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10AU73

Seventh Semester B.E. Degree Examination, June/July 2019
Mechanical Vibration and Vehicle Dynamics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain representation of harmonic motion in complex form. **(05 Marks)**

b. What do you mean by mechanical vibration? Explain the following:
i) Natural frequency ii) Resonance iii) Frequency **(05 Marks)**

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

2 a. What do you mean by undamped tree vibration? Derive differential equation by Newton's method for single spring mass system. **(06 Marks)**

b. Explain equivalent stiffness of spring combination:
i) Spring in series ii) Spring in parallel **(04 Marks)**

c. 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. **(10 Marks)**

3 a. Define logarithmic decrement and derive an expression for logarithmic decrement. **(06 Marks)**

b. What do you mean by damped free vibration? Name any four types of damping and explain dry fiction damping. **(06 Marks)**

c. A spring mass damper system is having mass of 175 kg spring stiffness K = 70000 N/m and damping coefficient C = 700 N-s/m. Determine: i) Natural frequency ii) Damping factor iii) Damped natural frequency iv) Logarithmic decrement. **(08 Marks)**

4 a. What do you mean by forced vibration and explain term magnification factor (MF) with usual mathematical notation. **(04 Marks)**

b. A 5 kg mass is placed at the end of a 300 mm long steel beam as shown in Fig.Q4(b) the Young's modulus of elasticity of steel is 200 GPa and the moment of inertia of beam 10^{-8} m^4. When the system is excited by a harmonic excited force of 150 N, an amplitude of 0.5 mm is observed. Find the frequency of excitation.

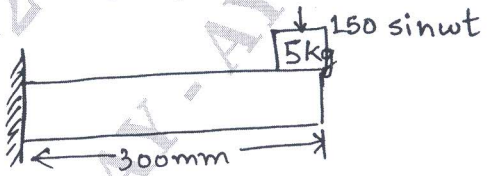

Fig.Q4(b) **(06 Marks)**

c. A machine of total mass 68 kg mounted on springs of stiffness K = 11000 N/cm with an assumed damping factor, ξ = 0.2 A. A piston within the machine has a mass of 2 kg has a reciprocating motion with stroke 7.5 cm and a speed of 3000 rpm. Assuming the motion of piston to be SHM. Determine:
i) Amplitude of machine
ii) Phase angle with respect to exciting force
iii) Transmissibility and force transmitted to foundation
iv) Phase angle of transmitted force with respect to exciting force. **(10 Marks)**

PART – B

5 a. Why we need to measure vibration? And explain measurement scheme. **(05 Marks)**

b. Explain Frahm tachometer with a neat diagram. **(05 Marks)**

c. Obtain an expression for whirling of shaft with air damping. **(10 Marks)**

6 a. Explain system with 2 degrees of freedom neat diagram for different example (any two). **(05 Marks)**

b. For the system shown in Fig.Q6(b):
i) Derive the equation of motion
ii) Set up frequency equation and obtain natural frequency of the system
iii) Obtain modal vectors
iv) Draw mode shapes.
Neglect the inertia of wheels and friction between wheel and surface.

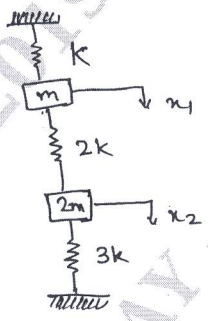

Fig.Q6(b) **(15 Marks)**

7 a. What do you mean by vehicle vibration? Explain sources of vibration of the vehicle. **(05 Marks)**

b. The springs of a motor vehicle carry a total load of 11281.5 N and with equal springing front and rear, the combined spring rates is 88290 N/m. Calculate the frequency of vertical natural vibration with the damper removed. If dampers are adjusted to give a total damping force 4415.5 N-s/m. Calculate the frequency of damped vibration. **(05 Marks)**

c. A vertical single cylinder engine weighing 5346.5 N is carried on elastic beams where static deflection under the weight of engines is 9.65 mm. Calculate the frequency of free vibration in a vertical plane. The engine run at 130 rpm the reciprocating parts weight 446.4 N, the strokes is 178 mm and length of connecting rod is 356 mm. Calculate from first principles, the vertical moment of engine due to:
i) Lack of primary balance ii) Lack of secondary balance. **(10 Marks)**

8 Explain Stodola's method. And determine fundamental mode of vibration and its natural frequency of spring mass system shown in Fig.Q8 by same method.

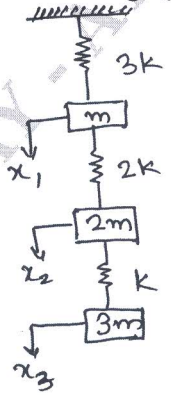

Fig.Q8 **(20 Marks)**

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