Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-I Remedial Examination April 2010

Subject code: 712002 Subject Name: Structural Dynamics

Date: 07 / 04 / 2010 Time: 12.00 noon – 02.30 pm

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** From the fourth order differential equation, calculate the natural frequency of a cantilever beam of span 6m and flexural rigidity of 20000kN-m^2. The self weight of the beam is 1000kg/m. **06**

(b) A single spring mass system has mass of 500kg, viscous damper having damping constant of 5000N-sec/m and spring constant of $5x10^6$ N/m. This spring mass system is having initial displacement and velocity of 0.01m and 2m/sec. Obtain the equation of the motion of the mass. Also calculate the time required to reduce its amplitude to 2% of the original amplitude. **06**

Q.2 **(a)** A cantilever beam of span 4m is supporting a machine having mass of 10000kg. The flexural rigidity of the beam is $3x10^6$kN-m2. When machine is switched on the unbalanced mass of 100kg rotates with 4000 rpm at an eccentricity of 0.02m. Calculate the static and dynamic displacements of the beam. **06**

(b) A single spring mass system has spring constant of 1000N/m and mass of 10kg. 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 motion. **06**

OR

(b) A single spring mass system has spring constant of 1000N/m and mass of 100kg. If it is loaded by a periodical load for which a single period is as shown in the **figure 2**, derive the equation of the motion. **06**

Q.3 **(a)** A single spring mass system has spring constant of 10kN/m and mass of 1t. If it is loaded by an impulsive load as shown in the **figure 3**, derive the equation of the motion after completion of the impulse. **06**

(b) A simple support beam has self weight of 1000kg/m and is supporting a concentrated mass of $10x10^3$kg at its midpoint. If the flexural rigidity and span of the beam is 2000kN-m^2 and 6m respectively, calculate the natural frequency of the beam. Assume the deflection function as $v(x) = \sin(\pi x/L)$) **06**

OR

Q.3 **(a)** A single spring mass system has spring constant of 10000N/m and mass of 100kg. If it is loaded by an impulsive load as shown in the **figure 4,** derive the equation of the motion after completion of the impulse. **06**

(b) Calculate the natural frequency of a cantilever beam having uniform mass of 2000kg/m, span of 5m and flexural rigidity of 2000kN-m^2. **06**

Q.4 **(a)** A three storeyed building has the stiffness at each floor level as 5000kN/m, 5000kN/m, 5000kN/m and mass for each storey as 50t, 50t, 50t from ground level respectively. Calculate all the frequencies of the building. **06**

(b) If in the above building, if the third floor is pulled by 6mm in the horizontal direction and left to vibrate, derive the displacement function of all the floors. **06**

OR

Q.4 **(a)** A three spring mass system has spring stiffness as 6000N/m, 3000N/m, 1000N/m and masses as 10kg, 10kg and 10kg from support respectively. Calculate the natural frequencies of the system. **06**

(b) If the above spring mass system is loaded by forces as 200sin3t, 200sin3t and 200sin3t at first, second and third mass form support respectively, obtain the equation of the motion of all the masses. **06**

Q.5 **(a)** What are the different methods for calculating natural frequency of a multi storeyed building? Explain in detail the consistent mass method. **06**

(b) For a building as shown in the **figure 5,** calculate the natural frequency using Stodala's method. The mass at the each floor level is 50000kg, column size for all the column is .4m x .4m and E for the concrete is $2x10^4 N/mm^2$. **06**

OR

Q.5 **(a)** Calculate the natural frequency of a simple support beam of span L and flexural rigidity of EI using the consistent mass matrix for beam element. Use two elements each of length L/2 and symmetry. **06**

(b) For a building as shown in the **figure.6,** calculate the natural frequency. The mass at the each floor level is 50000kg, column size for all the column is .4m x .4m and E for the concrete is $2x10^4 N/mm^2$. **06**

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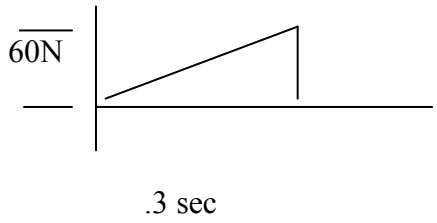

Figure 1

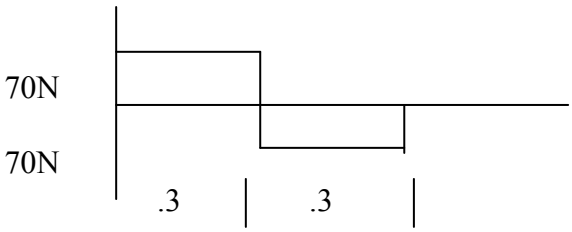

Figure 2

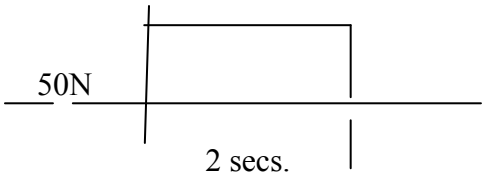

Figure 3

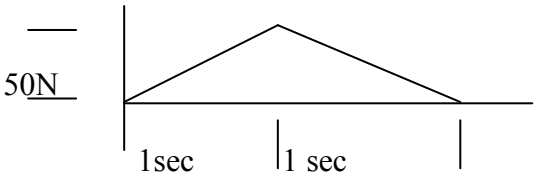

Figure 4

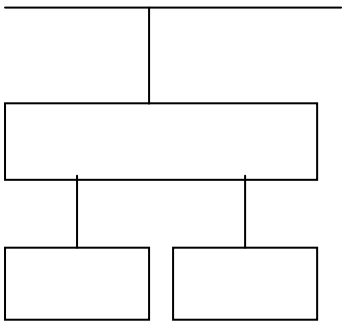

Figure.5

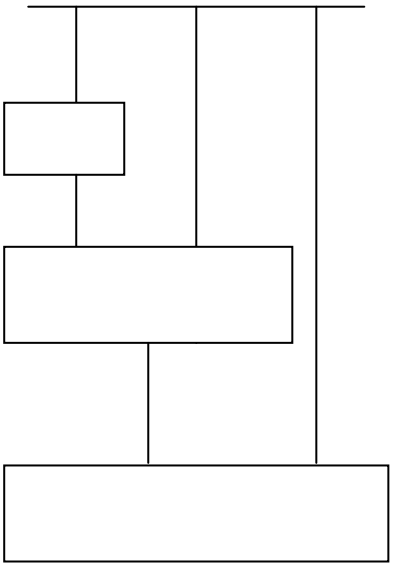

Figure.6

Note: In figure.5 and figure.6 each box represents mass of 100kg and each vertical line represents spring of spring constant of 1000N/m

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