BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER: V & VII**
BRANCH: CIVIL **SESSION: MO/2023**

SUBJECT: CE412 STRUCTURAL DYNAMICS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data handbook/Graph paper etc. to be supplied to the candidates in the examination hall.
6. IS 1893 (Part 1): 2016 is allowed in the examination hall.

			CO	BL
Q.1(a)	Consider a cantilever beam with two spring and a weight system as shown in figure 1. Assume that the beam and springs supporting the weight 'W' are massless.	[5]	1	4

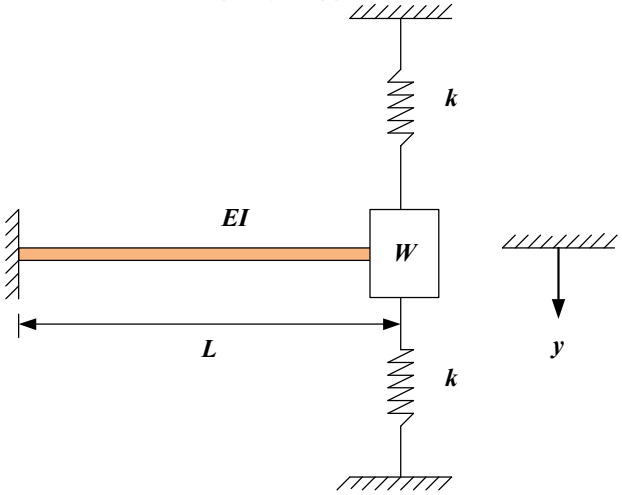

Figure 1 Cantilever beam with two spring weight system

If in this question, L = 150 cm, EI = 3 x 109 N-cm^2, W = 15000 N and K = 4000 N/cm. Find out the following:

1. Natural period
2. Equation of motion
3. If the weight 'W' has an initial displacement y0 = 2.5 cm and an initial velocity v0 = 50 cm/s then determine the displacement, velocity, and acceleration of the system after 1 second.

Q.1(b)	What do you mean by logarithmic decrement? Show that for an underdamped system in free vibration, the logarithmic decrement may be written as: $\delta = \frac{1}{k} ln \frac{y_i}{y_{i+k}}$ Where, k is the number of cycles separating two measured peak amplitudes y_i and y_{i+k}.	[5]	1	3
Q.2(a)	The undamped spring-mass system has a mass of 4.5 kg and a spring stiffness of 3500 N/m. It is excited by a harmonic force having an amplitude F_0 = 100 N and an excitation frequency of 10 radian/s. The initial displacement and initial velocity of the system are 0.015 m and 0.15 m/s respectively. Determine the following: 1. Frequency ratio of the system. 2. Amplitude of the forced response. 3. The displacement of the mass at time t = 2 second. 4. The velocity of the mass at time t = 4 second. 5. The acceleration of the mass at time t = 6 second.	[5]	1	4
Q.2(b)	Consider a spring mass system is subjected to a general type of force. Based on concept of impulse of a force, derive the expression of the complete total displacement of the system? Discuss the term Duhamel's integral in this context?	[5]	1	2

PTO

Q.3(a) Calculate the vibration frequencies of the structure shown in figure.2. The storey stiffness and floor mass are provided here as mass (m) = 20,000 kg and story stiffness (k) = 18 x 10^6 N/m. [5] 2 4

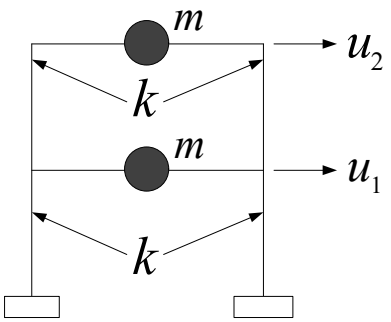

Figure 2 Two storey structure with two DOFs

Q.3(b) Draw the mode shapes of the structures shown in Question no. 3(a) with proper magnitudes at the 1st and 2nd floor level of the structure. Also show that mode shapes are orthogonal. [5] 2 4

Q.4(a) Differentiate among the following three finite difference method with suitable sketches: [5] 3 2

1. Forward difference method
2. Backward difference method
3. Central difference method

Out of these three methods which method is implicit type and why?

Q.4(b) Derive the expression for time domain solutions (necessary for algorithmic steps) of dynamic equation of motion of a spring mass damper SDOF system by Central Difference method. [5] 3 2

Q.5(a) Discuss the various steps for determining the design lateral forces at various floors of a building based on Equivalent Static Method as per IS 1893 (Part -1): 2016. [5] 4 2

Q.5(b) The plan and elevation of a three stored RCC school building is shown in figure 3. Determine the design seismic loads on the structure by equivalent static analysis method. The building is located in seismic zone V. The type of soil encountered is medium stiff. It is proposed to design the building with a special moment resisting frame. The intensity of dead load is 10 kN/m^2. The intensity of live load on the floors is 3 kN/m^2. [5] 4 4

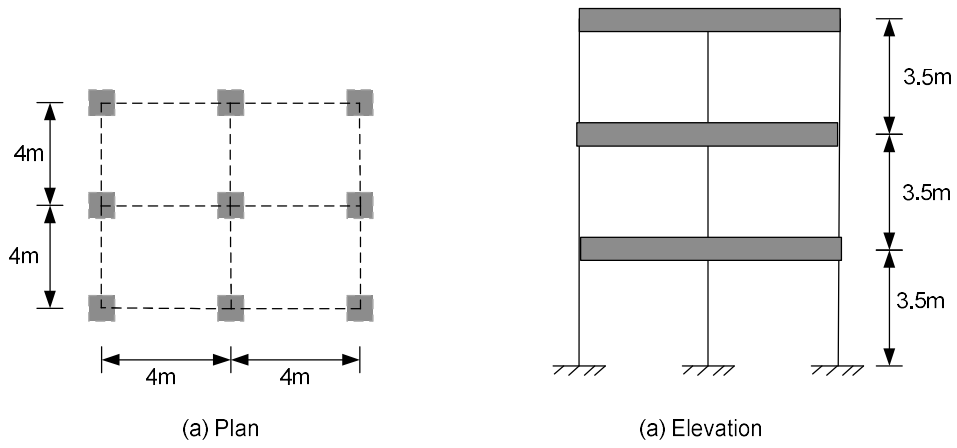

Figure 3 Building Configuration

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