CBCS SCHEME

USN | | | | | | | | | | 16MDE24

Second Semester M.Tech. Degree Examination, Dec.2017/Jan.2018
Advances Theory of Vibrations

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. Define the following, with suitable example:
i) Free and forced vibrations
ii) Undamped and damped vibrations
iii) Linear and non-linear vibrations
iv) Deterministic and Random vibrations **(08 Marks)**

b. Find the equivalent spring constant of a uniform rod of length 'l', cross sectional area 'A' and Young's modulus 'E' subject to an axial tensile (or compressive) force 'F' as shown in Fig.Q1(b). **(08 Marks)**

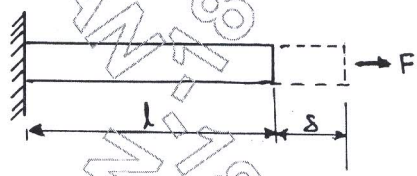

Fig.Q1(b)

OR

2 a. Define Damping.
Explain : (i) Viscous Damping (ii) Coulomb Damping (iii) Hysteritic damping **(08 Marks)**

b. Develop an expression for the damping constant of the Journal bearing shown in Fig.Q2(b). **(08 Marks)**

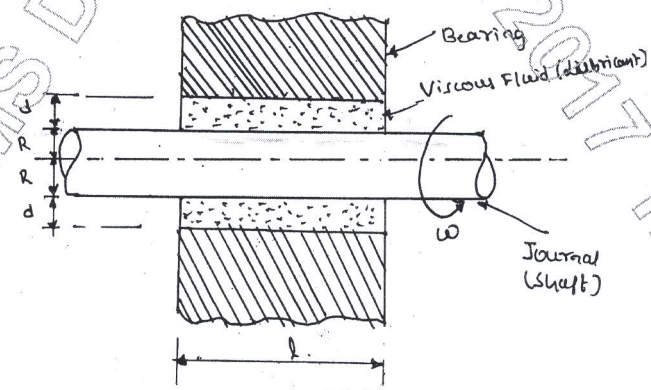

Fig.Q2(b)

Module-2

3 a. What are the differences between a transducer and a pick up? **(06 Marks)**

b. Name any two frequency measuring instruments and explain any one with neat sketch. **(10 Marks)**

OR

4 a. Describe the frequency response function in model analysis. **(08 Marks)**

b. A vibrometer having a natural frequency of 4 rad/sec and $\rho = 0.2$ is attached to a structure that performs a harmonic function/motion. If the difference between the maximum and minimum recorded value is 8mm, find the amplitude of motion of the vibrating structure when its frequency is 40 rad/sec. **(08 Marks)**

Module-3

5 a. Find the solution of equation

$$\dot{x} + ax = F(t)$$

when the forcing function is a unit impulse at $t = 0$ and determine the initial and steady state values of the response. **(08 Marks)**

b. Find the response of a spring-mass damper system subjected to the forcing function

$$F(t) = F_0\left(1 - \sin\frac{\pi t}{2t_0}\right)$$

In the interval $0 \le t \le t_0$ using a numerical procedure. Assume $F_0 = 1$, $K = 1$, $m = 1$, $\rho = 0.1$ and $t_0 = \tau_n/2$, where τ_n denotes the natural period of vibration given by

$$\tau_n = \frac{2\pi}{w_n} = \frac{2\pi}{(K/m)^{1/2}} = 2\pi$$

The value of x & $\dot{x}$ at $t = 0$ are zero. **(08 Marks)**

OR

6 a. The power spectral density of a stationary random process x(t) is shown in Fig.Q6(a). Find its autocorrelation function and the mean square value. **(08 Marks)**

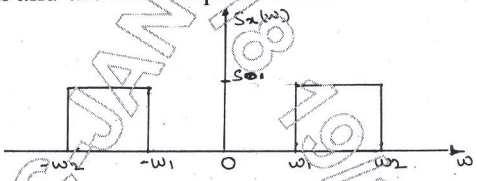

Fig.Q6(a)

b. What is Gaussian random process? Why is it frequently used in Vibration analysis? **(08 Marks)**

Module-4

7 a. With neat sketch explain he iterative method. **(08 Marks)**

b. Find the trajectories of an undamped pendulum. **(08 Marks)**

OR

8 a. Define the following terms:

i) Phase plane ii) Trajectory

iii) Singular point iv) Phase velocity **(08 Marks)**

b. Find the trajectories of a simple harmonic oscillator. **(08 Marks)**

Module-5

9 a. Determine the natural frequencies and mode shapes of a free-free rod (a rod with both ends free). **(08 Marks)**

b. Determine the Euler's differential equation for the lateral vibration of beams. **(08 Marks)**

OR

10 a. Determine the natural frequencies of vibration of uniform beam clamped at one end and free at the other. **(08 Marks)**

b. Determine the equations of motion of a rod in torsional vibration. **(08 Marks)**

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