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10AE65

Sixth Semester B.E. Degree Examination, Dec.2019/Jan.2020
Theory of Vibrations

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define the following terms:
(i) Longitudinal vibration (ii) Torsional vibration (iii) Resonance
(iv) Simple harmonic motion (v) Time period. **(10 Marks)**

b. Periodic motion in time domain is given by $x(t) = -20t + 2$ for $0 \le t \le 0.2$. Obtain Fourier's series equation in frequency domain. **(10 Marks)**

2 a. Determine the natural frequency of a spring mass system where the mass of the spring is also to be taken in to account. **(10 Marks)**

b. The solution to the differential equation for single degree freedom motion is given by $x = X\cos(100t + \phi)$ with initial condition $\dot{x}_{(0)} = 1250$ mm/sec and $x_{(0)} = 0.25$ mm, find the values of X and ϕ and express the given equation in the form $x = A\sin\omega_n t + B\cos\omega_n t$. **(10 Marks)**

3 a. Set up the differential equation for a spring mass damper system and obtain the complete solution for the over damped condition. **(10 Marks)**

b. A body of 5 kg is supported on a spring of stiffness 200 N/m and has dashpot connected to it, which produces a resistance of 0.002 N at a velocity of 1 cm/sec. In what ratio will the amplitude of vibration be reduced after 5 cycles. **(10 Marks)**

4 a. Derive an expression for a forced vibration due to base excitation of the support. **(10 Marks)**

b. A machine of mass 75 kg is mounted on springs of stiffness 12 kN/cm with an assumed damping factor 0.2. A piston within the machine of mass 2 kg has a reciprocating motion with a stroke of 7.5 cm and a speed 50 Hz. Assuming the motion of the piston to be harmonic determine (i) amplitude of the machine (ii) Transmissibility (iii) Force transmitted to the foundation (iv) The phase angle of the transmitted force with respect to the exciting force. **(10 Marks)**

PART – B

5 a. Write short notes on frequency measuring instruments. **(08 Marks)**

b. A disc of mass 4 kg is mounted on a shaft midway between the bearings which may be assumed to be simple supports. The bearing span is 0.48 m. The steel shaft is horizontal and is 9 mm in diameter. The centre of gravity of the disc is displaced 3 mm from the geometric centre. The equivalent viscous damping may be taken as 49 N.s/m. If the shaft rotates at 760 rpm, find the maximum stress in the shaft and compare it with dead load stress in the shaft. Also find the power required to drive the shaft. Take $E = 2\times10^{11}$ N/m^2. **(12 Marks)**

6 a. Derive expressions for amplitude of vibrations of the two masses shown in Fig. Q6 (a). **(10 Marks)**

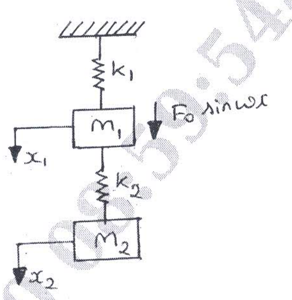

Fig. Q6 (a)

b. Explain the working principle of dynamic vibration absorber. **(10 Marks)**

7 a. Derive the general solution of a torsional vibration of rods. **(10 Marks)**

b. Derive suitable mathematical expression for longitudinal vibration of rod of uniform cross section. **(10 Marks)**

8 Find the natural frequency of the system shown in Fig. Q8 by Holzer's method. Assume $m_1 = m_2 = m_3 = 1$ kg and $k_1 = k_2 = k_3 = 1$ N/m. **(20 Marks)**

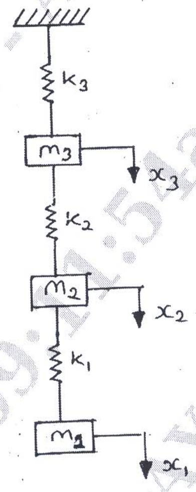

Fig. Q8

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