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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Sixth Semester, B.E. - Automobile Engineering

Semester End Examination; June/July - 2015

Mechanical Vibration and Vehicle Dynamics

Time: 3 hrs *Max. Marks: 100*

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

PART - A

1. a. Explain briefly the various elements of a vibrating system. 6

b. Determine the natural frequency of the system shown in Fig. 1.Q.1. (b) by neglecting the mass of the bell crank lever (arm). 6

c. Determine the natural frequency of oscillation of the homogeneous cylinder of mass 'm' and radius r^2 as shown in Fig. 2 Q.1. (c). 8

2 a. A thin plate of area A and weight W is attached to the end of the spring and is allowed to oscillate in a viscous fluid as shown in Fig.3. Q.2. (a) If f_1 is the frequency of oscillation of the system in air (damping is negligible) and f_2 that in the fluid. Show that $\eta = \frac{2\pi w}{gA}\sqrt{f_1^2 - f_2^2}$ where the damping force on the plate is $F_d = 2\eta A v$, 2A is total surface area of the plate and v is velocity. 10

b. A body weighting 100 N is suspended by a helical spring having stiffness of 2 kN/m. A dashpot having a resistance of 0.6 N at a velocity of 3 m/min is connected between the weight and fixed end of the spring. Determine the ratio of successive amplitudes, and the amplitude of the body 9 cycles after which it was released with an initial amplitude of 12 mm. 10

3 a. What is magnification factor? Derive an expression for magnification factor. 10

b. A Weight of 80 N is suspended by a spring of stiffness 1500 N/m is forced to vibrate by a harmonic force of 12 N. Assuming viscous damping of 90 N-s/m, find the resonant frequency, the amplitude at resonance, the phase angle at resonance, the frequency corresponding to the peak amplitude. 10

4.a What are the causes for vehicle vibration? Explain the vibration due to road roughness. 10

b. An automobile has a body weighing 13350 N, mounted on four equal springs which sag 0.23 m under the weight of the body. Each one of the four shock absorbers has a damping coefficient of 32 N for a velocity of 0.025 m/s. The car is placed with all four wheels on the test platform which is moved up and down at resonant speed with amplitude of 0.025 m. Find the amplitude of the car body on its springs, assuming the centre of gravity to be in the centre of the wheel base. 10

Contd…2

PART - B

5 a. Define critical speed of a rotating shaft. What are the assumptions used to derive the expression for maximum deflection of the shaft? 6

b. A turbine disc of mass 40 kg runs at 6000 rpm is mounted at the centre of the shaft and span is 0.8 m with a diameter of 50 mm. The disc has an unbalance of 10^{-3} kg-m. The damping ratio is 0.08. Determine the critical speed, whirling amplitude at critical speed, maximum bending stress in the shaft at the operating and power required to drive the shaft at a speed of 20% more than the critical speed. Assume E = 2×10^{11} N/m$^{2.}$ 14

6. a Explain briefly the following: (i) Semi definite system (ii) Principal coordinates (iii) Dynamic vibration absorber (iv) Semi definite system. 8

b. Determine the natural frequencies and the corresponding mode shapes for the system shown in Fig 4. Q.6. (b), m_1 = 2 m, m_2 = m, k_1= k, k_2 = 4k, k_3 = k. 12

7. Determine the fundamental frequency of the system shown in Fig. 5. Q.7 by using (i) Stodola method, (ii) Matrix iteration method. 20

8. Determine the natural frequencies of the torsional system shown in Fig.6. Q.8. by using Holzer's method. 20

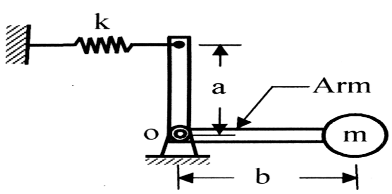

Fig.1, Q. No. 1 (b), P08AU65

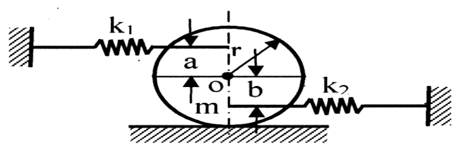

Fig.2, Q. No. 1 (c), P08AU65

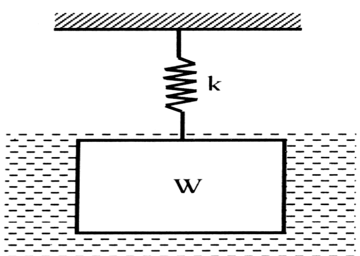

Fig.3, Q. No. 2 (a), P08AU65

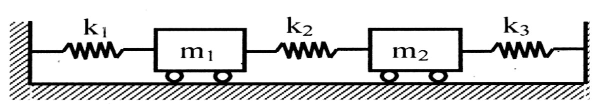

Fig.4, Q. No. 6 (b), P08AU65

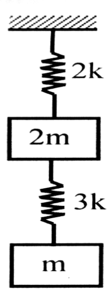

Fig.5, Q. No. 7, P08AU65

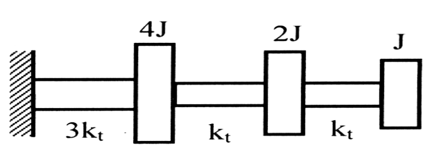

Fig.6, Q. No. 8, P08AU65

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