CBCS SCHEME

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18AS642

Sixth Semester B.E. Degree Examination, July/August 2022
Theory of Vibrations

Time: 3 hrs. Max. Marks: 100

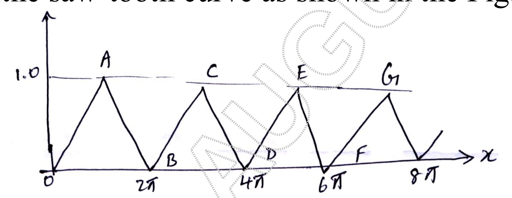
Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain different types of vibration. **(08 Marks)**

b. Find the Fourier series for the saw-tooth curve as shown in the Fig.Q.1(b).

Fig.Q.1(b)



(12 Marks)

OR

2 a. Define the term vibration, mention the causes of vibration and how to reduce it. **(08 Marks)**

b. Define the following terms: i) Simple harmonic motion ii) Damping iii) Degree of freedom iv) Resonance. **(04 Marks)**

c. A harmonic motion is given by the equation $x(t) = 5\sin\left(15t - \frac{\pi}{4}\right)$ where phase angle is in radians and t in seconds. Find: i) Period of motion ii) Frequency iii) Maximum displacement iv) Maximum velocity. **(08 Marks)**

Module-2

3 a. Derive an expression for natural frequency of torsional vibration with usual notation. **(10 Marks)**

b. Determine the natural frequency of a spring mass system where the mass of the spring is also to be taken into account. **(10 Marks)**

OR

4 a. Derive the equation for damped free vibration and solve for critical damping system. **(10 Marks)**

b. Derive an expression for logarithmic decrement of an under damped system. **(06 Marks)**

c. For the system shown below, the characteristic of the dash pot is such that when a constant force of 60N is applied to the piston, its velocity is found to be constant at 0.12m/s. Determine:

i) Damping co-efficient.

ii) Check whether the system is periodic (or) aperiodic. **(04 Marks)**

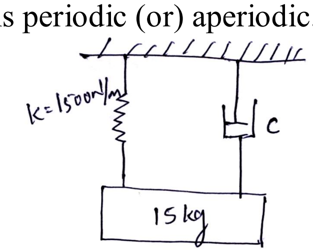


Fig.Q.4(c)

Module-3

5 a. With usual notation derive an expression for maximum displacement for a forced vibration of undamped single degree freedom system. **(10 Marks)**

b. A machine of a total mass 68kg mounted on springs of stiffness K = 11,000N/cm. With an assumed damping factor $\xi = 0.2$. A piston within the machine has a mass of 2kg has a reciprocating motion with stroke 7.5cm and a speed of 3000rpm. Assuming the motion of piston to be SHM. Determine:

i) Amplitude
ii) Phase angle with respect to existing force.
iii) Transmissibility and force transmitted to foundation.
iv) Phase angle of transmitted force with respect to exciting force. **(10 Marks)**

OR

6 a. With neat sketch explain the working of seismic instrument. **(08 Marks)**

b. A Frahm's Reed Tachometer is used for measuring the frequency of vibration of a system. The reed is at the resonance frequency of 30Hz when a mass of 0.025kg is placed at its end. The length and the thickness of the reed are 60mm and 0.6mm respectively. Determine its width if the Young's modulus of the reed material is 2.1×10^{11}N/m. **(06 Marks)**

c. A seismic instrument with a natural frequency of 5Hz is used to measure the vibration of a machine operating at 150rpm. The relative displacement of the seismic mass as read from the instrument is 0.05mm neglecting air damping, determine the amplitude of vibration of the machine. **(06 Marks)**

Module-4

7 a. Fig.Q.7(a) shows a torsional geared system. Determine: i) Stiffness of equivalent shaft ii) torsional frequency. **(10 Marks)**

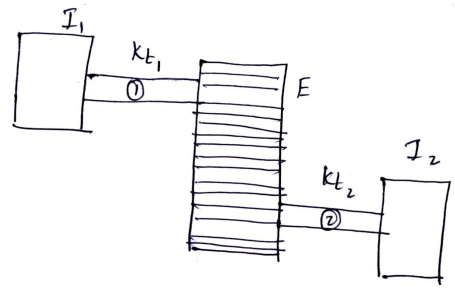


Fig.Q.7(a)

b. Derive an expression for the amplitudes of vibration of the two masses shown in Fig.Q.7(b) below. **(10 Marks)**

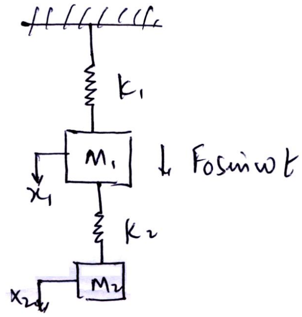


Fig.Q.7(b)

OR

8 a. Derive an expression for the free longitudinal vibration of a uniform bar of length L. One end of which is fixed and the other end free. **(10 Marks)**

b. Find the longitudinal forced vibration of a uniform cross section bar subjected to a sinusoidal force F_o sin wt as shown in the Fig.Q.8(b). **(10 Marks)**

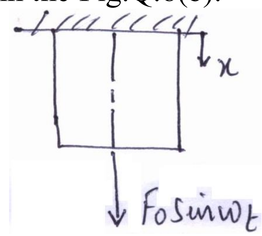
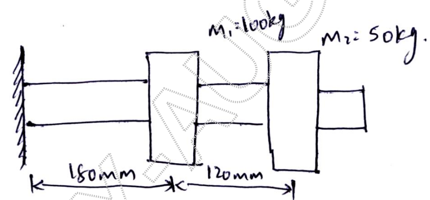


Fig.Q.8(b)

Module-5

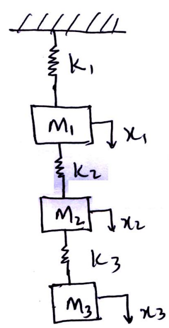
9 a. Find the natural frequency of the system shown in the Fig.Q.9(a) by Dunkerlay's method $E = 1.96 \times 10^{11} N/m^2$, $I = 4 \times 10^{-7} m^4$. **(06 Marks)**

Fig.Q.9(a)



b. Using Stodola's method find the fundamental mode of vibration and its natural frequency of spring mass system shown Fig.Q.9(b) below.
Given: $K_1 = K_2 = K_3 = 1N/m$, $M_1 = M_2 = M_3 = 1kg$. **(14 Marks)**

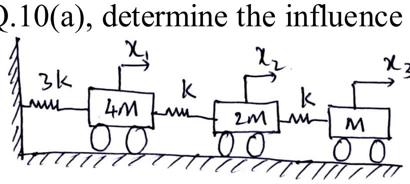
Fig.Q.9(b)



OR

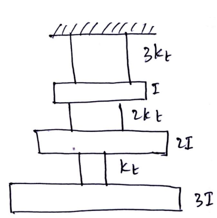
10 a. For the system shown in Fig.Q.10(a), determine the influence co-efficient. **(06 Marks)**

Fig.Q.10(a)



b. Using Holzer's method, determine the first two natural frequencies of the system shown in Fig.Q.10(b). **(14 Marks)**

Fig.Q.10(b)



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