Register Number:……..

KUMARAGURU
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B.E DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Sixth Semester

AERONAUTICAL ENGINEERING

U18AET6003: Vibration and Aeroelasticity

COURSE OUTCOMES

CO1: Determine the natural frequencies and mode shapes of the vibrating system.
CO2: Solve the equations of motion for multidegree-of-freedom systems.
CO3: Determine the natural frequency of continuous systems of free-vibration.
CO4: Identify the effects of vibrations on aircraft structures and the static and dynamic aeroelastic effects.
CO5: Determine the natural frequencies and mode shapes of the vibrating system.

Time: Three Hours **Maximum Marks: 100**

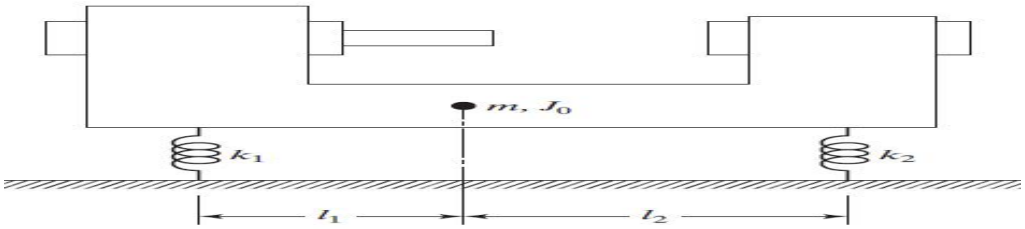
Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	State D'Alembert's principle.	CO1	[K_1]
2.	Consider two harmonic motions of different frequencies: $x_1(t) = = 2\cos 2t$ and $x_2(t) = \cos 3t$. Is the sum $x_1(t) + x_2(t)$ a harmonic motion?	CO1	[K_2]
3.	What is the difference between a vibration isolator and a vibration absorber?	CO2	[K_1]
4.	A vibrometer having the amplitude of vibration of the machine part as 4 mm and ξ=0.2. Performs harmonic motion. If the difference between the maximum and minimum recorded value is 5mm, determine the natural frequency (in rad/sec) of vibrometer, if the frequency of vibration part is 12 rad/sec.	CO2	[K_2]
5.	What is a semi definite system? Give two examples of physical systems that are degenerate.	CO3	[K_1]
6.	Define the terms wave length and frequency in sound wave.	CO3	[K_1]
7.	Write the boundary conditions for the lateral vibration of a string having (i) both ends free (ii) both ends fixed.	CO4	[K_2]
8.	State Hamilton's principle.	CO4	[K_2]
9.	Briefly explain about the wing divergence.	CO5	[K_1]
10.	Briefly explain about the buffeting.	CO5	[K_1]

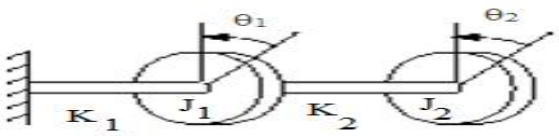
Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11.	Derive the General equation of motion for Spring-Mass-Damper system under free vibration and the equation for under damped motion.	16	CO1	[K4]
12.	A mass m of 10 kg traveling with the velocity v = 50 m/s strikes and becomes embedded in a massless board supported by a spring of stiffness k = 6.4x 10^4 N/m in parallel with a dashpot with the coefficient of viscous damping c = 400 N.s/m. Determine the time required for the board to reach the maximum displacement and the value of the maximum displacement.			

13.	A machine tool, having a mass of 1000 kg and a mass moment of inertia of J_0 = 300 kg-m^2 is supported on elastic supports, as shown in Figure given below. If the stiffness of the support is given by 3000 N/mm and 2000 N/mm, and the supports are located at 0.5 m and 0.8 m, find the natural frequencies and mode shapes.	16	CO5	[K4]



14.	Determine the equation of motion in matrix form, and then calculate the natural frequencies and mode shapes of the torsional system of fig. Assume that the torsional stiffness values provided by the shaft are equal (k_1= k_2) and that disk 1 has three times the inertia as that of disk 2(J_1=3J_2).	16	CO2	[K4]



15.	Derive the governing equation for transverse vibration of a beam and investigate its general solution.	16	CO3	[K3]
16.	Derive an expression for the divergence speed of a 2D wing.	16	CO4	[K3]

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