CBCS SCHEME

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18AE56

Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Theory of Vibrations

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Write neat sketches wherever required.***

Module-1

1 a. With a neat sketch, explain the phenomenon of beats. **(04 Marks)**

b. Define vibrations. Enumerate the causes effects and elimination/reduction of vibrations. **(06 Marks)**

c. Split the harmonic motion $x = 5\sin(3\omega t + \pi/4)$ into two harmonic motions having phase angles of zero and 60° verify the results graphically. **(10 Marks)**

OR

2 a. Explain the following types of vibrations
i) Free and forced vibrations
ii) Damped and undamped vibrations
iii) Deterministic and Random vibrations
iv) Linear and Non linear vibrations. **(10 Marks)**

b. Represent the periodic motion shown in Fig Q2(b) by harmonic series.

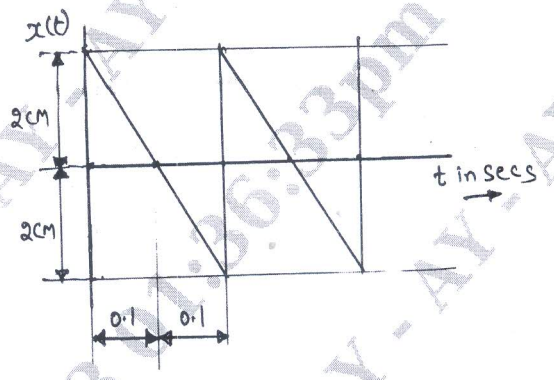


Fig Q2(b) **(10 Marks)**

Module-2

3 a. Find the natural frequency of the simple pendulum i) Neglecting the mass of rod ii) Considering the mass of rod by Newton's method. **(10 Marks)**

b. A 'U-tube' open to the atmosphere at both ends, contains a column length 'ℓ' of a certain liquid. Find the natural period of oscillation of the liquid column in the U-tube by energy method. **(10 Marks)**

OR

4 a. Define Logarithmic decrement. Show that logarithmic decrement $\delta = 2\pi\xi/\sqrt{1-\xi^2}$. **(08 Marks)**

b. A disc of torsional pendulum has mass moment of inertia 0.6Kg/m^2 which is immersed in a viscous fluid. The shaft is of 0.1m diameter and 0.4 long, when the pendulum vibrates, the amplitude of successive cycles are 9°, 6° and 4°. Determine :
i) Logarithmic decrement ii) Damping torque at unit velocity iii) Periodic time of vibration.
Take G = 44 GPa. **(12 Marks)**

Module-3

5 a. Define Magnification factor. Derive an expression for the magnification factor. **(10 Marks)**

b. A machine of mass 1000Kg is acted upon by an external force of 2450N at a frequency of 1500 rpm. To reduce the effect, vibration isolators of rubber having a static deflection of 2mm under machine load is applied. The ratio of two successive amplitude is 3.6. Determine :

i) Stiffness constant K
ii) Force transmitted to the foundation
iii) Amplitude of vibration of the machine
iv) Phase lag. **(10 Marks)**

OR

6 a. With Z/Y V/s frequency ratio plot, explain the vibrometer and accelerometer. **(10 Marks)**

b. A vertical shaft of diameter 20mm rotates in a long bearing and a disc of mass 18Kg is attached to the shaft at mid span. The span of the shaft is 0.8m. The eccentricity of the disc from the shaft axis is 0.5mm. Neglecting the mass of the shaft and considering the shaft to be fixed- fixed. Find the critical speed. Also determine the range of speed for which the stress in the shaft due to bending exceeds 150MPa. Take E = 210GPa. **(10 Marks)**

Module-4

7 a. Obtain the natural frequencies of the double pendulum and sketch its mode shape. Assume $M_1 = M_2 = M$. **(16 Marks)**

b. Write a brief note on Dynamic vibration absorber. **(04 Marks)**

OR

8 a. Derive one dimensional wave equation for Transverse vibration of a string. **(10 Marks)**

b. Derive the differential equation for torsional vibration of a uniform rod. **(10 Marks)**

Module-5

9 a. Determine the lowest natural frequency of the system shown in Fig Q9(a). Using Stodola method.

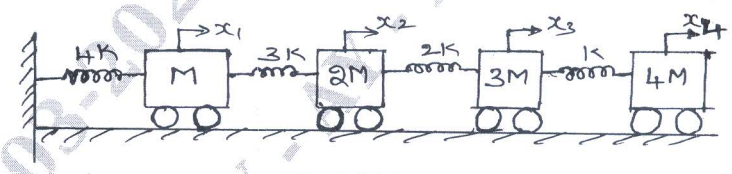
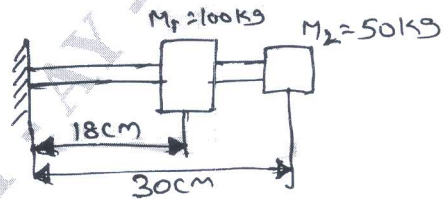


Fig Q9(a) **(12 Marks)**

b. Find the lowest natural frequency of vibration for the system shown in Fig Q9(b) by Dunkerley's method.



E = 196GPa
$I = 4 \times 10^{-7} m^4$

Fig Q9(b) **(08 Marks)**

OR

10 a. Determine the natural frequencies for the torsional vibration of a 4-DOF system shown in Fig Q10(a). Using Holzer's method.

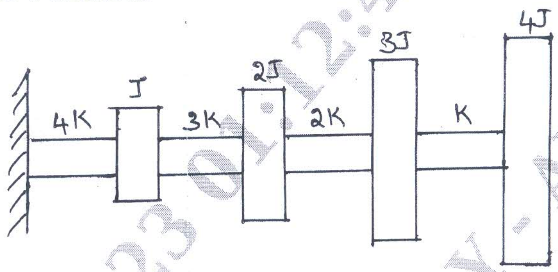


Fig Q10(a) **(15 Marks)**

b. Find the influence coefficients of the system shown in Fig Q10(b).

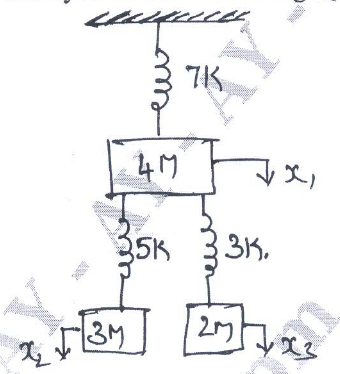


Fig Q10(b) **(05 Marks)**

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