Ref. No.: Ex/CON/PC/H/T/413/2024

B. Construction Engineering 4th Year 1st Semester Examination 2024

EARTHQUAKE ENGINEERING & DYNAMICS ANALYSIS (Hons.)

Time : Three hours Full Marks : 100

Assume any relevant data not provided

Answer any Four Questions

1 a) What are the **Basic Safety Objectives** from Earthquake considerations? Discuss the important **characteristics** of **Earthquakes?** 5[CO5]

b) Distinguish between **Magnitude & Intensity** of Earthquakes 5[CO5]

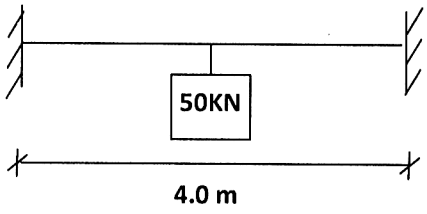
c) Define **Ductility** and draw ductile details of the **Beam-Column Joint.** 5[CO5]

d) Discuss **Favourable Structural Elevation** for better earthquake resistance 5[CO5]

e) Discuss Response Spectrum in Earthquake Engineering 5[CO5]

2 a) Describe **D' Alembert's principle** and derive the **dynamic equation of equilibrium** of SDOF structural system. 6[CO1]

b) Calculate natural & circular frequency, time period of the fixed beam spanning 4 m. The beam is made of mild steel **50 mm square section** and subjected to a concentrated load of **50 KN** at the central span as shown in Fig.1. Neglect the mass of the beam. 4[CO2]



$E = 2.0 \times 10^5$ MPa

Fig 1: Fixed Beam

c) If the beam is made of **circular section** mild steel of same cross sectional area calculate the **change in time period.** 4[CO3]

d) If the beam is made of 50 mm square **Aluminium** bar $E = 6.9 \times 10^4$ MPa, $\xi = 2.5\%$, calculate the **change in frequency** of the beam. 4[CO2]

e) If the **load is placed by a springs** at the centre of the beam, compute the change in the circular frequency of the system. The spring constants is **300 kg/cm.** 7[CO2]

3 a) Discuss **damping of dynamic system** and types of damped condition? 3 [CO3]

b) Derive free **under-damped** vibration solution of a **SDOF system.** 12[CO3]

c) Deduce **Logarithmic Decrement Method** for evaluating **Critical Damping Ratio** 10[CO3]

[Turn over

4 a) Discuss **Transient phase & Steady State Motion** in forced vibration? 4 [CO4]

b) Derive the solution for steady state motion of the **SDOF** system under Forced Vibration of $\mathbf{M}\ddot{x} + \mathbf{C}\dot{x} + \mathbf{Kx} = \mathbf{F_f}\,\mathbf{Cos}\,\omega_f\mathbf{t}$. 12[CO4]

c) Derive the expression for **Dynamic Load Factor** and discuss the significance of **Tuning Factor** & Critical Damping Ratio on DLF. 6[CO4]

d) **Evaluate D.L.F** when the tuning factor is **0.95** and damping ratio is **3 %.** 3[CO4]

5 A **Four Storied RCC frame office building** located in **Kakdwip, West Bengal**. The plan of the building is shown below in **Fig 2.** **25[CO6]**

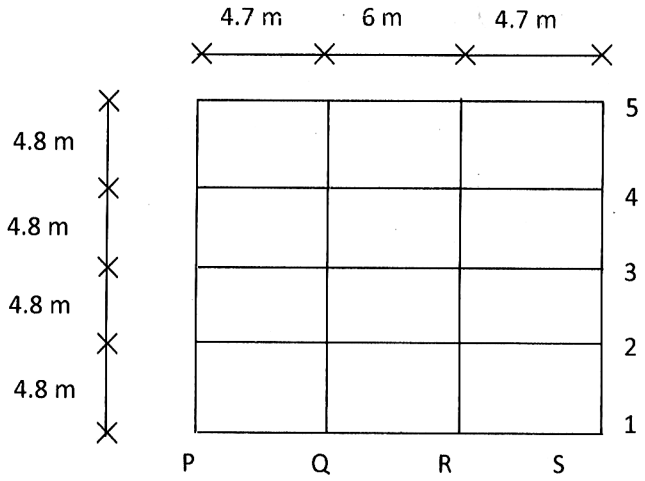


Fig. 2 : Plan of the Building

The building is supported by **raft foundation** on **soft** soil. The RC frames are in-filled with AAC Block. The floor height is 4 m, plinth height is 0.8 m and foundation depth is 1.7 m. **The lump weight due to Dead Load** is **11.5 KN/m^2** on floors and **10 KN/m^2** on roof. The Live load on floors is **3 KN/m^2**. Determine the Design seismic Force of the frame **2/P-Q-R-S** by **dynamic analysis** adopting **Response Spectrum Method** as per **IS:1893 Part-I, 2016**. The free vibration analysis dynamic properties are given below.

Natural Period (S)	Mode 1	Mode 2	Mode 3
	1. 5	**0.806**	**0.302**
Floor	**Mode Shape**		
Roof	**1.000**	**1.000**	**0.712**
3rd Floor	**0.737**	**0.394**	**-0.699**
2nd Floor	**0.561**	**-0.555**	**- 0.433**
1st Floor	**0.340**	**- 0.766**	**1.000**