[Total No. of Questions - 9] [Total No. of Printed Pages - 3]
(2125)

15278

B. Tech 7th Semester Examination

Mechanical Vibrations (NS)

ME-412

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : (i) Assume any data if necessary.

(ii) Attempt one question from each section A, B, C and D.

(iii) Section E is Compulsory.

SECTION - A

1. (a) Write down the definition of the following terms:

(i) Frequency.

(ii) Amplitude.

(iii) Forced vibration.

(iv) Damping.

(v) Degree of freedom. (10)

(b) A harmonic motion is expressed as x=12 sin (15 πt-π/3), where x is measured in mm, t in second and the phase angle in radians. Determine:

(i) The frequency and the period of motion.

(ii) The maximum displacement, velocity and acceleration.

(iii) The displacement, velocity and acceleration at t = 0 and t = 0.2 sec. (10)

[P.T.O.]

2. (a) A U-tube, open to atmosphere at both ends contains a column length l of a certain liquid. Find the natural period of oscillation of the liquid column. (10)

(b) Consider two harmonic motions $x_1 = \frac{1}{2}\cos\frac{\pi}{2}t$ and $x_2 = \sin \pi t$. Is the sum $x_1 + x_2$ a periodic motion? If so, what is its period? (10)

SECTION - B

3. (a) What is the various type of damping? Explain in detail. (10)

(b) Derive the equation of motion of a system subjected to base excitation. (10)

4. The mass of a spring-mass-dashpot system is given as initial velocity (from the equilibrium position) of $A\omega_n$. Where ω_n is the undamped natural frequency of the system. Find the equation of motion for the system, for the cases, when

(i) $\xi = 2.0$

(ii) $\xi = 1.0$

(iii) $\xi = 0.2$

ξ = Damping factor. (20)

SECTION - C

5. Derive the expression for undamped dynamic vibration absorber? (20)

6. Two bodies having equal masses as 70 kg each and radius of gyration 250 mm are keyed to both ends of a shaft 900 mm long. The shaft is 75 mm in diameter for 300 mm, 100 mm for next 300 mm and 90 mm for rest 300 mm, determine the frequency of torsional vibration. Assume G = 90 GPa. (20)

SECTION - D

7. Derive the expression of Rayleigh's method for multi-degree of freedom system. (20)

8. Find the lowest natural frequency of transverse vibrations for the system shown in Figure 1 by Rayleigh's method. $E = 1.96 \times 10^{11}$ N/m^2 and $I = 10^{-6}$ m^4. (20)

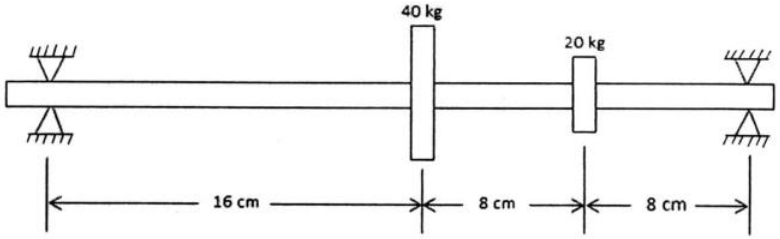

Figure 1

SECTION - E

9. Attempt the following question:

   (i) What are the various reasons of mechanical vibration?

   (ii) State D Alembert's principle.

   (iii) What methods are available for solving the governing equations of a vibration problem?

   (iv) Why is it important to find the natural frequency of a vibrating system?

   (v) What is the significance of wave velocity?

   (vi) How are τ, ω and f related to each other?

   (vii) What are the three elementary parts of a vibrating system?

   (viii) Define resonance.

   (ix) Define spring stiffness and damping constant.

   (x) How do you connect several springs to increase the overall stiffness? (2×10=20)