Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. SEMESTER I (old course)–EXAMINATION (Remedial) – WINTER 2015

Subject code: 712002 **Date: 09/12/2015**

Subject Name: Structural Dynamics

Time: 10:30 AM to 1:00 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)**	Write the differential equation for the free undamped single degree of freedom system and derive the equation of motion.	**07**
	(b)	A spring mass model consist of 10 kg mass and spring of stiffness 5 N/mm was tested for viscous damped vibration. The test recorded two consecutive amplitude is 1.0 cm and 0.8 cm respectively. Determine (i) natural frequency of undamped system (ii) logarithmic decrement (iii) damping ratio (iv) damping coefficient (v) damped natural frequency.	**07**
Q.2	**(a)**	Define the term (i) degree of freedom (ii) logarithmic decrement (iii) natural frequency (iv) dynamic magnification factor (v) mode shape (vi) harmonic loading (vii) resonance	**07**
	(b)	A SDOF system consists of 2.5 m high column of 200 mm diameter which supports the heavy mass of 1100 kg at its top. The system is subjected to a harmonic force of 1000sin50*t* N. Consider damping ratio as 0.2 and $E = 2 \times 10^5$ N/mm^2. Calculate the maximum dynamic amplitude and also state whether the system will have resonance or not?	**07**
		OR	
	(b)	Derive the equation of motion for the free under-damped single degree of freedom system.	**07**
Q.3	**(a)**	A single spring mass system has spring constant of 1000 N/m and mass of 10 kg. If it is loaded by a periodical load for which a single period is as shown in the Figure 1, derive the equation of the response using Fourier series.	**07**
	(b)	A single spring mass system has spring constant of 1000 N/m and mass of 10 kg. If it is loaded by an impulsive load as shown in the Figure 2, derive the equation of the response after completion of the impulse.	**07**
		OR	
Q.3	**(a)**	A single spring mass system has spring constant of 5000 N/m and mass of 50 kg. If it is loaded by a periodical load for which a single period is as shown in the Figure 3, derive the equation of the response.	**07**
	(b)	A single spring mass system has spring constant of 100 kN/m and mass of 1000 kg. If it is loaded by an impulsive load as shown in the Figure 4, derive the equation of the response after completion of the impulse and find the responses at t= 2 second.	**07**
Q.4	**(a)**	A simply supported beam having a span of 5 m, uniform mass of 1800 kg/m and flexural rigidity of 2000 kN-m^2. Assuming the deflection/shape function as $\gamma(x) = \sin(\acute{} x/L))$, determine the natural frequency of beam.	**07**

(b) Define mathematical model. Also draw the one suitable example of single degree, two-degree and three-degree of freedom system each and its mathematical model. **07**

OR

Q.4 (a) A cantilever beam having a span of 5 m, uniform mass of 2000 kg/m and flexural rigidity of 2000 kN-m^2. Assuming the deflection/shape function as ɣ(x) = (1-cos(´ x/2L)), determine the natural frequency of beam. **07**

Q.4 (b) (i) Differentiate between consistent mass matrix and lumped mass matrix. **07**
(ii) Define damping, critical-damped system, under-damped system and over-damped system.

Q.5 (a) A three storey building model has the stiffness as 100 kN/m, 60 kN/m and 30 kN/m and masses as 60 kg, 55 kg and 50 kg from support respectively. Evaluate the stiffness matrix, mass matrix and natural frequency of system using any method. **07**

(b) From the general solution of the equation of motion in free vibration, derive the equation of natural frequency of simply supported beam. Determine the first two natural frequencies of a simply supported beam having uniform mass = m kg/m, flexural rigidity = EI, and span beam = L. **07**

OR

Q.5 (a) A two storey building has the stiffness as 40000 N/m, at each storey and mass as 2000 kg and 1000 kg, respectively from ground level respectively. Calculate the frequencies and mode shape of the building. **07**

(b) If in the above building, if the third floor is pulled by 10 mm in the horizontal direction and left to vibrate, derive the displacement function of all the floors. **07**

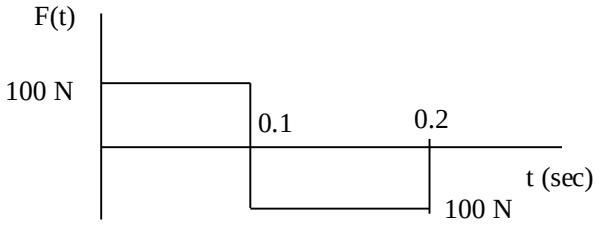

Fig.1

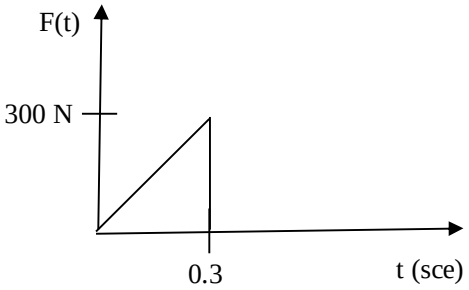

Fig.2

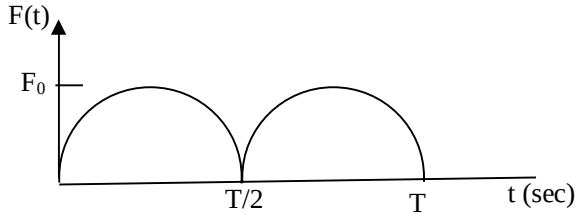

Fig.3

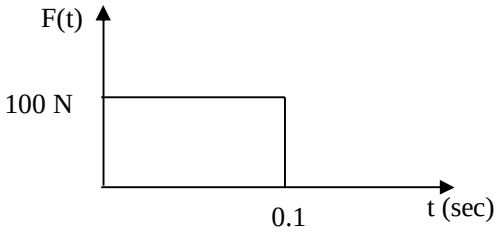

Fig.4

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