CBCS SCHEME

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18AE56

# Fifth Semester B.E. Degree Examination, July/August 2021
## Theory of Vibrations

Time: 3 hrs. Max. Marks: 100

**Note:** ***Answer any FIVE full questions.***





**1** a. What is vibration? Briefly explain the different types of vibrations. **(10 Marks)**

b. Add the following harmonic motions analytically and check the solution graphically. $x_1 = 4 \cos(wt + 10°)$, $x_2 = 6 \sin(wt + 60°)$. **(10 Marks)**

**2** a. Define and explain following terms:
i) Natural frequency
ii) Degree of freedom
iii) Simple harmonic motion
iv) Beats
v) Resonance. **(10 Marks)**

b. Find the Fourier series for saw tooth curve as shown in the Fig.Q.2(b). **(10 Marks)**

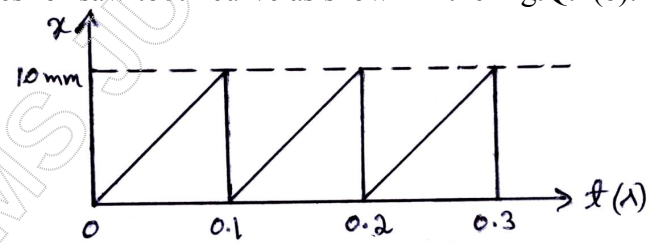


Fig.Q.2(b)

**3** a. Determine the natural frequency of the simple pendulum
i) Neglecting the mass of rod
ii) Considering the mass of rod. **(10 Marks)**

b. Determine the natural frequency of the system shown in Fig.Q.3(b), using Newton's method. **(10 Marks)**

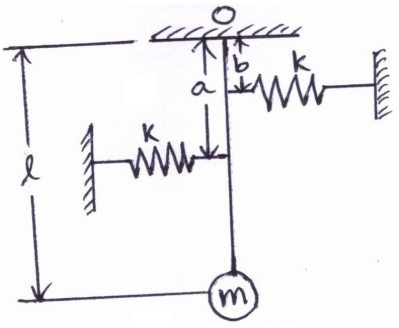


Fig.Q.3(b)

4 a. What are the types of damping? Explain any two types of damping. **(10 Marks)**

b. Find the natural frequency of vibration of the half solid cylinder shown in Fig.Q.4(b), when slightly displaced from the equilibrium position and released by using i) Newton's method ii) Energy method. **(10 Marks)**

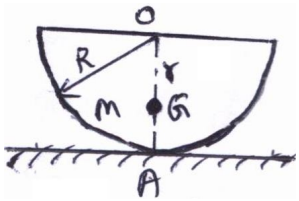


Fig.Q.4(b)

5 a. Explain the working principle of i) Vibrometer ii) Fullarton Tachometer. **(10 Marks)**

b. Derive an expression for amplitude of a whirling shaft without air damping. **(05 Marks)**

c. A vibrometer gives a reading of relative displacement 0.5mm. The natural frequency of vibration is 600rpm and the machine runs at 200rpm. Determine the magnitude of displacement, velocity and acceleration of the vibrating machine part. **(05 Marks)**

6 a. Briefly explain vibration isolation and transmissibility. **(10 Marks)**

b. A machine part of mass 4kg vibrates in a viscous medium. A harmonic exciting force of 40N acts on the machine and causes a resonant amplitude of 15mm with a period of 0.2s. Determine the damping coefficient. If the system is excited by a harmonic force of frequency 4Hz, what will be the percentage increase in the amplitude of forced vibration, when damper is removed? **(10 Marks)**

7 a. Write a short note on principal modes and normal modes of vibration. **(04 Marks)**

b. For the system shown in Fig.Q.7(b).

i) Derive the equation of motion

ii) Set up frequency equation and obtain natural frequencies of the system

iii) Obtain modal vectors

iv) Draw mode shapes. **(16 Marks)**

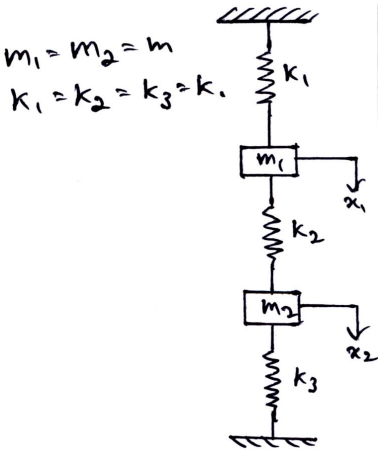


Fig.Q.7(b)

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

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

9 a. State and prove Maxwell reciprocal theorem. **(08 Marks)**

b. A shaft 100mm diameter is supported in short bearings 3m apart and carries 3 discs weighing 900N, 1400N, 700N situated in 1m, 2m and 2.5m from one of the bearings respectively. Assuming E = 200GPa and density of shaft material = 7800kg/m$^3$, calculate the frequency of transverse vibration, by Dunkerley's method. **(12 Marks)**

10 a. Using Stodola's method, determine the lowest natural frequency of the system shown in Fig.Q.10(a). **(10 Marks)**

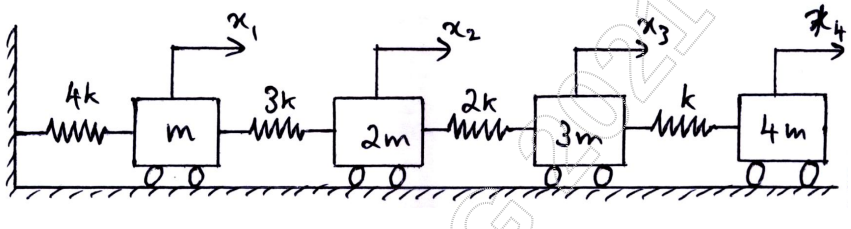


Fig.Q.10(a)

b. Determine the natural frequencies of the system shown in Fig.Q.10(b) by Holzer method. Given $J_1 = J_2 = J_3 = 1\text{kgm}^2$, $K_{t_1} = K_{t_2} = 1\text{N.m/rad}$ **(10 Marks)**

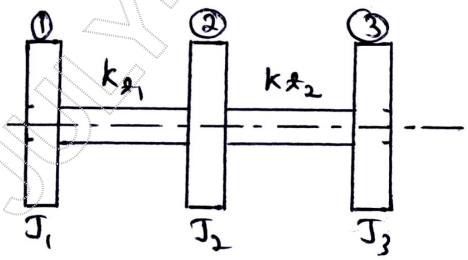


Fig.Q.10(b)

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