CBCS SCHEME

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15AE553

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Theory of Vibrations

Time: 3 hrs. Max. Marks: 80

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

Module-1

1 a. List the types of vibrations and explain any three. **(06 Marks)**

b. Derive an expression for work done by Hormonic force. **(04 Marks)**

c. The motion of a particle is represented by the equation, $x = 4\sin \omega t$. Sketch roughly, the variation of the maximum of,
(i) Displacement (ii) Velocity (iii) Acceleration (iv) Jerk **(06 Marks)**

OR

2 a. Show that the motion of the piston of an IC engine is periodic with terms containing the fundamental and even harmonics. **(10 Marks)**

b. Explain Beats phenomenon. **(06 Marks)**

Module-2

3 a. Derive an expression for natural frequency of an compound pendulum. **(06 Marks)**

b. Find the mutual frequency of the system shown in Fig. Q3 (b). **(06 Marks)**

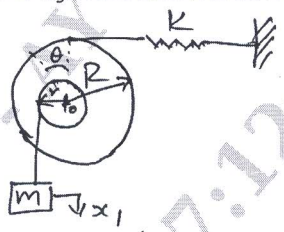

Fig. Q3 (b)

c. Find the mutual frequency of the system shown in Fig. Q3 (c). **(04 Marks)**

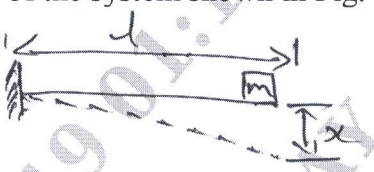

Fig. Q3 (c)

OR

4 a. Deduce an expression to related vibrational energy and logarithmic decrement. **(06 Marks)**

b. A gun borne / having mass 560 kg is designed with the following data:
Initial recoil velocity : 36 m/sec
Recoil distance : 1.5 m
Calculate : (i) Spring constant (ii) Damping coefficient
(iii) Time required for the barrel to return to a position of 0.12 m from its initial position. **(10 Marks)**

Module-3

5 a. List the service of excitation and explain. **(04 Marks)**

b. Investigate the terms involved in the equations of motion of one DoF system given by,
$5\ddot{x} + 3\dot{x} + 12x = 10\sin \omega t$. **(08 Marks)**

c. Prove that an undamped measuring instrument will show a true response for frequency ratio $\left(W/W_n\right) = 1/\sqrt{2}$. **(04 Marks)**

OR

6 a. What is quality factor and half power points and derive an expression for bandwidth. **(08 Marks)**

b. A trailer has 1000 kg mass when fully loaded and 250 kg when empty. The spring of the suspension is 350 N/m. The $\xi = 0.5$ when the trailer if full. The speed is 100 km/hr. The road varies sinusoidally with λ = 5 m. Determine the amplitude ratio of the trailer when fully loaded and empty. **(08 Marks)**

Module-4

7 a. Derive an expression for natural frequencies of dynamic and static coupling systems. **(10 Marks)**

b. Determine the frequency of the system Fig. Q7 (b), $K_1 = K_2 = 40$ N/m, K = 60 N/m, $m_1 = m_2 = 10$ kg **(06 Marks)**

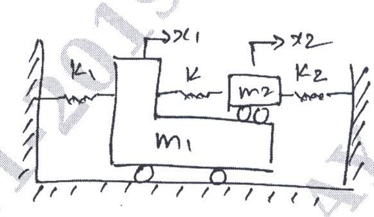

Fig. Q7 (b)

OR

8 a. With a neat sketch, explain Lanchester Damper and Houdaille damper. **(10 Marks)**

b. Derive ID wave equation for transverse vibration of beams. **(06 Marks)**

Module-5

9 a. Find the first natural frequency of the system by matrix iteration method. **(10 Marks)**

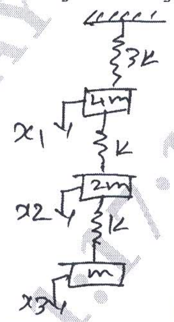

Fig. Q9 (a)

b. Determine the natural frequencies of the system. **(06 Marks)**

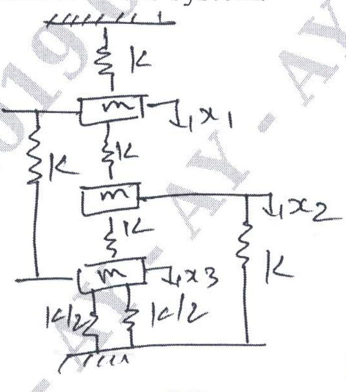

Fig. Q9 (b)

OR

10 Find the natural frequency by Holzer method, $m_1 = m_2 = m_3 = 1$ kg, $K_1 = K_2 = K_3 = 1$ N/m **(16 Marks)**

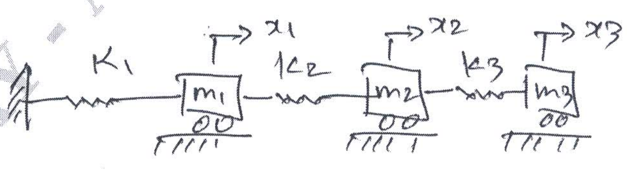

Fig. Q10

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