Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH (STRUC-ENGG)/SEM-2/SE-202/2012

2012
STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. 5 × 14 = 70

1. a) Define the following terms related to periodic motion : period, frequency. 2

   b) Derive the equation of motion of an undamped mass spring system and the solution with initial condition that at $t = 0$, displacement = x_0, velocity = v_0. 6

   c) A spring mass system has maximum velocity of 20 cm/sec, and time period of 1 sec. If the initial displacement is 1 cm. determine (i) amplitude, (ii) initial velocity, (iii) maximum acceleration, (iv) the phase angle. 6

2. a) What is logarithmic decrement ? Show that logarithmic decrement $\delta = 2\pi\xi$ for small value of ξ, where ξ = damping ratio. 6

b) Show that logarithmic decrement is also given by :

$\delta = \left(\frac{1}{n}\right) ln\ (x_o/x_n)$, Where x_n is the amplitude after n cycles. 4

c) For a system having a damping ratio ξ, determine the number of vibrating cycles required to reduce the displacement amplitude to 10% of the initial amplitude. 4

3. a) Determine the maximum value of the magnification factor of a damped SDOF system under harmonic excitation in terms of damping ratio and the frequency ratio at which it occurs. 4

b) In a forced vibration test under harmonic excitation it was noted that the amplitude of motion at resonance was exactly four times the amplitude at an excitation frequency 20% higher than the resonant frequency. Determine the damping ratio of the system. 4

c) Define transmissibility ratio (TR). Derive expression for TR for a damped SDOF system subjected to harmonic ground acceleration. 6

4. a) Outline the procedural steps of a direct integrating technique. 6

b) Derive the expression for incremental velocity and displacement for linear acceleration method. 8

5. a) Formulate the equation of motion for the three storey shear frame with lumped masses as shown in figure-1 below. 8

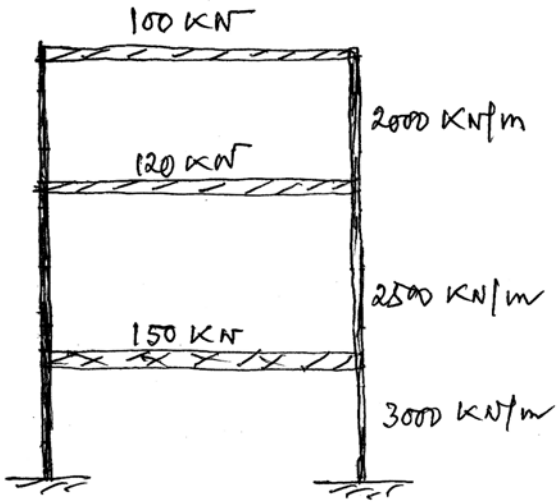

Figure 1

b) Derive the expression for determination of natural frequencies of vibration of the above system from basic principles. 6

6. What are the different types of vibrations that a structure experiences ? How the degrees of a vibrating body are defined ? Define ductility and explain its significance with reference to RC structures. How does energy dissipation take place due to ductile detailing ? Explain the concept of strong column and weak beams. What are the guidelines of ductility design ? 2 + 2 + 4 + 2 + 2 + 2

7. What type of material and structural form should be used for earthquake resistant design ? What are the different lateral load resisting system used in RC construction. Discuss the philosophy of earthquake resistant design as per IS 1893. What are the differences between wind and earthquake forces. 4 + 3 + 4 + 3

8. Enumerate the differences between static and dynamic methods of analysis. For what type of structural dynamic analysis is to be performed ? What is a soft storey ? What is the difference between Ordinary Moment Resistant Frames (OMRF) and a special Moment Resisting Frames (SMRF) ? Discuss the basic features of ductility detailing as per IS : 139200 for different structural elements. 3 + 2 + 2 + 3 + 4