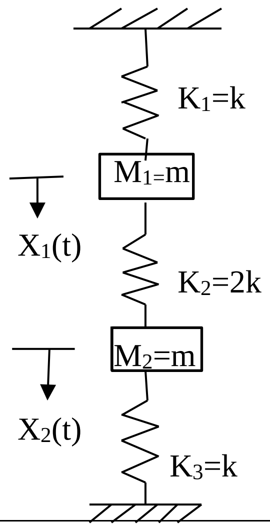
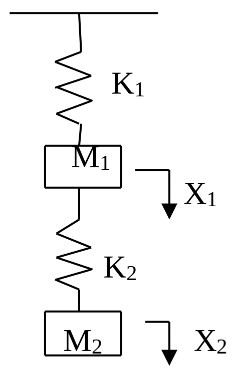
Fifth Semester B.E. Degree Examination
Theory of Vibrations

TIME: 03 Hours **Max. Marks: 40**

Note: 01. Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

Q. No		Module- 1	Marks
Q.1	(a)	The parameters of a single-degree-of-freedom system are given by m = 1 kg, c = 5 N-s/m, and k = 16 N/m. Find the response of the system for the following initial conditions: **(a)** $x(0)$ = 0.1 m and $\dot{x}(0)$ = 2 m/s **(b)** $x(0)$ = -0.1 m and $\dot{x}(0)$ = 2 m/s	12M
	(b)	Derive an Equation of motion of a spring- Mass- damper system for Free damped vibration.	8M
		OR	
Q.2	(a)	Explain the following in terms i. damping ratio ii. Critically damped vibration iii. Under damped vibration iv. Overdamped vibration	12M
	(b)	Explain the following terms: i. Principle of Superposition ii. Beats & Gibbs Phenomenon	8M

Q. No		Module- 2	Marks
Q.3	(a)	Determine the natural frequencies of a simple spring mass system using a) Newton's Second law of motion b) Energy method	5M
	(b)	Explain viscous, coulomb, structural damping with neat sketch	5M
	(c)	Determine the natural frequency of the simple pendulum neglecting the mass of the rod	10M
		OR	
Q.4	(a)	Show that the logarithmic decrement $\delta = \frac{1}{n} Ln\left(\frac{x_0}{x_n}\right)$ where x_0 is the intital amplitude and x_n is the amplitude after n cycles.	10M
	(b)	Determine the following with neat sketch a) Critical Damping coefficient b) Damping factor c) Natural frequency of damped vibrations d) Logarithmic decrement e) Ratio of two consecutive amplitudes of vibrating system which consists of mass of 25 kg, a spring of stiffness 15 KN/m, and a damper. The damping provided is only 15% only the critical value.	10M

Q. No		Module- 3	Marks
Q.5	**(a)**	Discuss the principle of operation of Seismic instrument, vibrometer and accelerometer; Draw the relevant frequency response curve for each.	10M
	(b)	Derive expression for steady state amplitude and phase lag of single degree freedom subjected to forced vibration	5M
	(c)	Explain the following with neat sketch (a)Frahm's reed tachometer (b)Fultron tachometer	5M
		OR	
Q.6	**(a)**	Define the following with neat sketch i. Forced vibration ii. Magnification factor iii. Vibration isolation iv. transmissibility	8M
	(b)	Derive an expression for amplitude of whirling shaft with air damping	10M
Q. No		**Module- 4**	**Marks**
Q.7	**(a)**	Explain about the Co-ordinate coupling and the Principal Co-ordinates.	10M
	(b)	Determine the Principal co-ordinates for the spring mass system shown in fig below.  	10M
		OR	
Q.8	**(a)**	Explain the Principal of dynamic vibration absorber and explain the demerits of it.	10M
	(b)	Fig shows the vibrating system having two degree of freedom. Determine the two natural frequencies of vibration and the ratio of amplitudes of the motion of M_1 and M_2 for two modes of vibration. Given, M_1=1.5kg, M_2=0.80kg, k_1=k_2=40 N/m.  	10M

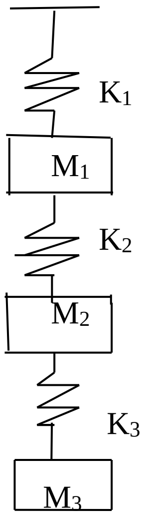
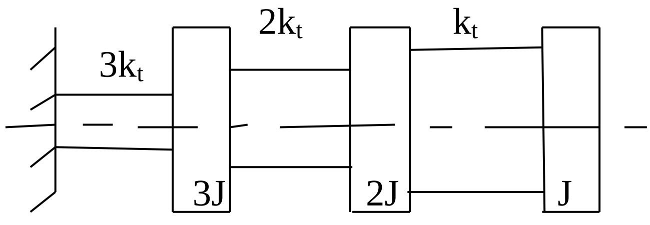
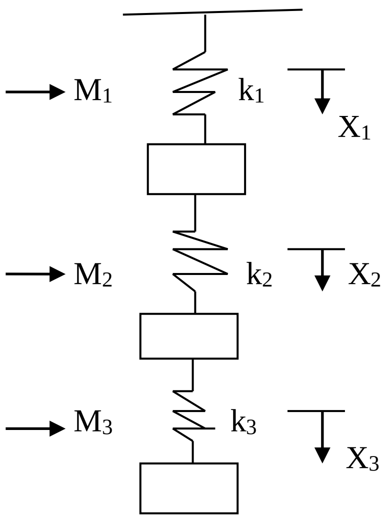
<table>
<tr><th colspan="3">Module - 5</th><th>Marks</th></tr>
<tr><td rowspan="2">Q.9</td><td>(a)</td><td>Use the Stodola method to find the fundamental mode of vibration and its natural frequency of the spring mass system as shown in fig. Take $k_1 = k_2 = k_3 = 1$, $M_1 = M_2 = M_3 = 1$.

</td><td>8M</td></tr>
<tr><td>(b)</td><td>Explain Influence Coefficients and the types of Influence co-efficient with neat sketch.</td><td>12M</td></tr>
<tr><td rowspan="2">Q.10</td><td>(a)</td><td>Determine the natural frequency of the system shown in fig by Holzer's method.

</td><td>12M</td></tr>
<tr><td>(b)</td><td>Determine three natural frequencies of the spring mass system as shown in fig by Holzer's method. Assuming the initial displacement X_1=1 and natural frequencies ω=0.30, 0.50, 0.75, 1.0, 1.25, 1.50, 1.75 and 2.0.

</td><td>8M</td></tr>
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Table showing the Bloom's Taxonomy Level, Course Outcome and Programme Outcome				
Question		**Bloom's Taxonomy Level attached**	**Course Outcome**	**Programme Outcome**
Q.1	(a)	L4	CO1	PO1, PO7
	(b)	L2	CO1	PO1
Q.2	(a)	L1	CO3	PO2,PO3
	(b)	L1	CO3	PO1,PO2
Q.3	(a)	L1	CO3	PO4
	(b)	L2	CO2	PO3
Q.4	(a)	L1	CO1	PO2,PO5
	(b)	L2	CO3	PO3,PO5
Q.5	(a)	L1	CO2	PO1,PO3
	(b)	L2	CO3	PO3,PO4
Q.6	(a)	L1	CO2	PO3
	(b)	L2	CO3	PO6,PO7
Q.7	(a)	L1	CO2	PO3
	(b)	L4	CO3	PO4
Q.8	(a)	L1	CO3	PO3,PO4
	(b)	L4	CO3	PO4,PO5,PO7
Q.9	(a)	L3	CO3	PO3
	(b)	L1	CO2	PO3
Q.10	(a)	L5	CO1	PO4,PO5
	(b)	L5	CO3	PO3,PO4,PO7

Bloom's Taxonomy Levels	**Lower order thinking skills**		
	Remembering(knowledge): L_1	Understanding Comprehension): L_2	Applying (Application): L_3
	Higher order thinking skills		
	Analyzing (Analysis): L_4	Valuating (Evaluation): L_5	Creating (Synthesis): L_6