USN | | | | | | | 15CV744

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019
Structural Dynamics

Time: 3 hrs.   Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1   a. Differentiate between : i) Forced vibrations and free vibrations
                                ii) Random excitation and harmonic excitation
                                iii) Oscillation and vibration   (06 Marks)

   A body of 10kg is supported on spring of stiffness 300N/in and a dash-pot is connected to it, which produces a resistance of 0.04N at a velocity of 0.02m/s. In what ratio will be the amplitude of vibration reduces after 5 cycle?   (10 Marks)

OR

2 a. Derive an expression for motion x(t) of an under damped Single Degree of Freedom system (SDOF) subjected to free vibration.   (10 Marks)

   b. A diver weighing 90kg stands at the end of a cantilever diving board of span lm. The diver oscillates at a frequency of 2Hz. What is the flexural rigidity of the diving board?   (06 Marks)

Module-2

3 a. What is magnification factor? Explain its dependence on frequency ratio and damping ratio with a qualitative graph relating to all the above three quantities.   (08 Marks)

   Source of vibration with frequency 300Hz is to be isolated from an equipment of mass 15kg. Determine the stiffness of spring if 50% of vibration is to be isolated, damping is negligible.
                                                                                  (08 Marks)

OR

4 a. Derive an expression for the force transmitted to the foundation in a damped Single Degree of Freedom (SDOF) system due to harmonic force, $F(t) = Fo \sin \omega t$.   (08 Marks)

   b. A machine weighing 600N is supported by springs of stiffness K = 20 N/mm and dampers of damping coefficient, C 0.01N-s/mm. A harmonic force of amplitude 20N is applied. Compute the resonant amplitude.   (08 Marks)

Module-3

5   Determine the natural frequencies and mode shapes for structure as shown in Fig Q5. Draw the mode shapes. Given $I = 5 \times 10^5 \ mm^4$, $E = 2.5 \times 10^4 N/mm^2$, $m_1 = 1360kg$, $m_2 = 660kg$.

Fig Q5.   (16 Marks)

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OR

6   Compute the natural frequencies and mode shapes for the shear frame shown in the Fig Q6. Given EI = 23.83 x 10^6 Nm^2 for all columns.

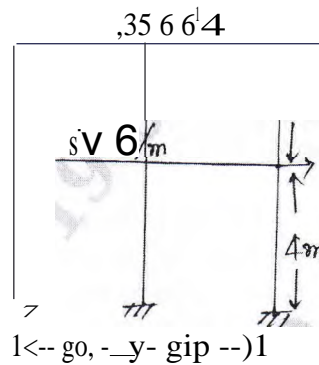Fig Q6   (16 Marks)

Module-4

7   Determine natural frequencies and steady state response of the multi degree freedom system frame at t = 0.1 sec for the Fig Q7.

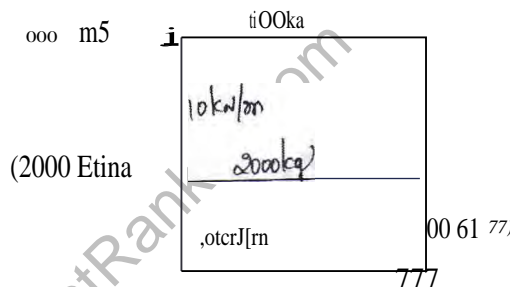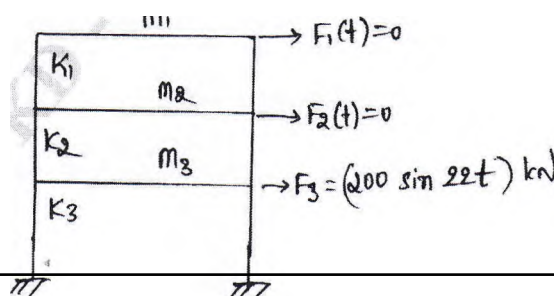Fig Q7   (16 Marks)

OR

8   For a three storeyed shear building subjected to harmonic loading (Fig Q8), compute the response, given the results of the free vibration analysis. Neglect axial deformities in all structural elements. Given: Stiffness of floor : K, = K2 = 160 x 10^6 N/m ; K3 = 240 x 10^6 N/m. Mass of the floor : M_1 = M2 = M3 = 20 x 10^3 kg (or Ns^2/m). The natural frequencies are \Iv, = 43.87 rad/s, w2 = 120.15 rad/s, w3 = 167 rad/s.

The mode shapes are as follows: $(1), = \begin{vmatrix} 1 \\ 0.76 \\ 0.34 \end{vmatrix}$ $(1)2 = \begin{vmatrix} 1 \\ -0.8 \\ -1.16 \end{vmatrix}$ $(1)3 = \begin{vmatrix} 1.0 \\ -2.43 \\ 2.51 \end{vmatrix}$

(16 Marks)

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Module-5

9   Develop stiffness matrix and mass matrix for a simply supported beam of length L, mass density p, cross section area A, flexural rigidity E1.   (16 Marks)

OR

10 Compute the lowest natural frequency of simply supported beam of span 2m and mass per unit length 500N/m, El = 833.33 x 10 Nmm . Consider the beam as a single element as indicated in Fig 10.
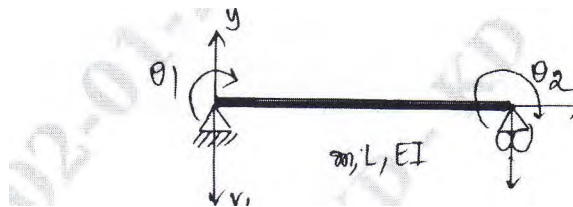

Fig Q10   (16 Marks)