

- (d) State the orthogonality conditions.
- (e) Summarize the evaluation of earthquake forces as per IS code.  $5 \times 4 = 20$
2. (a) Describe any two methods of finding natural frequency of MDOF system. 10
- (b) Derive the expression for the Duhamel's integral in respect of response of single degree of freedom system to generate dynamic loading. 10
3. A machine of weight 1,000 kg. is mounted on a steel beam of negligible weight at centre. The rotor in the machine generates a harmonic force of 3,000 kg. at a frequency 60 rad/sec. Assume 10% damping, calculate amplitude of motion of machine, force transmitted to supports and phase angle. Span of beam 3 m,  $E = 2 \times 10^5$  MPa and  $I$  of beam  $5000 \text{ cm}^4$ . 20
4. A vibrating system consists of a mass of 5 kg, spring of stiffness 120 N/m and a damper with a damping coefficient of 5 N-s/m. Calculate
- Damping factor
  - Natural frequency of the system
  - Logarithmic decrement

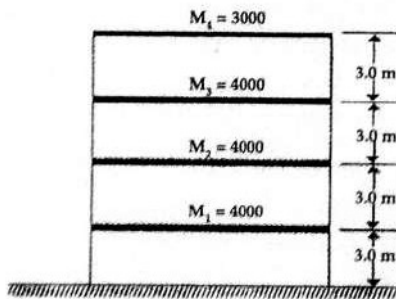
23732. (P-4)(Q-8)(23) (2)

- (d) The ratio of two successive amplitude
- (e) The number of cycles after which the initial amplitude reduces to 25%. 20
5. Explain floor diaphragm action and state the difference between rigid diaphragm and flexible diaphragm. 20
6. (a) What are various kinds of dynamic loadings? 10
- (b) What is modal analysis? Which properties of the eigen vector facilitate the modal analysis? 10
7. Describe the mechanism of liquefaction and the measures to reduce liquefaction potential. 20
8. A four-storey reinforced concrete frame building as shown is situated in Roorkee. The height between the floors is 3 m and total height of the building is 12 m. The dead load and normal live load is lumped at respective floors given in the figure as M4, M3, M2 and M1 (Take unit of load as kN). The soil below the foundation is assumed to be hard rock. Assume

23732. (P-4)(Q-8)(23) (3)

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building is intended to be used as a hospital. Analyse the building using seismic coefficient method and find the base shear as per IS 1893. Distribute the base shear along the height of the building and draw design lateral load distribution and the storey shear force distribution diagram. 20



Roll No. ....

**23732**

**M. Tech. 2nd Semester (Civil Engg.)  
(Computer Aided Structural Engg.)  
Examination – June, 2023**

**STRUCTURAL DYNAMICS & EARTHQUAKE  
ENGINEERING**

Paper : 21MTCASE22C2

Time : Three Hours ]

[ Maximum Marks : 100

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt any five questions. All questions carry equal marks.

1. (a) Examine the steps to be followed for the dynamic analysis of structure.
- (b) Distinguish between lumped mass and continuous mass systems.
- (c) List out the code based methods for seismic design.