CBCS SCHEME

USN | | | | | | | | | | |

15AU82

Eighth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Mechanical Vibration

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. What do you mean by Mechanical Vibration? Explain the following : (i) Natural frequency (ii) Resonance (iii) Frequency **(08 Marks)**

b. Add following harmonics analytically and check the solution graphically,
(i) $X_1 = 3\sin(\omega t + 30^\circ)$.
(ii) $X_2 = 4\cos(\omega t + 10^\circ)$ **(08 Marks)**

OR

2 a. What do you mean by undamped free vibration? Derive differential equation by Newton's method for single spring mass system. **(08 Marks)**

b. Determine Natural frequency and simple pendulum:
i) Neglecting the mass of rod by energy method.
ii) Considering the mass of rod by Newton's method. **(08 Marks)**

Module-2

3 a. Define logarithmic decrement and derive an expression for logarithmic decrement. **(08 Marks)**

b. Determine suitable expression for equation of motion of the damped vibratory system as shown in Fig. Q3 (b). Find the critical damping coefficient, when a = 0.10 m, b = 0.13 m, K = 4900 N/m and M = 1.5 kg. **(08 Marks)**

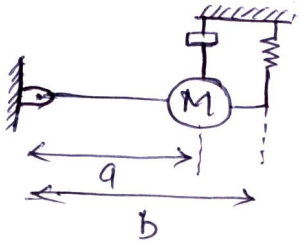

Fig. Q3 (b)

OR

4 a. Obtain an expression for whirling of shafts with air damping. **(10 Marks)**

b. Discuss the speeds above and below critical speeds with air damping and without air damping. **(06 Marks)**

Module-3

5 a. Derive the expression for the transmissibility ratio and the phase angle for the transmitted force. **(08 Marks)**

b. A refrigerator unit having a mass of 35 kg is to be supported on three springs, each having a stiffness K, unit operates at 480 rpm. Find the stiffness value K if only 10% of the shaking force is allowed to be transmitted to the supporting structure. **(08 Marks)**

OR

6 a. A machine of total mass 200 kg is supported on springs of total stiffness 16,000 N/cm has an unbalanced rotating element which results in a disturbing force 800 N at speed of 3000 rpm. Assuming $\xi = 0.2$. Determine:
i) Amplitude of motion due to unbalance
ii) Transmissibility
iii) Transmitted force **(08 Marks)**

b. A mass of 10 kg suspended from one end of helical spring the other end is fixed. The stiffness of the spring is 10 N/mm. The viscous damping causes the amplitude to decrease $1/10^{th}$ of initial value in four complete oscillation. If a periodic force of $150\cos 50t$ N is applied at the mass with vertical direction. Find the amplitude of forced vibration. What is the value at resonance? **(08 Marks)**

Module-4

7 a. Use Lagrange's equation to find the natural frequency and amplitude ratio of the system shown in Fig. Q7 (a). **(08 Marks)**

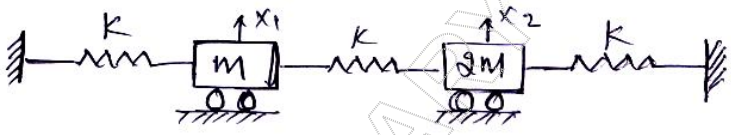

Fig. Q7 (a)

b. Explain the following:
i) Semi-definite system.
ii) Coordinate coupling. **(08 Marks)**

OR

8 a. List the types of Seismic transducers. Explain them briefly. **(08 Marks)**

b. Explain Fullorton Tachometer with a suitable sketch. **(04 Marks)**

c. Explain Frahm tachometer with a neat sketch. **(04 Marks)**

Module-5

9 a. Obtained the expressions for a beam of negligible mass carrying number of point load by using Rayleigh's method. **(08 Marks)**

b. Find the lowest natural frequency of vibration for the system as shown in Fig.Q9(b) by Rayleigh's method. $E = 1.96 \times 10^{11}$ N/m^2, $I = 4 \times 10^{-7}$ m^4.

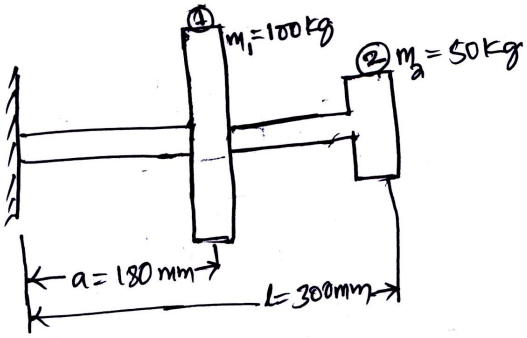

Fig.Q9(b) **(08 Marks)**

OR

10 a. Briefly explain the concept of Holzer's method for obtaining the natural frequencies of torsional system with equations. **(08 Marks)**

b. What is Stodola's method for obtaining natural frequency and to obtain the fundamental mode of vibration and natural frequency of the spring mass system? **(08 Marks)**

* * * * *