CBCS SCHEME

USN [| | | | | | | | |] **15AU82**

Eighth Semester B.E. Degree Examination, Dec.2019/Jan.2020

Mechanical 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 terms:
(i) Resonance (ii) SHM (iii) Degree of freedom **(06 Marks)**

b. Add the following harmonic analytically and check the solution graphically:
$x_1 = 3\sin(\omega t + 30^\circ)$ $x_2 = 4\cos(\omega t + 10^\circ)$ **(10 Marks)**

OR

2 a. An oscillating system with a natural frequency of 3.98 Hz starts with an initial displacement of x_0 = 10 mm and an initial velocity of $\dot{x}_0$ = 125 mm/sec. Calculate all the vibratory parameters. **(08 Marks)**

b. Determine the natural frequency of the system shown in Fig.Q2(b).

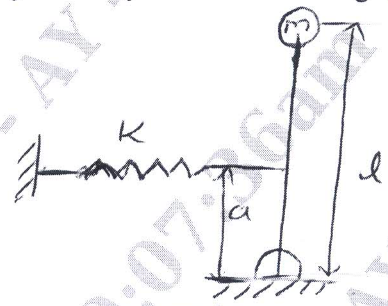

Fig.Q2(b) **(08 Marks)**

Module-2

3 a. Define "Logarithmic decrement" and show that it can be expressed as $\delta = \frac{1}{n}\ell n\left(\frac{x_0}{x_n}\right)$. **(08 Marks)**

b. A machine of mass 100 kg is mounted on springs and is fitted with a dashpot to dump out vibrations. There are 4 springs each of stiffness 7.5 N/mm and it is found that the amplitude of vibration diminishes from 3.84 cm to 0.64 cm in 2 complete oscillations. Assuming that the damping force varies as the velocity, determine the damping resistance at unit velocity. **(08 Marks)**

OR

4 a. Derive an expression for the deflection of the shaft mounted with a disc at the centre when the centre of gravity of the disc is displaced from the geometric centre by a distance 'e'. Neglect the effect of air damping and mass of the shaft. **(10 Marks)**

b. A vibrometer having a natural frequency of 5 rad/sec and ξ = 0.25 is attached to a structure that performs an harmonic motion. If the difference between the maximum and minimum recorded values is 10 mm. Find the amplitude of motion of the vibrating structure when its frequency is 50 rad/sec. **(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. Derive expressions for amplitudes of vibrations of the two masses shown in Fig.Q7(a).

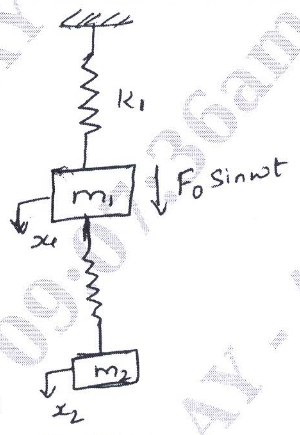

Fig.Q7(a) **(08 Marks)**

b. For the system shown in Fig.Q7(b),
(i) Derive the equation of motion
(ii) Set up frequency equation and obtain natural frequencies of the system

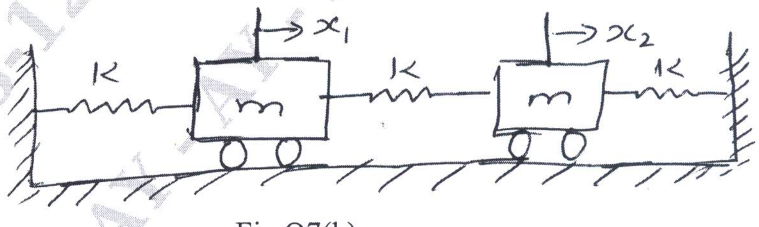

Fig.Q7(b) **(08 Marks)**

OR

8 a. Explain the working principle of vibrometer with a neat sketch. **(08 Marks)**

b. With a neat sketch, explain Fullerton Tachometer. **(08 Marks)**

Module-5

9 Determine the natural frequency and the mode shape of the system shown in Fig.Q9 by the Holzeris method.

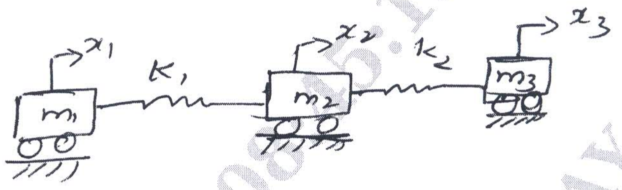

Fig.Q9

$m_1 = 2$ kg, $m_2 = 4$ kg, $m_3 = 2$ kg, $K_1 = 5$ N/m, $K_2 = 10$ N/m **(16 Marks)**

OR

10 Using Stodola's method find the fundamental mode of vibration and its natural frequency of the spring mass system. For $K_1 = K_2 = K_3 = 1$ N/m and $m_1 = m_2 = m_3 = 1$ kg. (Refer Fig.Q10)

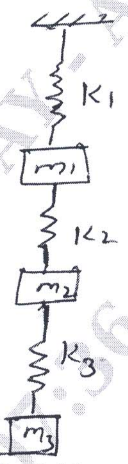

Fig.Q10 **(16 Marks)**

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