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BT-6 / M-18

MECHANICAL VIBRATION

Paper–ME 306 E Opt. II

Time allowed : 3 hours] *[Maximum marks : 100*

Note :- *Attempt **five** questions in all, selecting at least **one** question from each unit. All questions carry equal marks.*

Unit–I

1. (a) The displacement of a slider in slider crank mechanism is given by:

$x = 24\cos 8\pi t + 3/2\cos 16\pi t$

Plot a displacement *v/s* time diagram. What is the acceleration of piston at t = 1/8 sec. 15

(b) Derive an expression for the work done by Harmonic Force. 5

2. (a) Show that two SHM with frequency p and 2p when added will result in a periodic function of frequency p. Generalize the above for n number of harmonic functions with frequencies: p, 2p ..... n_p etc. 15

(b) State and derive Maxwell's reciprocity theorem for influence coefficients. 5

Unit–II

3. Determine the natural frequency of mass m = 15 kg as shown in fig. 1, assuming that the chords do not stretch and slide over the pulley rim. Assume that the pulley has no mass. Take $k_1 = 8\times10^3$ N/m; $k_2 = 6\times10^3$ N/m. 20

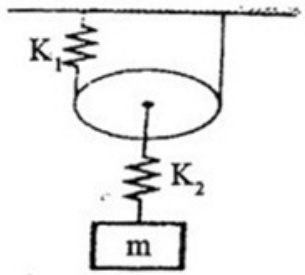

Fig. 1

4. (a) What is the difference between a vibration absorber and a vibration isolator? 5

(b) Determine the natural frequency of oscillation of the double pendulum as shown in fig. 2, where $m_1 = m_2 = 5$ kg; $\ell_1 = \ell_2 = 25$ cm. 15

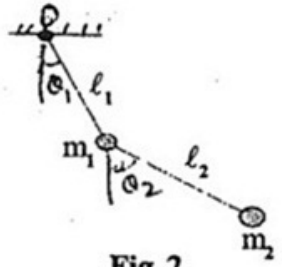

Fig. 2

Unit–III

5. A four rotor system is shown in fig. 3. The physical constants of the system are given alongside. A torque $T = T_o \sin \omega t$ acts on the second rotor. Determine the amplitude of vibration of various rotors. Also find the maximum twist in each section of the shaft and corresponding twisting moment. $J_1 = 100$ kg-m²; $J_2 = 50$ kg-m²; $J_3 = 10$kg-m²; $J_4 = 50$ kg-m². $k_{t1} = 1\times10^4$ Nm/rad; $k_{t2} = 1\times10^4$ Nm/rad; $k_{t3} = 2\times10^4$ Nm/rad; $T_o = 10000$ N-m; $\omega = 5$ rad/sec. 20

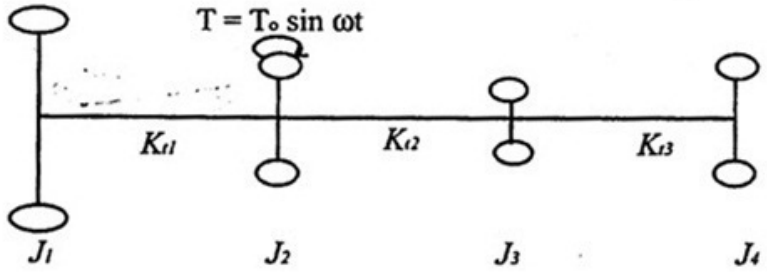

Fig. 3

6. (a) Find the lowest natural frequency of transverse vibrations for the system shown in fig. 4 by Rayleigh's method. Take $E = 1.96 \times 10^{11}\ N/mm^2$; $I = 10^{-6} m^4$. 15

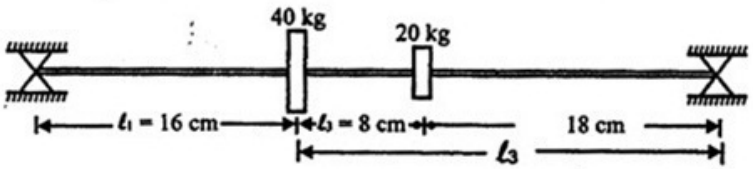

Fig. 4

(b) Derive an expression for deflection of beam by Dunkerley's Method. 5

Unit–IV

7. Derive the fourth degree differential equation in generalized form for transverse vibrations of Euler-Bernoulli's Beam. Also find the general solution for this equation. 20

8. What is whirling of shaft? Derive an expression for the ratio of deflection and eccentricity for critical speed of shaft with damping. 20

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