Name: **Enrolment No:**	UPES University of Tomorrow

UPES

End Semester Examination, December 2023

Course: Vibration & Aeroelasticity **Semester: VII**
Program: B. tech ASE **Time : 03 hrs.**
Course Code: ASEG 4018 **Max. Marks: 100**

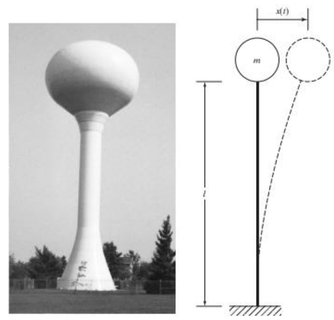
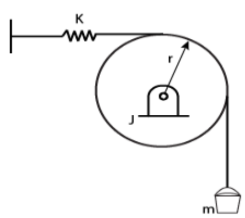
Instructions: Assume any suitable value for the missing data.

SECTION A
(5Qx4M=20Marks)

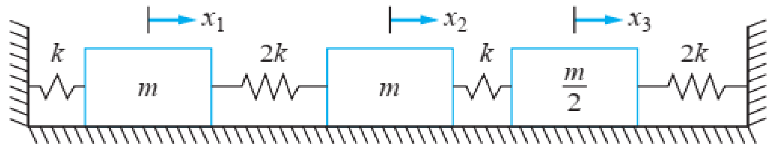
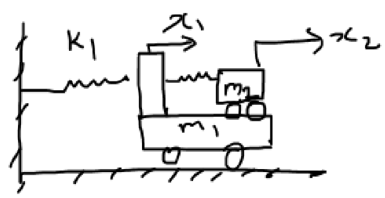
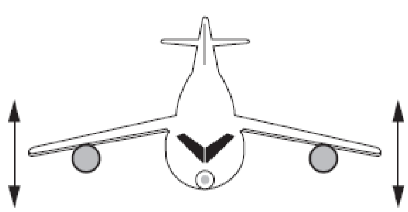
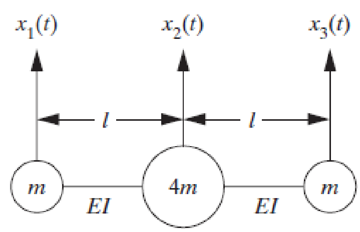
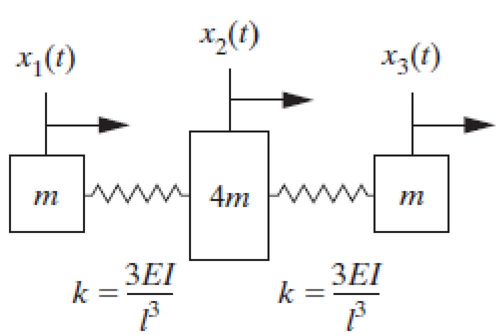
S. No.		Marks	CO
Q 1	State True/False for the below statements a) For a harmonic force, the amplitude of the forced vibration is always the same as the amplitude of the external force. b) For a heavily overdamped system, the response reaches equilibrium more quickly than an underdamped system in free vibration. c) Lowest eigen value correspond to the highest frequency of the system in vibration problem. d) A larger logarithmic decrement value indicates a system with less damping and a slower rate of amplitude decay.	**4**	**CO1**
Q2	A harmonic oscillator with a mass of 0.5 kg and a spring constant of 100 N/m is subjected to damping by a damping coefficient of 5 Ns/m. Calculate the critical damping coefficient for the system and determine whether it is underdamped, critically damped, or overdamped	**4**	**CO2**
Q3	A mass-spring-damper system has a mass of 2 kg and a spring constant of 1000 N/m. The damping ratio is 0.2. Calculate the natural frequency and the damped frequency of vibration for the system	**4**	**CO2**
Q4	Briefly explain aerodynamic flutter, state the main cause of the flutter in a/c.	**4**	**CO3**
Q5	State the difference between critically damped and overdamped systems.	**4**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q6	Illustrate and explain control reversal, derive an expression of control reversal speed for 2 D wing. Highlight major ways by which it can be controlled in the a/c.	**10**	**CO3**
Q7	The column of the water tank shown in Fig. below is 60 m high and is made of reinforced concrete with a tubular cross section of inner diameter 16 m and outer diameter 20 m. The tank weighs 5000kg when filled with water. By neglecting the mass of the column and assuming the Young s modulus of reinforced	**10**	**CO2**

	concrete as 290 GPa, determine the following: the natural frequency and the natural time period of transverse vibration of the water tank. 		
Q8	A rope goes over a pulley of mass M, with mass m, hanging from the rope connected with spring of stiffness K. Assume rope is inextensible, massless and there is no slip between pulley and rope The pulley radius is r and its mass moment of inertia is J. Assume that the mass is vibrating harmonically about its static equilibrium position. Derive the expression for natural frequency and find natural frequency of the system if M = 3 kg, m = 1 kg and K = 20 N/m and r= 100 mm. 	**10**	**CO2**
Q9	A 75 kg machine is mounted on springs of stiffness $k=11.76\times10^{6}$ N/m with a damping factor of 0.2. A 2 kg piston within the machine has a reciprocating motion with a stroke of 0.08 m and a speed of 3000 rpm. Assuming the motion of the piston to be harmonic, determine the amplitude of vibration of machine and the vibratory force transmitted to the foundation.	**10**	**CO3**

SECTION-C
(2Qx20M=40 Marks)

Q10	A railroad car of mass 1500 kg is to be coupled to an assembly as ashown in fig. below. The couplers are elastic connections of stiffness 4x 10^3 N/m. Describe the motion of the three-railroad car for the three frequencies.  **OR** Determine the natural frequency of the system shown in fig. below K_1 = 60 N/ m , K_2 = 40 N/m , m_1 = m_2 = 10 kg.  	**20**	**CO4**
Q11	The vibration in the vertical direction of an airplane and its wings can be modeled as a 3DOF system, with one mass corresponding to the right wing, one to the left, and one for the fuselage. Determine the equation of motion is For m = 3000 kg; E = 6.9 GPa, I = 5.2 x 10^{-6} m^4, and L = 2 m, calculate the natural frequencies and corresponding mode shapes    	**20**	**CO4**