B.E./B.TECH. Degree Examination, December 2020

Seventh Semester

CE16701 - Structural Dynamics & Earthquake Engineering

(Regulation 2016)

Time: Three hours Maximum : 80 Marks

(Use of IS 1893 Part1- 2016, IS13920:2016 , IS 4326-2013 and SP16 code books are permitted)

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. An SDOF system with a frequency ratio of 0.71 and phase angle is 30 degrees, then the damping ratio is

   (a) 0.39 (b) 0.29 (c) 0.2 (d) 0.1

2. In the equation of motion, the first row first column element of 2x2 damping matrix in a free vibration response of the viscously damped (damping coefficients are c1 and c2) two degrees of freedom system is

   (a) c1+c2 (b) c1 (c) c2 (d) –c2.

3. The ductile moment resistant RC residential building supported on medium stiff soil in Bhuj has a period of vibration of 0.6 sec. What is the horizontal seismic coefficient?

   (a) 0.082

   (b) 0.09

   (c) 0.136

   (d) 0.15

4. Which one of the following is the 'local damage mechanism' of masonry structures against earthquake?

   (a) In-plane shear damage

   (b) In-plane sliding shear damage

   (c) In-plane flexural rocking

   (d) Out-of plane damage due to thrust from roofs

5. A displacement -time plot for a free vibration analysis of a SDOF system gives a displacement of 7.5 mm at time t1 and 1 mm after 7 cycles. Determine the logarithmic decrement.

6. In a single bay two storey building, the flexural rigidity of each column is EI N-m^2. The height of columns in each floor is 3 m. Determine the stiffness of each floor.

7. Explain the concept of earthquake mechanism in accordance with elastic rebound theory.

8. A 10 storey moment- resistant RC residential building has a plan dimension 25 m x 35 m and has 33 m height above the ground. It is located in Chennai. Estimate the fundamental period of vibration without infill panels.

PART B - (4 X 16 = 64 marks)

9. (a) (i) A SDOF system consists of a mass 400 kg and a spring stiffness of 300 kN/m. By testing it was found that a force of 100 N produces a relative velocity 12 cm/s. Find (a) damping ratio, (b) damped frequency, (c) logarithmic decrement, and (d) ratio of two consecutive amplitudes. **(8)**

(ii) A machine of 150 kg mass is supported on four parallel springs of total stiffness 800 kN/m has a unbalanced rotating component which result in a disturbing force of 380 N at a frequency of 2500 rpm. If damping ratio is 0.2, determine: **(8)**

(1) Amplitude of motion due to the unbalance

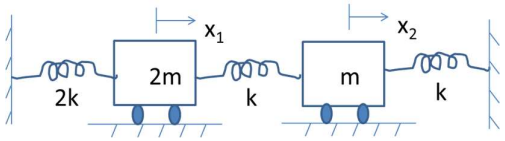
(2) Transmissibility

(3) Transmitted force.

(OR)

(b) An SDOF system has a mass of 50 kg, a damping ratio of 0.1, a natural frequency of 10 rad/s and is subjected to a harmonic excitation of amplitude 2500 N and frequency of 150 rad/s. Determine the steady state amplitude and phase angle of the response. **(16)**

10. (a) Determine the natural frequencies and modes of vibration for the system shown in the following figure. **(16)**



(b) Obtain the natural frequencies and mode shapes for a single bay three storey shear frame. EI= 4.5 x 10^6 N-m^2 and height of all columns is 3 m. Mass of each floor is 5000 kg. **(16)**

11. (a) Plan and elevation of a four-storey reinforced concrete office building is shown in figure. The details of the building are as follows. **(16)**

Number of storey=4

Zone=V

Live load = 3.5 kN/m^2

Columns= 400X500 mm

Beams= 280X420 mm

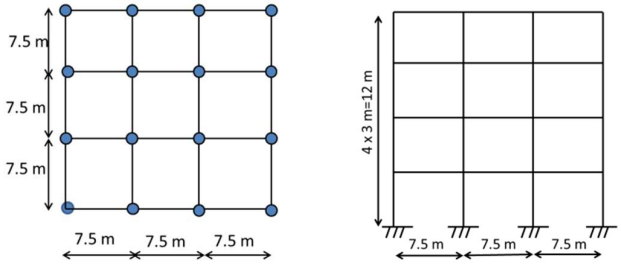
Thickness of slab=150mm

Thickness of wall=120 mm

Importance factor=1.0

Structure type=OMRF buildings

Determine the base shear and storey shear force distribution as per IS1893 Part 1:2016.



(OR)

(b) A three storeyed single bay building frame of a hospital building is of reinforced concrete. It is situated in zone IV. The height between floors is 3 m. The dead load and live loads are lumped at the respective floor levels. The structure is resting on hard rock. Stiffness of each column in I, II and III floors are 400 kN/m, 300 kN/m and 300 kN/m respectively. The seismic weight of I, II and II floors are 80 kN, 40 kN and 40 kN respectively. Detremine the total base shear and the equivalent lateral loads at various floor levels using the empirical method of IS 1893 (Part I)- 2016. **(16)**

12. (a) Design a rectangular beam section of a multistory building for ductility with M20 concrete and Fe415 Steel subjected to an ultimate moment of 150 kNm. **(16)**

(OR)

(b) Design the column of a multi storeyed building for ductility with M25 and Fe415 subjected to an axial force of 1000 kN and bending moment of 91.67 kNm **(16)**