Reg No.:_____ Name:_____

03000AO304052001

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth semester B.Tech examinations (S), September 2020

Course Code: AO304

Course Name: Vibration and Aero Elasticity

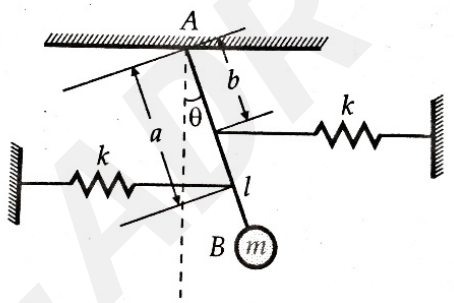
Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks. Marks

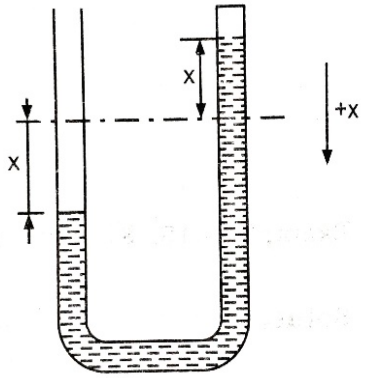
1 a) Draw any one example for single, two and multi degree of freedom systems. (3)

b) Calculate the natural frequency of the system shown by D'Alembert's principle. If the mass of the rod is negligible compared to the mass m. (7)



2 a) Define longitudinal, transverse and torsional vibrations. (3)

b) A simple U-tube manometer filled with liquid of mass density ρ is shown. Calculate the frequency of resulting motion by energy method. If the minimum length of manometer tube is 0.15 m. (7)



3 a) A load W acting on the simply supported beam of length L, determine its natural frequency for symmetrical loading. (5)

b) A torsional pendulum has a natural frequency of 5 Hz. The steel wire has a diameter of 2 mm and the suspended mass has inertia of 0.0098 kgm^2. Calculate the length of the wire. Take G = $0.85x10^{11}$ N/m^2. (3)

c) Write the magnification factor for harmonically forced vibrations with viscous damping. (2)

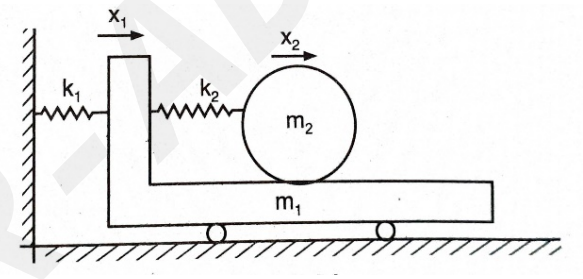
4 The mass of a spring-mass-dashpot system is given an initial velocity (from equilibrium position) of $A\omega_n$ where ω_n is the undamped natural frequency of the system. Find the equation of motion for the system for $\zeta = 2.0$ and $\zeta = 0.2$ (10)

PART B

Answer any three full questions, each carries 10 marks.

5 a) Write the general differential equation for angular motion. (2)

b) Derive the equation of motion of the vibrating system shown and determine the natural frequencies if m_1 = 196 kg, m_2 = 49 kg, k_1 = 98000 N/m, k_2 = 19600 N/m. (8)



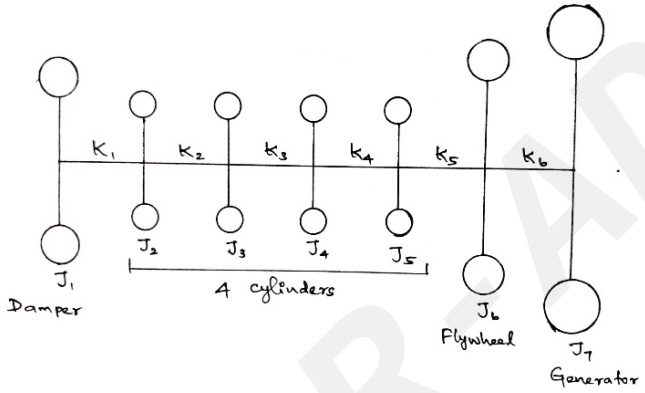
6 a) The main vibration system consists of mass m_1 supported by spring of stiffness k_1 which is subjected to an excitation F_o sin ωt. And a vibration absorber consists of mass m_2 and spring with stiffness k_2. Find out the amplitudes for coupling of main system and vibration absorber. (8)

b) Write the general equation of Hamilton's principle for conservative and non-conservative system. (2)

7 The deflection of a simply supported beam of length l is $y = Y\left[1 - \frac{4x^2}{l^2}\right]$. Calculate the frequency of the beam using Rayleigh's method. (10)

8 A four cylinder engine whose shaft is coupled to a damper at one end and a (10)

generator at the other end has a flywheel mounted on the shaft between the engine and the generator. The schematic of the system is shown with the values of the rotor inertias and the stiffness of the shafts. Estimate the two lowest natural frequencies by Holzer method. J_1=10, J_2=J_3=J_4=J_5 = 1.5, J_6 = 20, J_7 = 120, k_1 = 40x10^6, k_2=k_3=k_4 = 30x10^6, k_5 = 60x10^6, k_6 = 10x10^6. All inertias are in kgm^2 and all stiffness are in Nm/rad.

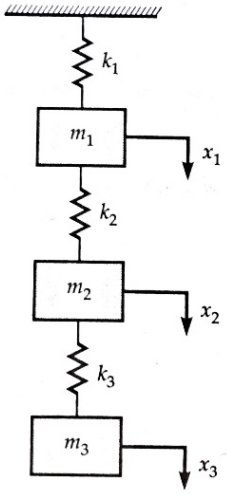


PART C

Answer any four full questions, each carries 10 marks.

9 Determine the normal functions in transverse vibration for a simply supported beam of length l and uniform cross section. (10)

10 Find the fundamental natural frequency and the corresponding mode shape for the system shown for k_1=k_2=k_3 and m_1=m_2=m_3 using matrix iteration method. (10)



11 a) Write the general procedure with formulas of stodola method for the calculation (6)

of fundamental natural frequency of undamped free vibrations for multi-degree of freedom system.

b) What are the assumptions should be carried out while deriving the equation of motion for continuous system. (4)

12 Using Collar's triangle, explain various aeroelastic phenomena in detail. (10)

13 Explain flutter behaviour from the consideration of extraction of energy from airstream. (10)

14 a) When the wing is said to be torsionally divergence? Justify your statement. (3)

b) What is Wing Divergence Speed? What are its effects? (3)

c) What is critical aileron-reversal speed? (2)

d) Define aileron efficiency. (2)

****