Master of Construction Engineering 2nd Semester Examination 2024

STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING

Assume any relevant data not provided

Answer any Three Questions out of Five

1 a) Derive **Free vibration solution** of an **Damped SDOF** structural system. Show the damped natural time period expression. **15**

b) Derive **Logarithmic decrement method** to evaluate the critical damping ratio. **8**

c) Calculate the **natural frequency and time period** of the simple supported beam as shown in Fig.1. Neglect the mass of the beam. **4**

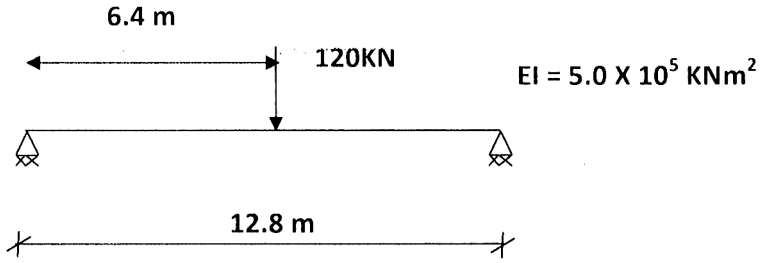

Fig.1

d) If a **springs is placed just below the load** (at the centre of the beam). Compute the change in the circular frequency of the system. The spring constants are **3 kN/m.** **3**

e) Find the natural frequency of the system with the spring at the mid span when the **supports are fixed** instead of simple supported system **3**

2 (a) What do you mean by '**Fundamental Natural Frequency' of MDOF** system? Distinguish between SDOF & MDOF system of a shear building model in this context. **5**

(b) Derive the equation for **Multi Degree Freedom System (MDOF)** and derive the **Eigen solution** of the MDOF system? **20**

(c) Discuss on the various **natural frequencies and corresponding mode shapes** and their participation in the overall vibration of the system. **8**

3 a) Derive the solution for steady state motion of the **SDOF** system under Forced Vibration of $\mathbf{M}\ddot{x} + \mathbf{C}\dot{x} + \mathbf{K}x = \mathbf{F_f}\,\mathbf{Cos}\,\omega_f\mathbf{t}$. **16**

b) Discuss **Resonance** in forced vibration and its effect on structures **5**

c) Derive the expression for **Dynamic Load Factor** and discuss the significance of **Tuning Factor & Critical Damping Ratio** on **it**. **8**

d) **Evaluate the D.L.F** when the tuning factor is **0.99** in case of steel structures **4**

4 a) Discuss on favourable of **structural features** to **mitigate earthquake** hazards. **5**

b) Discuss in brief on the **Richter's Scale** and **MMI Scale** of Earthquakes? **4**

c) What are the **Basic Safety Objectives** from **Earthquake Resistant Design**? **3**

d) Define **Ductility** and its **role on earthquake resistant design.** **5**

e) **Distinguish** between **Near field & Far field effect** of earthquake. **8**

f) Distinguish between **Equivalent Static** and **Response Spectrum** methods of analysis for Earthquake Resistant Design of Structures. 8.

5 A **Four Storied RCC frame office building** located at **Darbhanga, Bihar**. The plan of the building is shown below in **Fig 1.**

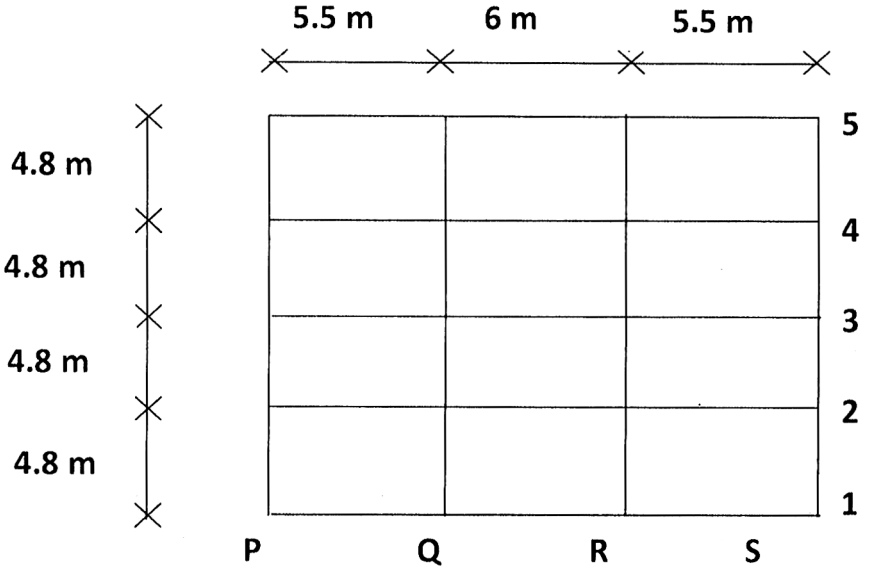

Fig. 1

The **Soil** condition is **Soft** and supported on **Raft** foundation. The RC frames are in-filled with **AAC Blocks. The lumped** weight due to **DL** is **9.5 KN/m^2** on intermediate floors and **9 KN/m^2** on roof. The **Live load** on floors is **2 KN/m^2**. Determine the Design seismic Force of the **2D frame 3/P-Q-R-S** by **Response Spectrum** method. **34**

The free vibration analysis dynamic properties are given below.

Natural Period (Sec)	**Mode 1**	**Mode 2**	**Mode 3**
	1.15	**0.81**	**0.39**
Floor	Mode Shape		
Roof	1.000	- 0.879	0.801
3rd Floor	0.901	- 0.201	- 0.609
2nd Floor	0.672	1.000	0.103
1st Floor	0.433	0.566	1.000