Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2720817 Date: 31/05/2016

Subject Name: NOISE AND VIBRATIONS ANALYSIS

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.**

Q.1	**(a)**	For the system shown in Fig. 1, m_1 = 10 kg, m_2 = 1 kg with spring stiffness k_1=300 N/mm and k_2 = 50 N/mm. Find natural frequency of the vibrations of the system, normal modes and equation of motions in terms of normal modes.	**09**
	(b)	Derive the equation of magnification factor for the undamped forced vibration of the system.	**05**
Q.2	**(a)**	For a double pendulum, having both the bobs with equal mass *m* and equal lengths of strings *l*, find natural frequencies of vibration. Assume small amplitudes.	**07**
	(b)	One of the wheels and leaf springs of an automobile, traveling over a rough road, is shown in Fig. 2. The automobile has a mass of m_1 = 1000 kg and the leaf springs have a total stiffness of 400 kN/m. The wheels and axles have a mass of m_2 = 300 kg and the tires have a stiffness of 500 kN/m. If the road surface varies sinusoidally with an amplitude of 0.1 m and a period of 6 m, find the critical velocities of the automobile.	**07**
		OR	
	(b)	Find the total response of a SDOF system having m = 10 kg, c = 20 N.s/m, and k = 4000 N/m. The system is subjected to initial displacement of 0.01 m and zero initial velocity. The system is subjected to a force given as 100 cos (10t).	**07**
Q.3	**(a)**	For the system shown in Fig 3, derive the equation of motion using Langrange's equation.	**07**
	(b)	An assembly plant uses a hoist to raise and manoeuvre large objects. The hoist shown in Fig 4. A beam that can move along a track. Determine the natural frequency of the system when the hoist is used to raise a 800-kg machine part at a cable length of 9 m.	**07**
		OR	
Q.3	**(a)**	A machine of mass 25 kg is placed on an elastic foundation. A sinusoidal force of magnitude 25 N is applied to the machine. A frequency sweep reveals that the maximum steady-state amplitude of 1.3 mm occurs when the period of response is 0.22 s. Determine the equivalent stiffness and damping ratio of the foundation.	**07**
	(b)	Determine the response of a SDOF damped system when its support is harmonically excited.	**07**
Q.4	**(a)**	Determine the natural frequencies and normalized mode shapes for a simply supported beam.	**08**
	(b)	Explain following terms: 1. Stiffness influence coefficient. 2. Logarithmic decay 3. Magnification factor.	**06**
		OR	
Q.4	**(a)**	Explain following terms: 1. Vibration Isolation 2. Vibration Absorption 3. Beat	**06**

(b) A suspension system of a car is modelled as a spring – damper system. The car deflects 0.05 m under its own weight. The system should have damping ratio of 0.3. If mass of the car is 1361 kg, calculate the equivalent damping coefficient and equivalent stiffness of the system. If an additional mass of passengers, fuel and luggage is considered to be 290 kg, determine the effective damping ratio. **08**

Q.5 **(a)** A 50-kg mass is subjected to the harmonic force F(t) = 1000 cos (120t). Design an undamped isolator so that the force transmitted to the base does not exceed 5% of the applied force. Also, find the displacement amplitude of the mass of the system with isolation. Neglect the effect of damping. **07**

(b) With the help of a neat sketch, explain the measurement with the help of sound level meter. **07**

OR

Q.5 **(a)** Derive the relation between logarithmic decay and damping coefficient of SDOF undamped system. **07**

(b) Considering a tightly stretched elastic string of length *l*. Determine the wave equation. **07**

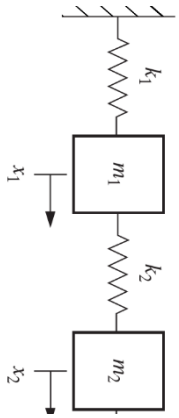

Fig. 1

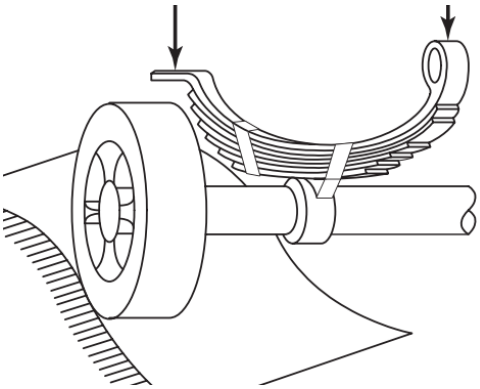

Fig. 2

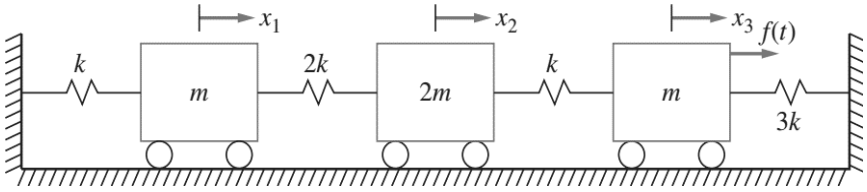

Fig. 3

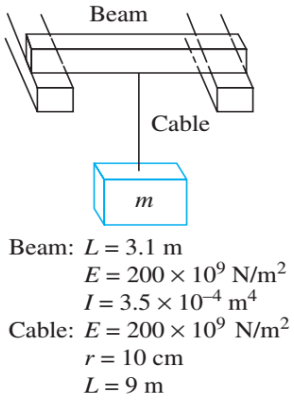

Fig. 4

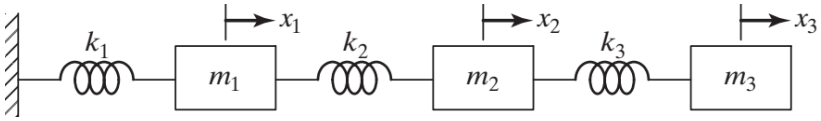

Fig. 5

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