Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.Tech(CE-NEW)/SEM-6/CE-604C/2013

2013
STRUCTURAL DYNAMICS AND 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.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

    $10 \times 1 = 10$

    i)   If $\xi = 6\%$ then the logarithmic decrement is

    a) 0·377   b) 0·378

    c) 0·375   d) 0·376.

    ii) A system is said to have underdamped condition when

    a) $c > c_{cr}$ b) $c = c_{cr}$

    c) $c < c_{cr}$ d) all of these.

6425   [Turn over

CS/B.Tech(CE-NEW)/SEM-6/CE-604C/2013

    iii)   Response reduction factor in case of ordinary moment resisting frame as per IS1893 is

        a)   3   b)   4

        c)   5   d)   2.

    iv)   In case of damped forced vibration

        a)   the steady state response vanishes

        b)   the transient response vanishes

        c)   all the responses remain

        d)   none of these.

    v)   The average response acceleration coefficient for normal period of vibration of 0·1 sec is

        a)   2·5   b)   1

        c)   3·5   d)   2

        e)   none of these.

    vi)   Richter scale indicates

        a)   Earthquake magnitude

        b)   Earthquake intensity

        c)   Energy released

        d)   Both (a) and (c).

    vii)   Earthquake shaking measuring instrument is

        a)   seismograph   b)   seismogram

        c)   seismoscope   d)   all of these.

viii) Earthquake force may act in

    a)   vertical direction only

    b)   horizontal direction only

    c)   both vertical and horizontal directions

    d)   every direction.

ix) Dynamic magnification factor in resonance condition is

    a)   zero   b)   infinity

    c)   cannot be determined   d)   unity.

x) Which of the following materials performs better in seismic condition ?

    a)   Elastic material   b)   Ductile material

    c)   Brittle material   d)   Rigid material.

xi) A vibrating system consists of a weight $W = 10$ N and spring having stiffness $K = 20$ N/m. The angular frequency of the system is

    a)   4·43   b)   5·4

    c)   2·5   d)   3·25

    e)   none of these.

xii) Earthquake resistant design of RCC framed building should be done in accordance with

    a)   IS 1893-2002   b)   IS 13930

   c)   IS 4325   d)   Both (b) and (c)

    e)   None of these.

CS/B.Tech(CE-NEW)/SEM-6/CE-604C/2013

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Discuss the critically damped and overdamped systems of vibration with relevant expresions.

3. What is Duhamel's integral? Discuss its application in dynamic analysis of structures.

4. Find the angular natural frequency, time period and the spring constant of the system as shown below. The mass of the beam may be neglected. $E = 2 \cdot 1 \times 10^5 \ N/mm^2$.
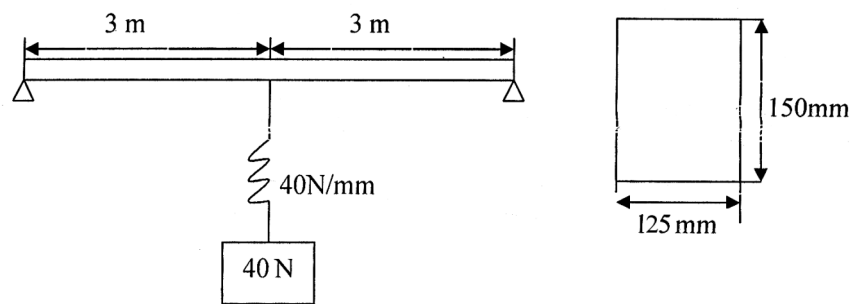
5. A system as shown in figure below, has $K_1 = K_2 = 8 \times 10^4$ N/m and mass, $m = 250$ kg. Determine the equivalent stiffness and the natural frequency of the system.


6425 4
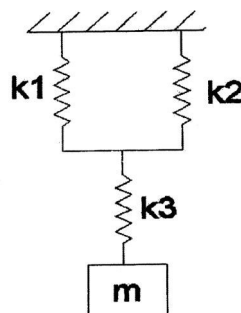
6. A platform of weight w = 2000 kg, is being supported by four columns (equal length) clamped to the foundations. Experimentally it has been determined that a static force of F = 450 kg applied horizontally to the platform produces a displacement Δ = 0·003 m. It is estimated that the damping in the structure is of the order of 5% of the critical damping. Determine the following :

   a) Undamped Natural Frequency

   b) Absolute Damping Coefficient

   c) Logarithmic Decrement

   d) The number of cycles and the time required for the amplitude of motion to reduce from an initial value of 0·003 m.

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following.   3 × 15 = 45

7. A four storied RCC framed building will be constructed in Kolkata in medium soil. Floor to floor height = 3m. It is a square building of plan size 15 m × 15 m. Columns are spaced @ 5 m c/c in both the directions. Live load on floor = 3 kN/m^2 and a nominal live load = 0·75 kN/m^2 has to be considered . Thickness of floor and root slab = 160 mm. The size of beam may be considered 250 mm × 500 mm and columns may be considered 400 mm × 400 mm. Determine the base shear and its distribution along the height as per IS 1893-2002.

CS/B.Tech(CE-NEW)/SEM-6/CE-604C/2013

8. A tower is subjected to a dynamic load as shown below. Evaluate its response numerically by using Duhamel's integral.
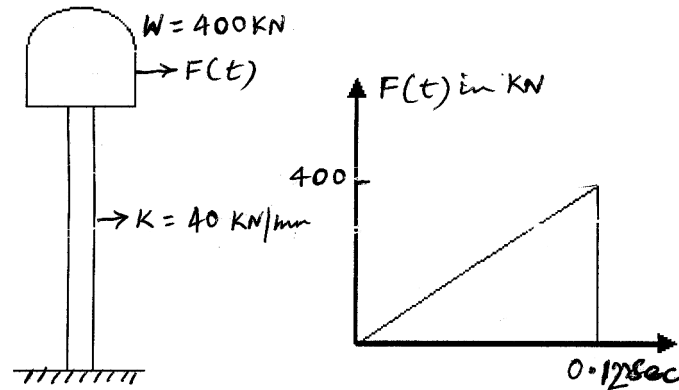
9. Consider a two-storey building as shown below. Calculate the natural periods and draw the mode shapes.
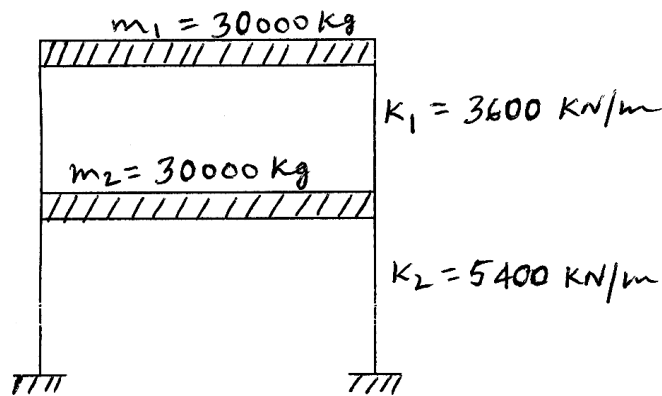
10. Describe the longitudinal and transverse reinforcement detailing rules for columns for a member of a special moment resisting frame (ductile detailing with special confining reinforcements as per IS : 13920).

6425 6

11. Write short notes on the following : 3×5

    a)   Epicentre

    b)   Seismic response factor

    c)   Plate tectonics.

═══════