U.S.N | | | | | | | | | | |

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

(An Autonomous Institution affiliated to VTU, Belagavi)

Sixth Semester, B.E. - Automobile Engineering

Semester End Examination; July / Aug. - 2022

Mechanical Vibration

Time: 3 hrs Max. Marks: 100

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1	a.	Define the following: (i) Torsional vibration (ii) Damped vibration (iii) Transient vibration	6
	b.	Derive an equation motion and natural frequency of vibration of a spring mass system in vertical position by Newton's method.	6
	c.	Determine the natural frequency of a spring mass system Fig.1c where the mass of the spring is also to be taken into account	8
2	a.	Explain; (i) Viscous damping and (ii) Solid / Structural damping.	6
	b.	Explain Beats phenomenon and simple Harmonic motion.	4
	c.	What is logarithmic decrement? Derive a relationship for logarithmic decrement in terms of damping ratio.	10

UNIT - II

3	a.	Derive a maximum displacement equation for forced vibration of undamped single degree freedom system.	10
	b.	A mass of 10 kg suspended from one end of helical spring, the other end is fixed. The stiffness of spring is 10 N/mm. The viscous damping causes the amplitude to decrease $1/10^{th}$ of initial value in four complete oscillations. If a periodic force of 150 cos 50t N is applied at the mass with vertical direction. Find the amplitude of forced vibration.	10
4	a.	Derive vibration isolation. Show that vibration is not possible when the frequency ratio is less than $\sqrt{2}$.	10
	b.	An engine weighing 1,000 N including reciprocatory parts is mounted on springs. The weights of the reciprocating parts are 22 N and the stroke is 90mm. The engine speed is 720 rpm (i) Neglecting damping, find the stiffness of the springs, so that the force transmitted to the foundation is 5% of the amplitude force, (ii) If under the actual working condition the damping reduces the amplitude of successive vibration by 25%, determine the force transmitted at 720 rpm.	10

UNIT - III

5 a. Explain Vibrometer and Accelerometer. 8

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. 12

6 a. Find the critical speed of Whirling of shaft without air damping. 8

b. A ring is connected to a shaft by means of spiral spring. It is used for measuring torsional acceleration. The system is provided with a viscous damper having a constant of 0.12 Nm.sec/rad The torsional stiffness of the spring is 1 Nm/rad and the moment of inertia of the ring is 0.05 km. Determine the maximum acceleration of the shaft, if the relative amplitude between the ring and the shaft is 2.5°. The frequency of the shaft is 20 cycles/minute. 12

UNIT - IV

7 a. Explain principal modes and normal modes of vibration 6

b. Determine the following from Fig. 7b; 14

(i) Equation of motion

(ii) Frequency equation and natural frequencies of the system

(iii) Mode shape

8 a. Explain Dynamic vibration absorber. 6

b. An engine drives a centrifugal pump through gearing. The shaft from engine flywheel to gear is 8cm diameter and 1m long while that from pinion to pump impeller is 6 cm diameter and 40 cm long. The pump runs at 3 times engine speed. The M.I in kg, m^2 are as follows; Engine flywheel = 90, Gear wheel = 9, Pinion = 1. Pump Impeller = 20. Determine the natural frequency of free torsional vibration of system. Take G-84 GPa. 14

UNIT - V

9 a. Derive an expression for finding the natural frequency by Rayleigh's method. 10

b. Find the lowest natural frequency of vibration for the system shown in the Fig. 9b by Rayleigh's method. $E = 1.96\times10^{11}$ N/m^2, $I = 4\times10^{-7}$m^4. 10

10. Find the natural frequencies of the system shown in Fig. 10a. Use Holzers method. $m_1 = 2$ kg, $m_2 = 4$ kg, $m_3 = 2$ kg, $k_1 = 5$ N/m, $k_2 = 10$ N/m 20

Contd... 3

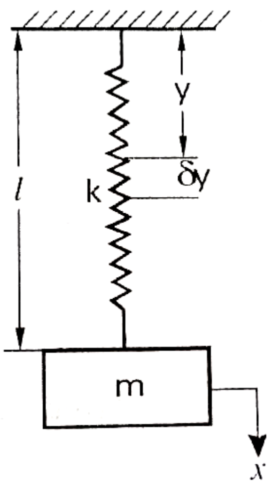

Fig. 1c

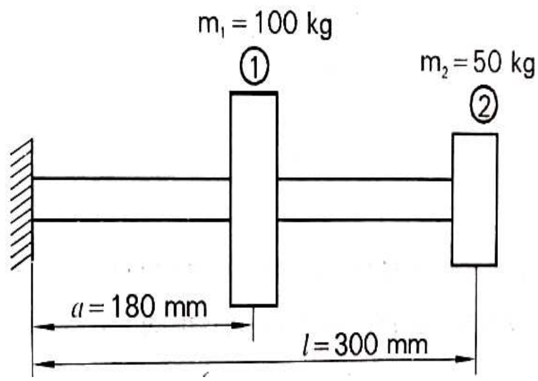

Fig. 9b

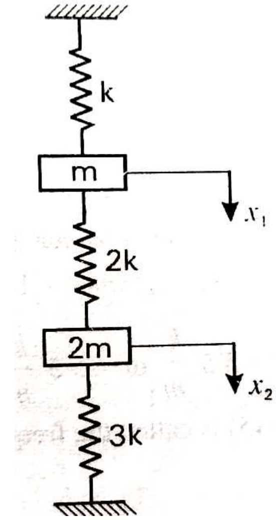

Fig. 7b

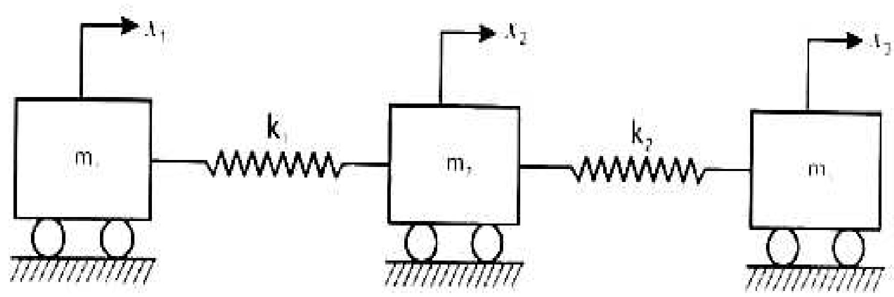

Fig. 10a

* * * *