

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
**EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2019**

**Course Code: CE468**

**Course Name: STRUCTURAL DYNAMICS AND EARTHQUAKE RESISTANT DESIGN**

Max. Marks: 100

Duration: 3 Hours

*(IS 1893, IS 13920 & IS 4326 are permitted in the exam hall.)*

**PART A**

*Answer any two full questions, each carries 15 marks.*

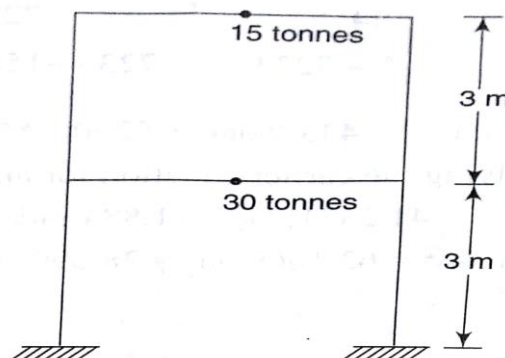
Marks

- 1 a) Distinguish between lumped mass and continuous mass systems. (3)
- b) For the free vibration of a damped SDOF system, derive the condition for occurrence of: i) over-damped motion ii) critically damped motion iii) under-damped motion. (12)
- 2 a) Determine the free vibration displacement response of a SDOF system at  $t = 5$  s for the following data. (5)  
 Natural frequency = 12 rad/s, Damping ratio = 0.15, Initial velocity = 10 cm/s, Initial displacement = 5 cm.
- b) What is harmonic loading? Give examples of any two cases when a system is subjected to harmonic loading. (3)
- c) Prove the condition of orthogonality of mode shapes. (7)
- 3 a) How does the free vibratory response of an undamped SDOF system differ from that of an undamped MDOF system? (3)
- b) A model of two storey RCC frame is shown in the figure 1. Determine the natural frequency and mode shapes for the following data. (12)

Cross sectional dimension of column -250 mm by 250 mm

Storey Height – 3m

M 25 grade concrete is used.



**Figure 1**

**PART B**

*Answer any two full questions, each carries 15 marks.*

- 4 a) Consider the following causes for the occurrence of earthquakes: i) volcanism ii) (3)  
rupture of tectonic plates iii) reservoir induced seismicity. Assuming the causes do not occur simultaneously, which of the above three causes will produce earthquake of relatively greater magnitude? Justify your answer.
- b) Distinguish between seismogram and accelerogram. (4)
- c) Briefly explain the classification of seismic waves. (8)
- 5 a) Consider the case of an Earthquake which occurred in Kathmandu, Nepal which (3)  
recorded a Richter scale magnitude 7.2 and a MSK scale Intensity IX at its source. Comment on the magnitude and intensity of the earthquake in New Delhi.
- b) State the assumptions involved in seismic design as per IS 1893. (4)
- c) Enumerate the steps involved in response spectrum method of analysis of (8)  
buildings.
- 6 a) A four-storey reinforced concrete frame building as shown is situated in Roorkee. (12)  
The height between the floors is 3m and total height of the building is 12m. The dead load and normal live load is lumped at respective floors given in the figure as  $M_4$ ,  $M_3$ ,  $M_2$  and  $M_1$  (Take unit of load as kN). The soil below the foundation is assumed to be hard rock. Assume 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.

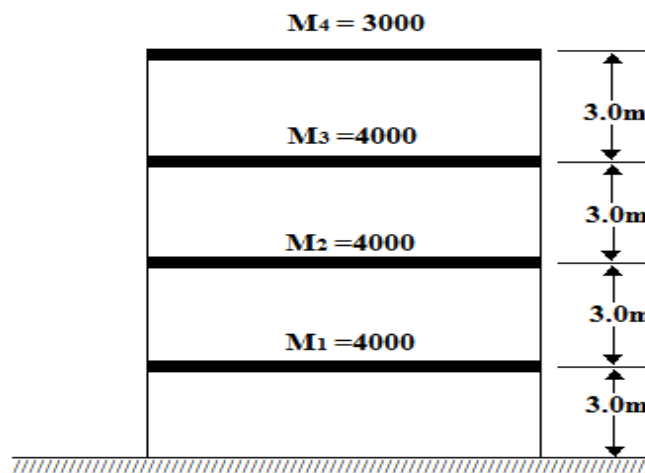


Figure 2

- b) Distinguish between ordinary moment resisting frame and special moment resisting frame. (3)

**PART C**

*Answer any two full questions, each carries 20 marks.*

- 7 a) With reference to the effect of irregularities on structural behaviour, briefly explain : i) plan irregularities ii) vertical irregularities iii) structural irregularities (15)
- b) Distinguish between soft storey and weak storey. (5)
- 8 a) Distinguish between centre of mass and centre of rigidity of a building. How can the possibility of occurrence of torsional behaviour explained using the relative position of centre of mass and centre of rigidity. (7)
- b) Briefly explain the terms : i) strength ii) stiffness iii) ductility. (5)
- c) What are shear walls? State the classification of shear walls as per IS 13920. Also use sketches to show the predominant failure modes of squat shear wall and slender shear walls. (8)
- 9 a) Briefly discuss the provisions of IS 13920 for ductile detailing of RC columns under the following heads: 1) Cross section proportioning and Minimum grades of reinforcing steel and concrete 2) longitudinal reinforcement 3) transverse reinforcement 4) development/ anchorage length requirements. Use neat sketches. (20)

\*\*\*\*