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10AU73

# Seventh Semester B.E. Degree Examination, June/July 2017
## Mechanical Vibration and Vehicle Dynamics

Time: 3 hrs. Max. Marks:100

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



### PART – A

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

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

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

2 a. What do you mean by undamped free 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. What do you mean by Damped free vibration? Name any 4 types of damping and explain dry friction damping. **(06 Marks)**

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

c. A spring mass damper system is having mass of 175kg spring stiffness K = 70000 N/m and damping co-efficient C = 700N-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 5kg mass is placed at the end of a 300mm long steel beam as shown in Fig Q4(b). the Young's modulus of elasticity of steel is 200GPa and the moment of inertia of beam $10^{-8}m^4$. When the system is excited by a harmonic excited force of 150N, an amplitude of 0.5mm is observed. Find the frequency of excitation. **(06 Marks)**

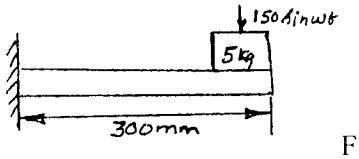



Fig Q4(b)

c. A machine of 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 2 kg has a reciprocating motion with stroke 7.5cm and a speed of 3000rpm. 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 examples? (Any two). **(05 Marks)**

b. For the system shown in Fig Q 6(b)

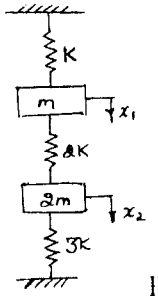
i) Derive the equation of motion.

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. **(15 Marks)**




FigQ6(b)

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 11281.5N and with equal springing front and rear, the combined spring rate 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 9.65mm. Calculate the frequency of free vibration in a vertical plane. The engine run at 130rpm the reciprocating parts weight 446.4N, the strokes is 178mm and length of connecting rod is 356mm. 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 Q 8, by same method. **(20 Marks**

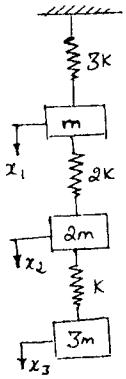



Fig Q 8

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