CBCS SCHEME

USN

18CAE/MDE12

First Semester M.Tech. Degree Examination, Aug./Sept.2020
Advanced Theory of Vibrations

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Enumerate vibration of mechanical systems and causes of vibration. **(06 Marks)**

b. A body describes simultaneously two motions $x_1 = 3\sin 40t$, $x_2 = 4\sin 41t$. What is maximum and minimum amplitude of combined motion and what is the beat frequency? **(04 Marks)**

c. Obtain an expression for the natural frequency of spring mass system taking mass of spring into account. **(10 Marks)**

OR

2 a. Explain active vibration control system with neat sketches and example. **(10 Marks)**

b. Find total response of a single degree of freedom system with mass of 10 kg damping coefficient 20 N-S/m, spring constant 4000 N/m, initial displacement = 0.01m, initial velocity = 0 m/s under the following condition.

An external force $F(t) = F_0 \cos\omega t$ acts on the system with $F_0 = 100$ N and $\omega = 10$ rad/s. **(10 Marks)**

Module-2

3 a. Explain why vibration measurement is necessary. **(04 Marks)**

b. Write a note on vibration measurement scheme with block diagram. **(06 Marks)**

c. What is transducers? Explain any two transducers used in vibration analysis. **(10 Marks)**

OR

4 a. Explain two approaches used in dynamic testing of machines and structures. **(08 Marks)**

b. Explain the following:

(i) Machine maintenance technique

(ii) Machine condition monitoring techniques **(12 Marks)**

Module-3

5 a. Determine the response of spring mass system subjected to step excitation. **(10 Marks)**

b. Find the response equation for a spring mass dashpot system subjected to impulse force when time t = 0. **(10 Marks)**

OR

6 a. Explain the following terms with respect to random vibrations:

(i) Mean square value

(ii) Wide band

(iii) Narrow band

(iv) White noise

(v) Band limited excitation **(10 Marks)**

b. The eccentricity of a rotor (x), due to manufacturing errors, is found to have the following distribution

$$P(x) = \begin{cases} kx^2 & 0 \le x \le 5 \\ 0 & \text{elsewhere} \end{cases}$$

where k is constant. Find:

(i) the mean, standard deviation, and the mean square value of the eccentricity and

(ii) the probability of realizing x less than or equal to 2 mm. **(10 Marks)**

Module-4

7 a. Differentiate linear and non-linear system of vibrations. **(04 Marks)**

b. Construct the trajectories of a simple harmonic oscillator by the method of isoclines. The equation of simple harmonic is given by $\ddot{x} + \omega_n^2 x = 0$. **(08 Marks)**

c. Find the trajectories equation for undamped pendulum, and show trajectories on phase plane. **(08 Marks)**

OR

8 a. Explain perturbation method for non-linear vibrations. **(10 Marks)**

b. Explain hard spring and soft spring characteristics. **(05 Marks)**

c. Explain Mathieu equation. **(05 Marks)**

Module-5

9 a. Determine displacement equation for vibration of strings. **(10 Marks)**

b. A bar fixed at one end is pulled at the other end with a force P. The force is suddenly released. Investigate the vibration of the bar as shown in Fig.Q9(b).

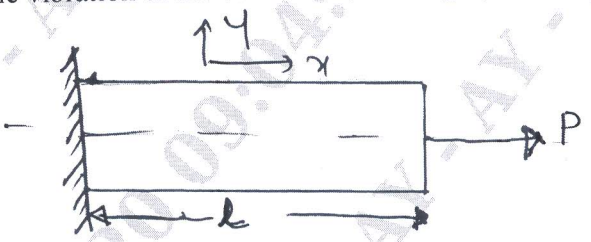

Fig.Q9(b) **(10 Marks)**

OR

10 a. Derive an equation for the torsional vibrations of circular shafts. **(10 Marks)**

b. Write short notes on the following:

(i) Phase plane method for nonlinear vibration system **(04 Marks)**

(ii) Logarithmic decrement **(03 Marks)**

(iii) Energy method **(03 Marks)**

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