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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 - 2016

Mechanical Vibrations and Vehicle Dynamics

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data may suitably assume.

UNIT - I

1 a. Explain with neat sketch the following :
(i) Simple harmonic motion (ii) Phase difference (iii) Degrees of freedom. 6

b. Discuss the equivalent stiffness of spring combinations. Obtain the expression for equivalent stiffness of spring combinations when the springs are,
(i) in series and (ii) in parallel. 8

c. A U-tube open to atmosphere at both ends contains a column length l of a certain liquid. Determine lateral frequency of a liquid column. 6

2 a. Derive an expression for logarithmic decrements. 8

b. A gun barrel having a mass of 560 kg as designed with the following data :
Initial recoil velocity = 36 m/s, Recoil distance on firing = 1.5 m. Calculate;
(i) Spring constant (ii) Damping coefficient
(iii) Time required for the barrel to return to a position 0.12 m from its initial position. 12

UNIT - II

3 a. Discuss the forced vibrations with reciprocating unbalance. Obtain the expression for steady state amplitude and phase angle. 10

b. A reciprocating engine of the mass 20 kg running at 400 rpm is supported on the spring of the stiffness 6400 N/m and a dashpot of damping coefficient of 125 N-s/m. The unbalanced mass of 0.5 kg rotates at 50 mm radius. Determine;
(i) Damping factor (ii) Amplitude of vibration and phase angle
(iii) Resonant speed and Resonant amplitude
(iv) Forces exerted by the spring and dashpot on the engine. 10

4 a. Derive an expression for force transmittibility. 10

b. A vehicle body of mass 70 kg is supported on a spring which deflects 20 mm under the load. It is subjected to damping effect adjusted to a value of 0.23 times that required for critical damping. Determine the natural frequency of undamped and damped vibrations and ratio of successive amplitudes for damped vibrations. If the body is subjected to periodic disturbing force of 700N and frequency equal to 0.78 times the natural frequency. Determine the amplitude of forced vibrations and phase difference with respect to disturbing force. 10

UNIT - III

5 a. Sketch and explain seismic Instrument. 8

b. A disc of mass 4 kg is mounted midway between bearings which may be assumed simply supports. The bearing span is 48 cm. The steel shaft which is horizontal is 9 mm in diameter. The centre of gravity of the disc is displaced 3 mm from the geometric centre. The equivalent damping coefficient at the centre of the disc-shaft may be taken as 49 N-s/m. If the shaft rotates at 760 rpm determine; 12

(i) Amplitude of steady state vibrations (ii) Dynamic load on the bearing

(iii) Damping torque (iv) Power required to derive the shaft

Take; $E = 1.96 \times 10^{11}$ N/m^2.

6 a. Derive an expression for deflection of rotating shaft with a single disc without damping. Discuss the possible phase relationship. 10

b. A periodic motion observed on the oscilloscope is illustrated in the Fig. 6(b). Represent the motion by Harmonic service. 10

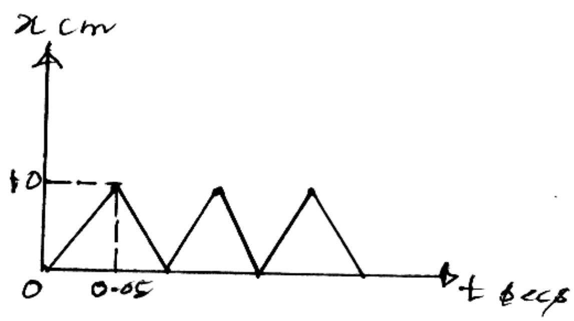

Fig Q 6(b)

UNIT - IV

7 a. Explain the following :

(i) Dynamic vibration absorber (ii) Coordinate coupling 10

(iii) Maxwell's reciprocal theorem.

b. Determine the natural frequencies and amplitude ratio for the system shown in the Fig. 7(b). The masses $m_1 = 10$ kg and $m_2 = 15$ kg and spring stiffness $k = 320$ N/m. 10

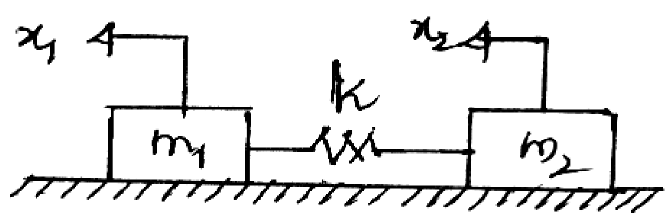

Fig Q 7(b)

8. Determine the natural frequencies and corresponding mode shapes of the system shown in the Fig (8). The masses $m_1 = 1.5$ kg, $m_2 = 0.8$ kg and spring stiffness = $K_1 = K_2 = 40$ N/m. 20

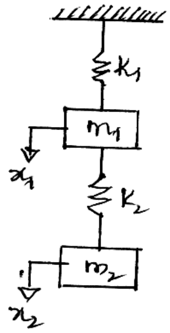

Fig Q(8)

UNIT - V

9 a. Derive Dunkenlay's equation for multi degree of freedom system. 8

b. Use matrix iteration method to determine fundamental frequency of the triple pendulum shown in the Fig. 9(b). 12

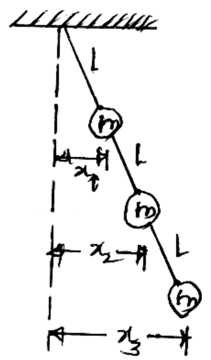

Fig Q 9(b)

10. Use Holzer method to determine the first three natural frequencies of multi degrees of freedom system shown on the Fig. (10) m = 1, k = 1. 20

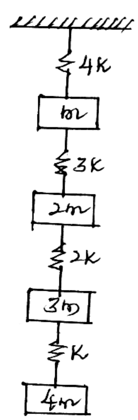

Fig Q (10)

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