Master of Construction Engineering 2nd Semester Examination 2017

STRUCTURAL DYNAMICS & EARTHQUAKE ENGINEERING

Assume any relevant data not provided

Answer any Four Questions

Times : Three hours | Full Marks : 100

1 a) Discuss **D' Alembert's principle** for equation of motion of a dynamic system 4

b) Derive **free vibration solution of an Un-damped SDOF** system & its significance. 11

c) Discuss the **Critical Damping Ratio**. How do you evaluate it? 10

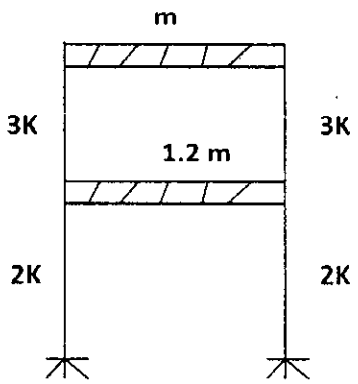
2 a) Discuss '**Steady State Motion**' of a under-damped forced vibration system? 4

b) Derive the solution for steady state motion of the **SDOF** system under Forced Vibration of $\mathbf{M}\ddot{x} + \mathbf{C}\dot{x} + \mathbf{Kx} = \mathbf{F_0}\ \mathbf{Sin}\ \mathbf{w_f t}$. 14

c) Derive the expression for **Dynamic Load Factor**. Discuss its significance and evaluate the D.L.F when the tuning factor is **0.98** and damping ratio is **0.2 %.** 7

3 a) Derive the equation for **Multi Degree Freedom System (MDOF)** of a lumped mass model and discuss the significance of different **Natural Frequencies** and corresponding **mode shapes** of a dynamic system? 11

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



m = 300 N/Sec^2 /meter

K = 2.5 KN/meter

Fig. 1

4 a) Discuss on **unfavourable structural features** in light of **Seismic Disaster Mitigation.** 5

b) Distinguish between the **Near field & Far field effect** of earthquake on structures. 6

c) What are the important characteristics of an **Earthquake?** 4

d) Distinguish between **Magnitude & Intensity** of earthquake. 4

e) What are the **Basic Safety Objectives** from Earthquake considerations? Define **Ductility** and discuss the **role of ductility** in achieving the objectives. 6

5 a) Distinguish between Dynamic Analysis and Response Spectrum method with respect to seismic design of structure according to relevant Indian code. 8

b) Calculate **natural period, circular frequency** of the cantilever beam spanning 0.7 m. The member is made of **mild steel round section of diameter 50 mm** and subjected to a load of 18 KN at the free end as shown in **Fig.2.** Neglect the mass of the beam. 7

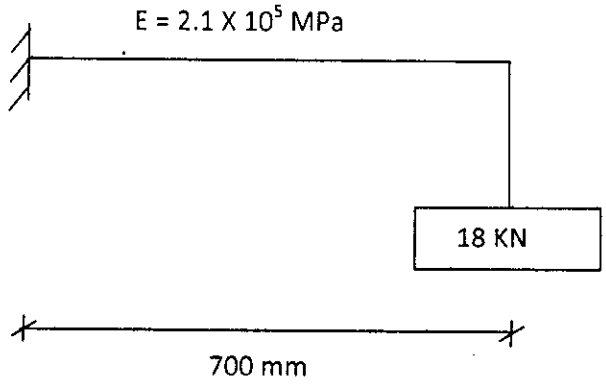


Fig 2

c) Find also the damped natural frequency of the system with the spring at the end if the critical damping ratio (ξ) is 2 % 3

b) If the cantilever is made of square section mild steel of same cross sectional area calculate the change in time period. 4

e) If the same cantilever is made with 50 mm diameter round bar made of Aluminium with E = 7.0 X 10^4 MPa, ξ = 3.0%, calculate the change in frequency of the beam. 3

6 Calculate the Total Base Shear (Vb) of the building as shown in **Fig.1** by **Dynamic method of analysis as per IS: 1893, Part-I** adopting **SRSS** method. Seismic weights of the building at roof and first floor levels are 1000 KN and 1200 KN respectively. Plan dimension of the building is 12 m by 16 m.

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