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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: VI**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME6DCMEV/16ME6DCMEV **Max Marks: 100**
Course: Mechanical Vibrations **Date: 15.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Derive an expression for the natural frequency of a simple pendulum by considering the mass of the rod. **10**

b) When a sphere of radius 'r' and mass 'm' is made to oscillate on a spherical surface of radius 'R', find the natural frequency of the system. **10**

UNIT - II

2 a) The mass of a spring mass dashpot is given an initial velocity of $X\omega_n$ where ω_n is the undamped natural frequency of the system. Find the equation of motion for the system for the cases when (i) ξ =2.5 and (ii) ξ =0.5 **10**

b) Set up a differential equation of motion for the system shown in figure 1 and solve the differential equation for (i) critical damping coefficient (ii) Damped natural frequency **10**

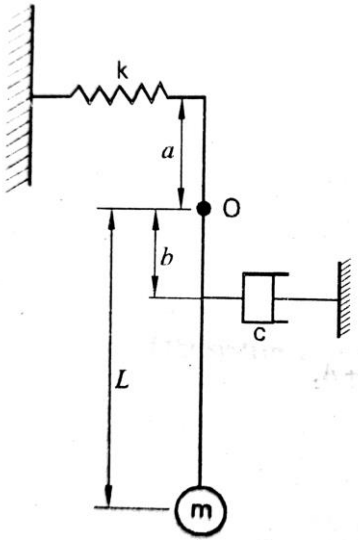

Figure 1

UNIT - III

3 a) Derive an expression for the ratio of amplitude for a harmonically excited spring-mass-dashpot system. **10**

b) A single cylinder vertical petrol engine of total mass 320kg is mounted upon steel chassis and causes a vertical static deflection of 2mm. The reciprocating parts of the engine have a mass of 24kg and move through a vertical stroke of 150mm with simple harmonic motion. A dashpot attached to the system offers a resistance of 490 N at a velocity of 0.3 m/s. Determine **10**

i) The speed of driving shaft at resonance

ii) The amplitude of steady state vibration when the driving shaft of the engine rotates at 480 rpm.

OR

4 a) What do you understand by critical speed of shaft? Derive the necessary relations for the shaft carrying unbalanced disc at the center considering effect of air damping. **10**

b) A shaft carrying a rotor of mass 50 kg and eccentricity 2 mm rotates at 12000rpm. Determine **10**

i)steady state whirl amplitude

ii) Maximum whirl amplitude during startup conditions of the system.

Assume stiffness of the shaft as $40x10^6$ N/m and external damping ratio as 0.1

UNIT - IV

5 a) Determine the natural frequencies of the system shown in figure 5a. Given $K_1= K_2=40$ N/m, K=60 N/m, $m_1=m_2=10$ kg **10**

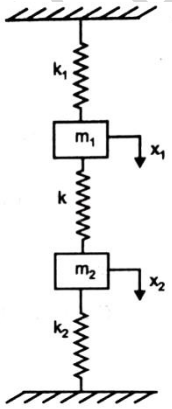

Figure 5a

b) What is vibration absorber? Show that spring force of the absorber system is equal and opposite to the exciting force when the main system is stationary. **10**

UNIT - V

6 a) Determine the influence coefficient of the system shown in figure 6a **10**

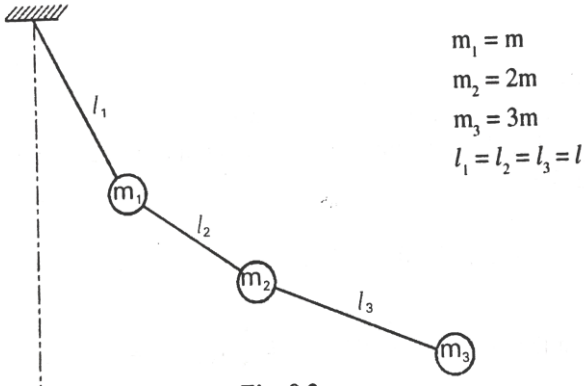

Figure 6a

b) Using Stodola's method, determine the lowest natural frequency of the torsional system shown in figure 6b **10**

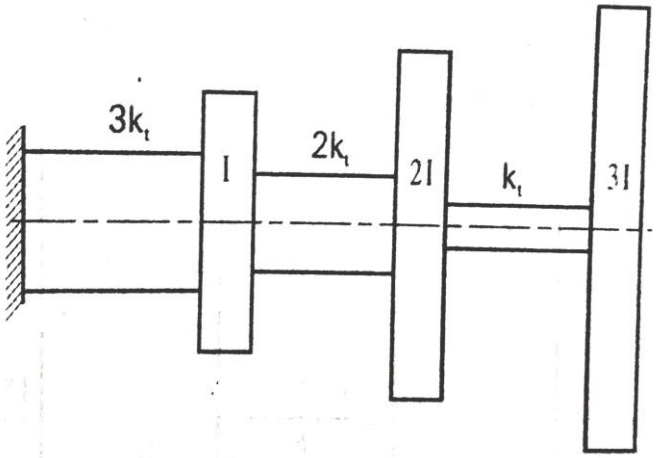

Figure 6b

OR

7 a) Determine the natural frequencies of the system shown in figure 7a by Holzer's method **15**

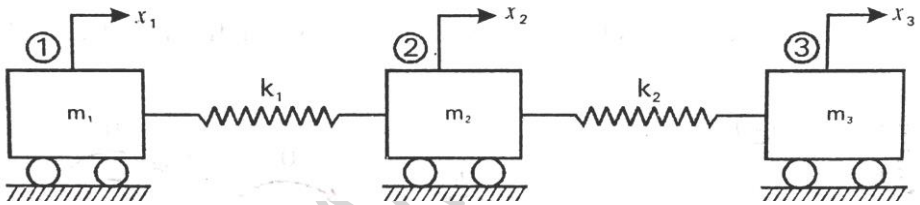

Figure 7a

m_1=2kg, m_2=4kg, m_3=2 kg, k_1=5 N/m, k_2= 10N/m

b) Explain the matrix method for determining natural frequencies of Multi degree system. **05**

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