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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Mechanical Engineering

Semester End Examination; February - 2022

Mechanical Vibrations

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

*CO1: **Develop** mathematical models of single degree of freedom damped and undamped free vibratory systems and **Solve** their natural frequencies.*

*CO2: **Analyze** the response of simple single degree of freedom systems subjected to forced vibration.*

*CO3: **Explain** the working principle of vibration measuring instruments. **Solve** the whirling speed of shafts and harmonics of general forcing functions using Fourier series.*

*CO4: **Develop** mathematical models and **Solve** natural frequencies, corresponding mode shapes of two degrees of freedom systems and **Explain** noise.*

*CO5: **Apply** numerical methods to **Solve** multi degree of freedom systems for their natural frequencies and mode shapes.*

***Note**: **I) PART - A** is compulsory. **Two** marks for each question.*

***II) PART - B**: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	Define phase difference.	2	L1	CO1	PO1
b.	Define transmissibility.	2	L1	CO2	PO1
c.	Mention any two necessity of vibrating measuring instrument.	2	L2	CO3	PO1
d.	Define two degrees of freedom system and mention an example for same.	2	L2	CO4	PO1
e.	Define influence coefficient.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	List and explain types of vibrations.	9	L2	CO1	PO1
b.	A block of mass 0.05 kg is suspended from a spring having a 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/s. Determine; i) Natural frequency ii) Period of oscillation iii) Maximum velocity iv) Maximum acceleration v) Phase angle	9	L3	CO1	PO1,3

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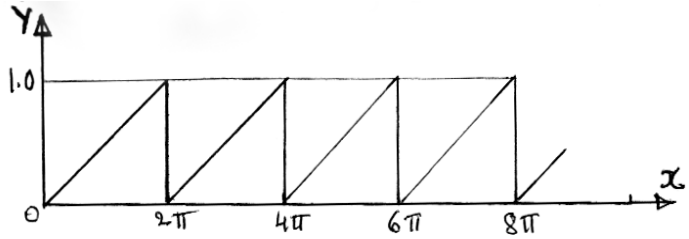
c.	The disc of a torsional pendulum has a moment of inertia of 0.06 kgm^2 and is immersed in a viscous fluid. The brass shaft attached to it is of 100 mm diameter and 400 mm long, when the pendulum is vibrating. The amplitudes on the same side for the successive cycles are 9°, 6° and 4°. Determine; i) Logarithmic department ii) Damping torque at unit velocity iii) Periodic time of vibration Assume for brass shaft G = 4.4×10^{10} N/m^2. What would be the frequency, if the disc is removed from the viscus fluid?	9	L3	CO1	PO1,3

UNIT - II **18**

2 a.	Derive an expression for phase lag and mention the value of displacement transmissibility for various values of frequency ration in absolute motion condition.	9	L2	CO2	PO3
b.	A machine of total mass 17 kg is mounted on spring having stiffness k = 11000 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. Assuming the motion to be SHM. Determine; i) Amplitude of machine ii) Transmissibility iii) Force transmitted to the ground Take ξ (zeta) = 0.2.	9	L3	CO2	PO3
c.	The springs of an automobile trailer is compressed 0.1 m under its own weight. Find the critical speed when the trailer is travelling over a road with a profile approximated by a sine wave of amplitude 0.08 m and wave length of 14 m. What will be the amplitude of vibration at 60 km/hour?	9	L3	CO2	PO3

UNIT - III **18**

3 a.	With neat sketch, explain two types of frequency measuring instruments.	9	L2	CO3	PO1,3
b.	Derive an expression for whirling of shafts without air damping.	9	L3	CO3	PO2
c.	Find the Fourier series for the saw tooth curve as shown in Fig. 3(c).  	9	L4	CO3	PO3

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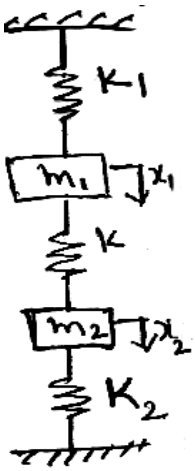
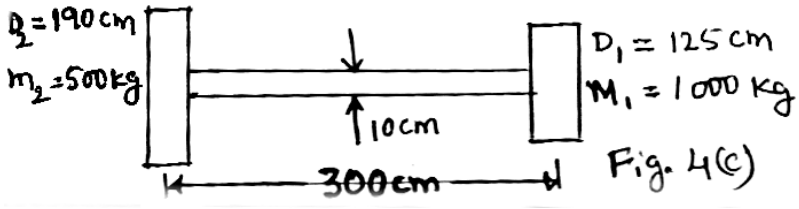
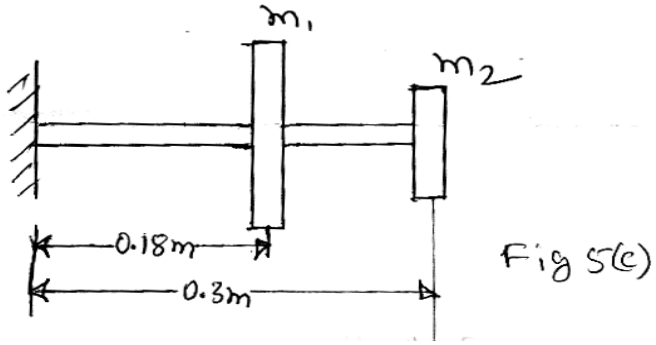
UNIT - IV **18**

4 a.	Explain the concept of coordinate coupling.	9	L2	CO4	PO1
b.	Determine the frequency of system shown in Fig. 4(b). Where $k_1 = k_2 = 40$ N/m, $k = 60$N/m, $m_1 = m_2 = 10$ kg  Fig. 4(b)	9	L3	CO4	PO3
c.	Determine the natural frequency of the system contain shaft with two circular disc as shown in Fig. 4(c) .Take G = 0.83×10^{11} N/m^2  Fig. 4(c)	9	L3	CO4	PO3

UNIT - V **18**

5 a.	Explain Rayleigh's method of finding fundamental natural frequency.	9	L2	CO5	PO1
b.	A shaft of 50 mm diameter and 3 m long is supported at the ends and carries three weights of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. Take E = 200 GPa, find the frequency of transverse vibrations by using Dunkerley's method.	9	L3	CO5	PO3
c.	Use Stodala's method to find the natural frequency of the system shown in Fig. 5(c).  Fig 5(c) Take $E = 1.96\times10^{11}$N/m^2, $I = 4\times10^{-7}$m^4, $m_1 = 100$ kg, $m_2 = 50$ kg.	9	L3	CO5	PO3

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