

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**ME – SEMESTER I (OLD) – • EXAMINATION – SUMMER 2016**

**Subject Code:** 712002**Date:** 17/05/2016**Subject Name:** Structural Dynamics**Time:** 02:30 pm to 05:00 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) Define the term (i) degree of freedom (ii) time period (iii) natural frequency (iv) dynamic magnification factor (v) static and dynamic loading (vi) harmonic loading (vii) resonance **07**
- (b) A spring mass model consist of 20 kg mass and spring of stiffness 2000 N/m 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) Write the differential equation for the free undamped single degree of freedom system and derive the equation of motion. **07**
- (b) A SDOF system consists of 3.0 m high column of 500 mm diameter which supports the heavy mass of 7500 kg at its top. The system is subjected to a harmonic force of  $1500\sin 50t$  N. Consider damping ratio as 0.5 and  $E = 2 \times 10^5$  N/mm<sup>2</sup>. Calculate the maximum dynamic amplitude and also state whether the system will have resonance or not? **07**
- OR**
- (b) What is damping? Define underdamped, critically damped and over damped system. Show that the damping can be neglected for frequency calculations. **07**
- Q.3** (a) 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**
- (b) A simply supported beam having a span of 5 m, uniform mass of 1200 kg/m and flexural rigidity of 2000 kN-m<sup>2</sup>. Assuming the deflection/shape function as  $(x) = \sin(x/L)$ , determine the natural frequency of beam. **07**
- OR**
- Q.3** (a) A uniform cantilever chimney of length L has mass per unit length is m and flexural rigidity EI. Assuming the deflection/shape function as  $(x) = (1-\cos(x/2L))$ , determine the natural frequency of chimney. **07**
- (b) (i) Differentiate between consistent mass matrix and lumped mass matrix. **07**
- (ii) Explain in brief Logarithmic decrement.

**Q.4 (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 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 750 N/m and mass of 7.5 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.4 (a)** A single spring mass system has spring constant of 2500 N/m and mass of 25 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 using Fourier series. **07**

**Q.4 (b)** A single spring mass system has spring constant of 3000 N/m and mass of 30 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  $t = 1$  second. **07**

**Q.5 (a)** A two storey shear building model has the stiffness as 200 kN/m, and 100 kN/m and masses as 1000 kg, and 500 kg from support respectively. Evaluate the stiffness matrix, mass matrix and natural frequency of building. **07**

**(b)** Show that the modes of vibration of the above shear building satisfy the orthogonality properties. **07**

**OR**

**Q.5 (a)** A two storey building has the stiffness as 50000 N/m at each storey and mass as 500 kg and 250 kg, respectively from ground level respectively. Calculate the frequencies and mode shape of the building. **07**

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

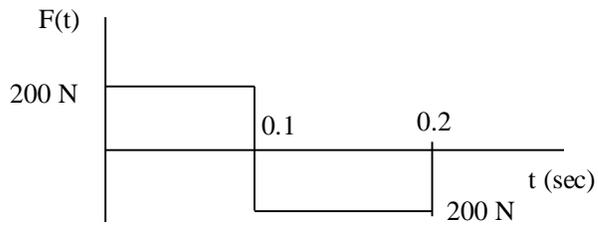


Fig.1

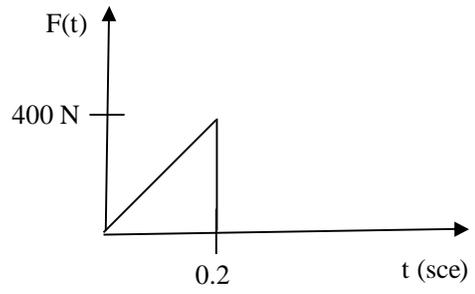


Fig.2

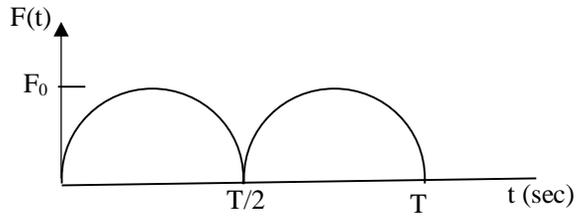


Fig.3

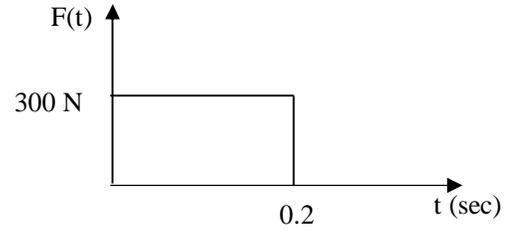


Fig.4

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