Master of Construction Engineering 2nd Semester Examination 2018

STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING

Time : Three hours | Assume any relevant data not provided | Full Marks : 100

Answer any Four Questions

1 a) What are the **Basic Safety Objectives** from Earthquake considerations? Discuss the important characteristics of an **Earthquake?** 5

b) Distinguish between **Near field & Far field effect** of earthquake. 5

c) Discuss on **favourable structural features** for **earthquake hazards mitigation** 4

d) Define **Ductility** and draw ductile details of the **Beam-Column Joint.** 5

e) Discuss **Response Spectrum Method** for Dynamic Analysis of structures 6

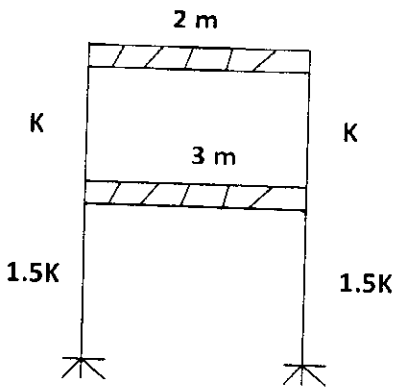
2 a) Discuss **damping of a dynamic system ?** 3

b) Derive **Free vibration** solution of an **Under damped SDOF** system. 12

c) What do you mean by Critical Damping Ratio.
Evaluate Critical Damping Ratio by **Logarithmic Decrement Method.** 10

3 a) Derive the equation for **Multi Degree Freedom System (MDOF)** of a lumped mass model and discuss the significance of **Eigen values** and **Eigen vectors** of various modes of a dynamic system? 11

b) Calculate the natural frequencies and mode shapes of the following 2DOF system. 14



m = 250 N/Sec^2 /meter

K = 4 KN/Meter

Fig. 1

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

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

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

d) **Evaluate the D.L.F** when the tuning factor is **0.95** and damping ratio is **2 %.** 3

5 A Four Storied RCC frame office building located in Bhuj, Gujrta. The plan of the building is shown below in Fig 2. The floor to floor height is 4 m & Plinth level to Foundation level is 2 M.

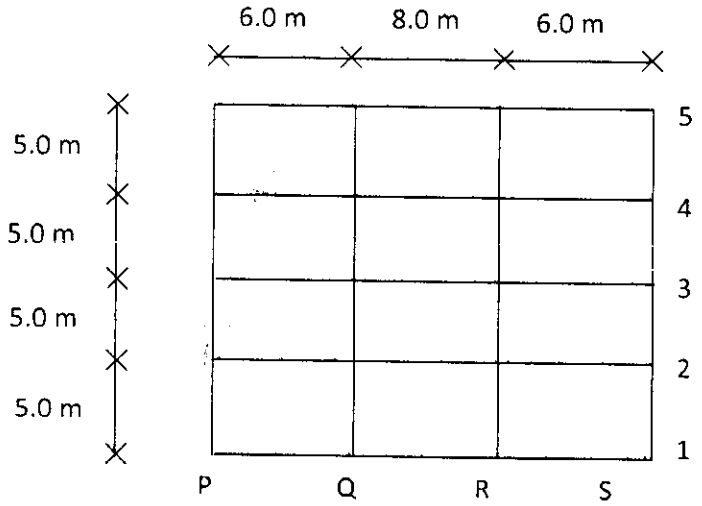


Fig. 2

The soil condition is medium stiff and supported on Raft foundation. The RC frames are in-filled with brick-masonry. The lump weight due to DL is 14.5 KN/m^2 on floors and 12.5 KN/m^2 on roof. The Live load on floors is 5 KN/m^2. Determine the Design seismic Force of the frame R/1-2-3-4-5 by **dynamic analysis** method. The free vibration analysis dynamic properties are given below. 25

Natural Period (S)	Mode 1	Mode 2	Mode 3
	1.48	0.854	0.436
Floor	Mode Shape		
Roof	1.000	1.000	0.724
3rd Floor	0.824	0.368	-0.798
2nd Floor	0.576	-0.548	- 0.526
1st Floor	0.367	- 0.734	1.000