Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 712002N **Date: 02-12-2014**

Subject Name: Structural Dynamics

Time: 10:30 am - 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)**	Explain with illustration Mathematical Modeling.	**07**
	(b)	Derive the equation for the free vibration displacement response of an overdamped single-degree-of-freedom (SDOF) system due to initial displacement x_0 and initial velocity v_0.	**07**
Q.2	**(a)**	A steel rigid frame shown in Fig. 1 supports a rotating machine, which exerts a horizontal force of 50,000 sin11t N at the girder level. Assume 4% of critical damping, determine: (i) steady state amplitude of vibration and (ii) amplitude of vibration at resonance. Assume that girder is infinitely rigid. Take $E = 2 \times 10^5$ Mpa and I for column = 28083. 5×10^4 mm^4.	**07**
	(b)	A vibrating system consists of a mass 5 kg, a spring of stiffness 3000 N/m and a viscous damper. The amplitude of vibration of the system is observed to decrease 90 % after 10 cycles. Determine: (i) the logarithmic decrement, (ii) the damping ratio, (iii) the damping coefficient and (iv) the damped natural frequency.	**07**
		OR	
	(b)	From the fourth order differential equation, calculate the first three natural frequencies of a fixed beam having uniform mass of 2000 kg/m, span of 4 m and flexural rigidity of 2000 kN-m^2.	**07**
Q.3	**(a)**	A cantilever beam of span 8 m carries a point load of 150 kN at its free end. The self-weight and flexural rigidity of the beam are 15 kN/m and 2000 kN-m^2, respectively. Calculate the natural frequency of the beam. Assume the shape function $\psi(x) = 1 - \cos(\pi x/2L)$.	**07**
	(b)	For a beam element, derive the consistent mass matrix in terms of mass per unit length and span of the beam.	**07**
		OR	
Q.3	**(a)**	A single spring mass system has spring constant of 10 kN/m and mass of 2500 kg. If it is loaded by an impulsive load as shown in the Fig. 2, derive the equation for the displacement response of the system after completion of the impulse.	**07**
	(b)	A body of mass 10 kg is supported on a spring of stiffness 40 N/m and has dashpot connected to it which produces a resistance of 20 N at a velocity of 1 m/sec. The body is moved 0.2 m to the right of the equilibrium position and released from rest at time $t = 0$. Determine its displacement at time $t = 2$ sec.	**07**
Q.4		For the two storey shear building shown in Fig. 3, obtain natural frequencies and mode shapes. Verify that the modes satisfy the orthogonality properties.	**14**
		OR	
Q.4		A multi-degree-freedom-system is shown in Fig. 4. If the 1500 kg mass is pulled by 10 mm in the horizontal direction and left to vibrate, derive the displacement function of all the masses.	**14**

Q.5 **(a)** A propped cantilever beam of span 8 m and flexural rigidity of 2000 kN-m^2 has self weight of 15 kN/m. Calculate the natural frequency of the beam using the shape function from the Macaulay's Method. **07**

(b) Calculate the fundamental natural frequency and fundamental mode of the system shown in Fig. 5 using Stodola's method. **07**

OR

Q.5 **(a)** A single spring mass system has spring constant of 2000 N/m and mass of 20 kg. If it is loaded by a periodical load for which a single period is shown in the Fig. 6, derive the equation for the displacement response of the system. **07**

(b) Discuss in detail the various methods of finding out the damping ratio by experimental work. **07**

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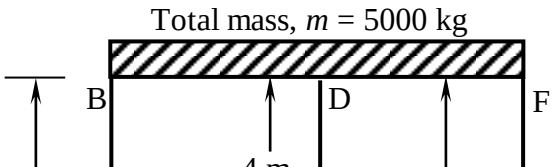

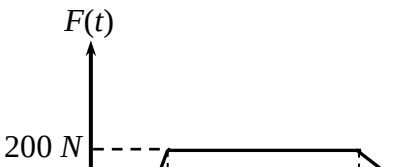

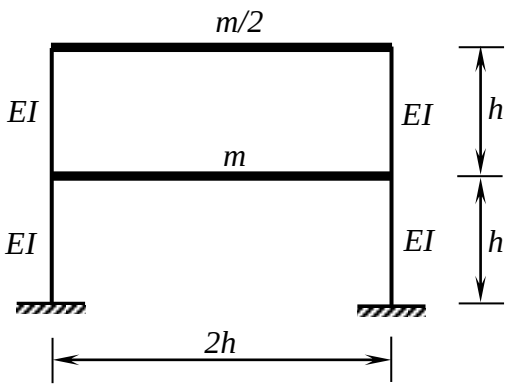

Fig. 3

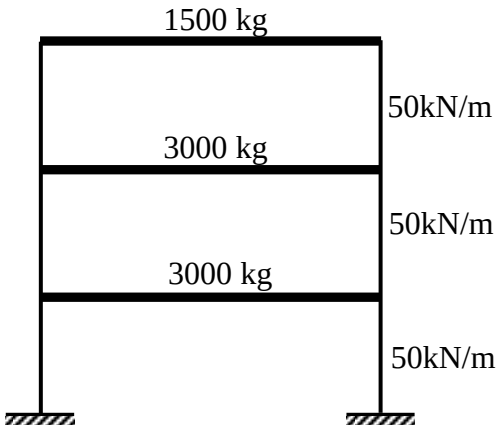

Fig. 4

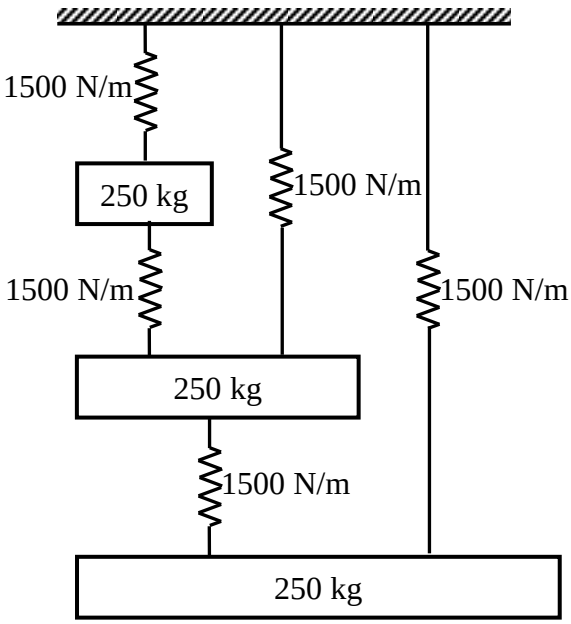

Fig. 5

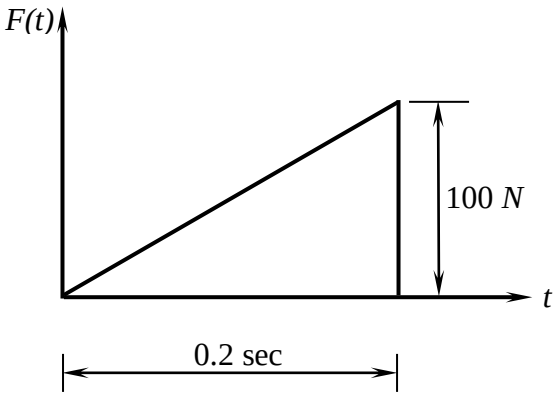

Fig.6