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

CLASS: MTECH **SEMESTER : I**
BRANCH: CIVIL **SESSION : MO/18**

SUBJECT: CE503 STRUCTURAL DYNAMICS

TIME: 3 HOURS **FULL MARKS: 60**

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 hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Derive the equation of motion for a cantilever concrete beam of length 'l' and flexural rigidity 'EI' carrying a weight 'w' sustained from a spring of stiffness 'k_s' at its free end also Determine natural frequency of the system. [5]

Q.1(b) A string of length L is under tension N between two fixed supports at its ends. The string has negligible mass and supports a concentrated mass m at a distance 'a' from the left support. Write the equation of motion for small transverse oscillations of m from the equilibrium position and find the angular frequency. [5]

Q.2(a) A rotating machine having a total mass of 200 kg is supported by four isolators on a rigid floor. The total stiffness of the isolators is 1000×10^3 N/m. When operating, the machine generates a vertical harmonic force with an amplitude of 450N at a rotation frequency of 50 Hz. Assuming that the damping is $\xi = 0.20$, check that the amplitude of motion does not exceed the allowable amplitude of 0.03mm and that the force that is transmitted to the floor does not exceed the allowable force of 50 N. [5]

Q.2(b) A steel rigid frame (one bay one storey) having hinged supports, carries a rotating machine. This escorts a horizontal force at girder level in the form of "50000 sin 11 t" N assuming 4% critical damping, what is steady state amplitude of vibration? Moment of inertia for columns $=1500\times10^{-7}m^4$, $E=21\times10^{10}N/m^2$. [5]

Q.3 For any given arbitrary time, varying force on a SDOF system, develop solution technique using central difference method and thereby write a computer algorithm to determine the response. [10]

Q.4 A model of two-storey RCC frame is shown in figure Q.4. Determine the natural frequency and mode shapes assuming the beam- column joints to be rigid, for the following data. Dimensions of columns 250 × 250 mm, Storey height 3 m [10]

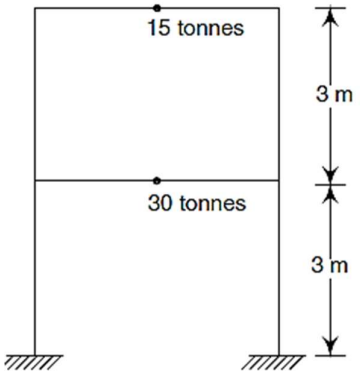

Figure Q.4

Q.5(a) Consider the concrete frame shown in Figure Q.5(a1) with 5% damping ratio. Assume that the total 50 kN weight is concentrated on the beam. Assume that the beam is rigid in flexure with respect to the 300mm square columns. Considering that the beam is longitudinally rigid, calculate the maximum response of the frame where the maximum ground acceleration is 0.2g. The response parameters to be determined are: (a) the maximum displacement at beam level, (b) the Base shear. Use the design spectrum shown in Figure Q.5(a2) [5]

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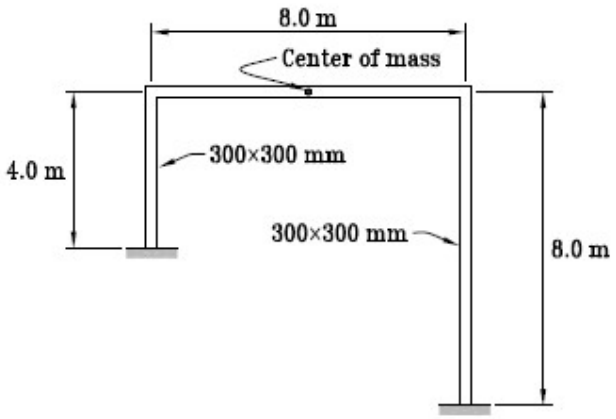

Figure Q.5(a1)

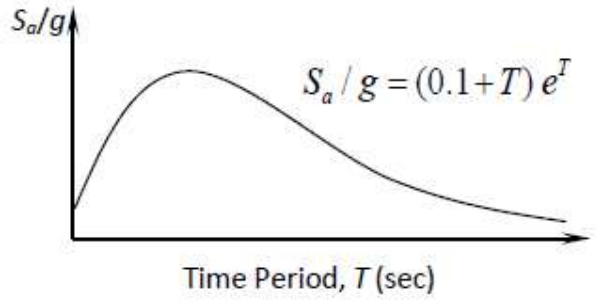

Figure Q.5(a2)

Q.5(b) Outline the assumptions made by IS1893 for the earthquake resistant design of structures. [5]

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