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T 3 Examination – December 2018

M. Tech. 1st Semester (Structural Engineering) & B. Tech. 7th Semester (Civil Engineering)

Course Code: *11M1WCE112*
Course Name: *Structural Dynamics*
Course Credit: *03*

Max. Marks: 35

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]

(c) Describe Free Vibrations of a structure and differentiate it from Forced Vibrations [2]

Q. 2 (a) What are the different types of Dynamic Loading? Categorize them on the basis of their sources. [2]

(c)Determine the natural frequency of a Single Degree of Freedom system having a weight of 10kN and a stiffness of 1000 N/mm^2. [2]

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 'xo'. Formulate the necessary equations of response of the system. [4]

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 (Fo),

(ii). Un-damped frequency of vibration (ω), and

(iii). Damping Ratio (ξ). [4]

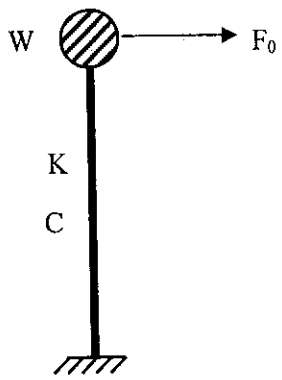

Figure 1: Schematic of a single degree of freedom system

Q.7 Develop the Fourier series for the square wave force function shown in Figure 2. Draw a graph of the partial Fourier sums including 1, 2, 3, and 4 terms. (Assume fundamental frequency of force function F(t) is ω_f, time period for one cycle is T).

[6]

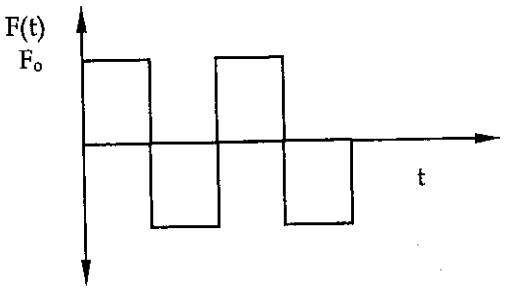

Figure 2: Square wave loading function

Q. 8 calculate the vibration frequencies of the structure illustrated in Figure 3. The lateral story stiffness and floor mass are 18000000 N/m and 20,000 kg, respectively. Also calculate the mode shape of the structure. Generalize the masses and stiffness corresponding to the mode shapes of the structure.

[6]

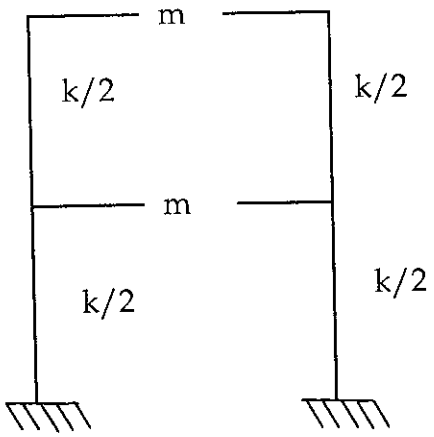

Figure 3: Two-story structure with two DOFs