

Course Code: 11M1WCE112

Max. Marks: 35

Course Name: Structural Dynamics

Course Credit: 03

Max. Time: 120 Minutes

Note: All questions are compulsory. Carrying of mobile phone during examination will be treated as case of unfair means. Assume any missing data.

- Q.1 (a) Write a short note on Equivalent Stiffness of a structure. [2]
(b) Describe Free Vibrations of a structure and differentiate it from Forced Vibrations [3]
- Q. 2 (a) What are the different types of Dynamic Loading? Categorize them on the basis of their sources. [2]
(b) Determine the natural frequency of a Single Degree of Freedom system having a weight of 10kN and a stiffness of 1000 N/mm². [3]
- Q.3 Draw a graph showing the variation of displacement response of an undamped Single Degree of Freedom (SDoF) system with a mass 'm', and stiffness 'k' vibrating freely when subjected to an initial displacement of 'x₀'. Formulate the necessary equations of response of the system. [5]
- Q.4 Derive the Equation of motion of a Single Degree of Freedom (SDoF) system, subjected to an external force 'f(t)'
(a) using Newton's second law of motion. [2]
(b) using D' Alembert's Principle. [2]
- Q.5 Discuss salient differences between under-damped, critically damped and over-damped systems. [3]
- Q.6 A free vibration test is conducted on a Single Degree of Freedom System (SDoF) structure as shown in Figure 1 below. During the test, the roof of the system is displaced by 5 mm. After the instantaneous release of this initial displacement, the maximum displacement at the end of first complete cycle of oscillation was only 4mm and the period of this displacement cycle is T=1.4. Assuming that the weight (W) and stiffness (k) of the system are 87583 kg and 180kN/mm, respectively, determine:
(i) Force required to displace the mass by 5mm (F₀),
(ii). Un-damped frequency of vibration (ω), and

(iii). Damping Ratio (ξ).

[4]

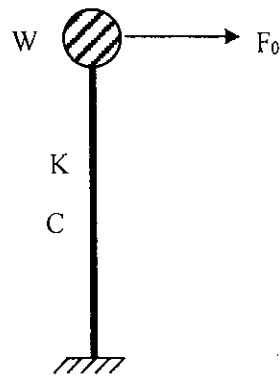


Figure 1: Schematic of a single degree of freedom system

Q. 8 calculate the vibration frequencies of the structure illustrated in Figure 2. The lateral story stiffness are 20 kN/mm, 18 kN/mm, and 22 kN/mm for 1st, 2nd, and 3rd story, respectively and mass are 200 kN for each storey. Also calculate the mode shape of the structure. Generalize the masses and stiffness corresponding to the mode shapes of the structure. [9]

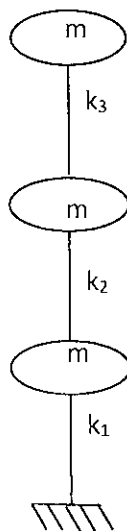


Figure 2: Three-story structure with three DOFs