

CRASH COURSE

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10ME72

Seventh Semester B.E. Degree Examination, May 2017 Mechanical Vibrations

Time: 3 hrs.

Max. Marks:100

Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.

PART - A

- 1 a. If $x_1 = 2 \cos(2t + 0.5)$ and $x_2 = 5 \sin(2t + 1)$, find
- Resultant of x_1 and x_2 analytically and verify the same graphically. (10 Marks)
 - Time period of resultant motion. (04 Marks)
- b. $x_1(t)$ and $x_2(t)$ are two harmonic motions of periods T_1 and T_2 respectively. Show that the resultant motion $(x_1 + x_2)$ can be periodic only if two integers m and n can be found such that $mT_1 = nT_2 = T$. (04 Marks)
- c. For the periodic motion shown in Fig.Q1(c), find:
- Fundamental frequency, ω
 - The coefficient of $\sin 5\omega t$ of the Fourier's series of this function.



Fig.Q1(c)

(06 Marks)

- 2 a. A rim type of flywheel of mass 35 kg having outside and inside diameter of 0.4 m and 0.3 m was allowed to swing as compound pendulum about a knife edge at inner side of the rim. If the measured period of oscillation is 1.22 s, determine the moment of inertia of the flywheel about its geometric axis. (10 Marks)
- b. A U-tube, open to atmosphere at both ends contains a liquid for a column length ' l '. Find the natural period of oscillation of the liquid column. (10 Marks)
- 3 a. The mass of a spring-mass-dashpot system is given an initial velocity (from the equilibrium position) of $2\omega_n$ m/s where ω_n is undamped natural frequency of the system. Damping ratio of the system is 2. Find an expression for the position of mass at any time. (10 Marks)
- b. The disc of a torsional pendulum has a moment of inertia of 600 kg-cm^2 and is immersed in a viscous fluid. The brass shaft attached to the disc is light and of diameter 0.1 m and length 0.4 m. For free vibrations, the observed amplitudes on the same side from mean position are 9° , 6° and 4° for successive cycles. Find:
- Logarithmic decrement
 - Damping coefficient
 - Periodic time of vibrations
- (modulus of rigidity of brass = 44 GPa) (10 Marks)

- 4 a. A spring-mass-dashpot system is subjected to a harmonic excitation $F_0 \sin \omega t$. Define 'magnification factor' for this system. Assuming the expression for 'magnification factor', find the value of ω/ω_n When the magnification factor is maximum? (10 Marks)
- b. Define transmissibility and state the expression for transmissibility. Plot (not to scale) variation of transmissibility with frequency ratio (ω/ω_n) for different damping ratio. For effective transmissibility at high ω/ω_n , machine is attached with a large concrete block. Why? Explain in brief. (10 Marks)

PART - B

- 5 a. Write a brief note seismic instrument along with a neat sketch. (06 Marks)
- b. Determine the mass 'M' to be placed at the end of reed in order that the reed be in resonance at a frequency of 30 Hz. The steel reed is 50 mm long, 6 mm wide and 0.75 mm thick. Young's modulus of the steel is 196 GPa. (08 Marks)
- c. A light shaft supported in two bearings at its end, carries a heavy unbalanced rotor at its centre. Under what conditions for undamped system,
 i) Rotor rotates with heavy side outwards?
 ii) Rotor rotates with light side outwards?
 Explain in brief. (06 Marks)
- 6 Obtain the differential equations of motion for the double pendulum (pendulum $l_2 - m_2$ attached to pendulum $l_1 - m_1$). If $m_1 = m_2 = m$ and $l_1 = l_2 = l$, find: i) natural frequencies, ii) ratio of amplitudes and draw mode shapes. (20 Marks)
- 7 a. Using Dunkerly's method, find the fundamental natural frequency of transverse vibrations for the system shown in Fig.Q7(a).

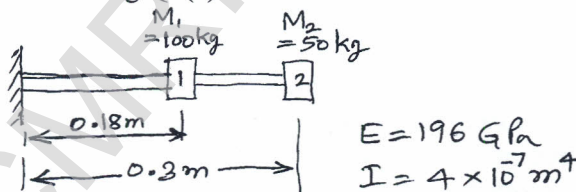


Fig.Q7(a)

(08 Marks)

- b. Find the fundamental natural frequency for the system shown in Fig.Q7(b) by the method of matrix iteration.

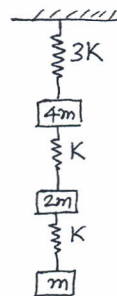


Fig.Q7(b)

(12 Marks)

- 8 a. What is the hardware of an equipment necessary for experimental modal analysis? Explain in brief. (10 Marks)
- b. Explain in brief the various types of machine maintenance techniques. (10 Marks)
