Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2023

Subject Code:3160109 Date:10-07-2023

Subject Name:Theory of Vibration

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define vibration. What do you think vibration is desirable or undesirable in any system? List three examples of each.	**03**
	(b)	Derive an expression for equation of motion of single degree free un-damped vibration. Write the equation of natural frequency it.	**04**
	(c)	The disc of a torsional pendulum has a mass moment of inertia of 0.06 Kg-m^2. The brass shaft attached to it is of 100 mm diameter and 400 mm long. When the pendulum is vibrating, the observed amplitudes on the same side of the rest position for successive cycles are 9^0, 6^0 and 4^0. Find (i) logarithmic decrement, (ii) damping torque at unit velocity, (iii) natural frequency of damped vibration. Assume modulus of rigidity as 4.4 * 10^{10} N/m^2.	**07**
Q.2	**(a)**	Explain the terms vibration isolation and vibration damping.	**03**
	(b)	Explain continuous system.	**04**
	(c)	Find the natural frequency of the system shown in figure 2.1. Mass supported by spring is 100 tones. K1 = K2 = K3 = K4 = K5 = K6 = K= 1000 N/m.	**07**

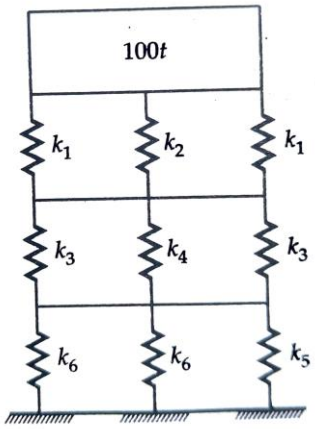


Figure 2.1

OR

	(c)	A machine of 100 kg is supported on springs of total stiffness 700 KN/m and has an unbalanced rotating element, which results in a disturbing force of 300 N at a speed of 2500rpm. Assuming a damping factor of 0.25, determine amplitude of forced vibration and force transmitted to the foundation.	**07**
Q.3	**(a)**	What do you understand by vibration analysis? Explain with suitable example.	**03**
	(b)	Derive an expression for natural frequency of torsional vibration of a disc connected at one end of the shaft.	**04**
	(c)	Derive an expression of natural frequency of a simple pendulum.	**07**

OR

Q.3 **(a)** Define the terms: (i) Natural frequency, (ii) degree of freedom (iii) forced vibration **03**

(b) Explain with neat sketch measurement of natural frequency of given system using Frham's single reed tachometer. **04**

(c) A gun barrel of mass 600 Kg has a recoil spring of stiffness 34 N/mm. If the barrel recoils 1.3 meter on firing, determine, (i) the initial recoil velocity of the gun & (ii) the critical damping coefficient which is engaged at the end of the recoil stroke. Assume no energy is lost in the recoil of the barrel. **07**

Q.4 **(a)** Explain the term dynamic magnifier. **03**

(b) Explain in brief about vibration measuring instruments. **04**

(c) Plot the frequency response curve of transmissibility for the various damping factors in the rage 0 to 2. State the observations made from the plot. **07**

Q.4 **(a)** Define Degree of Freedom. Give one example of single degree, two degrees and multi degree of freedom systems. **03**

(b) A mass of 25 kg is supported by a spring and dashpot. The stiffness of the spring is 1635 N/m and damping coefficient of 1000 N-sec per meter. If the support is oscillating in SHM, with amplitude 25 mm and frequency 6 rad/sec, find the amplitude of load. **04**

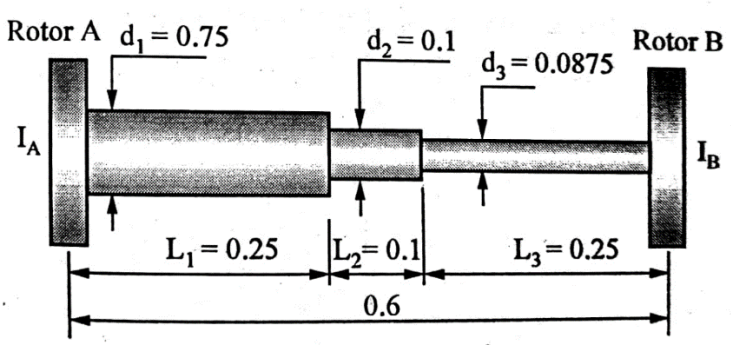
(c) Explain Rayleigh's method for finding natural frequency of transverse vibration of beams. **07**

Q.5 **(a)** Define: Node, Principal mode of vibration, Normal mode of vibration. **03**

(b) Derive an expression for Torsionally Equivalent Shaft System. **04**

(c) Two identical rotors are attached to the two ends of a stepped shaft as shown in figure given below. Each rotor weighs 450 kg and has radius of gyration of 0.38 m. The total length of the shaft is 0.6 m. find the frequency of free torsional vibration of the system and the position of the node from either mass. **07**

Assume modulus of rigidity as $80 * 10^9$ N/m^2.



OR

Q.5 **(a)** What do you mean by whirling of shaft? Why and where it is necessary to check the whirling speeds of the shaft? **03**

(b) Write a note on Co-ordinate Coupling. **04**

(c) Derive an expression for critical speed of a shaft carrying rotor and with damping. **07**

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