Register Number:……………..

KUMARAGURU
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B.E DEGREE EXAMINATIONS: NOV / DEC 2024

(Regulation 2018)

Sixth Semester

AERONAUTICAL ENGINEERING

U18AET6003: Vibration and Aeroelasticity

COURSE OUTCOMES

CO1: Explain the concept and types of vibration.

CO2: Determine the natural frequencies and mode shapes of the vibrating system.

CO3: Solve the equations of motion for multi degree-of-freedom systems.

CO4: Determine the natural frequency of continuous systems of free-vibration.

CO5: Identify the effects of vibrations on aircraft structures and the static and dynamic aeroelastic effects.

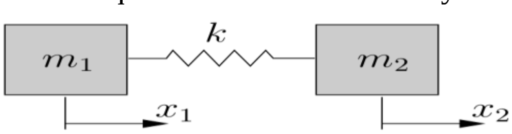
Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

(Answer not more than 40 words)

1. Two springs having stiffness 10N/mm and 5 N/mm are attached in series and a mass is suspended at the end of it. Determine the equivalent spring stiffness of the two springs ? CO1 [K_3]
2. Calculate the spring constant of a simply supported beam having length (L), modulus of elasticity (E) and area moment of inertia (I) subjected to load W at mid-point. CO1 [K_3]
3. A body describes simultaneously two motions, X_1=4sin41t, X_2=3sin40t. What is the maximum and minimum amplitude of the combined motion and what is the beat frequency? CO2 [K_3]
4. A spring-mass system with m=0.8 kg and k=15,000 N/m with negligible damping, is used as a vibration pickup. When mounted on a structure vibrating with an amplitude of 6 mm, the total displacement of the mass of the pickup is observed to be 14 mm. Find the frequency ratio of the vibrating structure. CO2 [K_3]
5. Find the equation of motion of the system as shown in the below figure CO3 [K_3]



6. What is meant by static and dynamic coupling? How can you eliminate coupling of the equations of motion? CO3 [K_2]
7. How does a continuous system differ from a discrete system in the nature of its equation of CO4 [K_2]

motion?

8. State the possible boundary conditions at the ends of a string. CO4 [K_2]

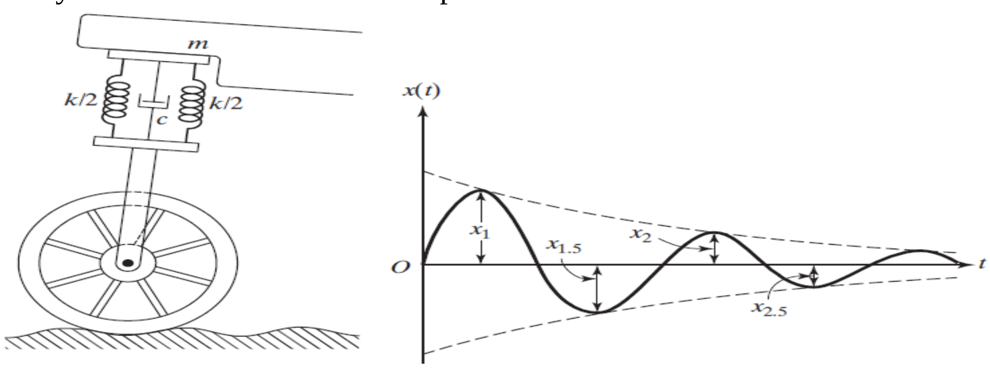
9. Briefly explain about the flutter. CO5 [K_1]

10. What is meant by buffeting? CO5 [K_1]

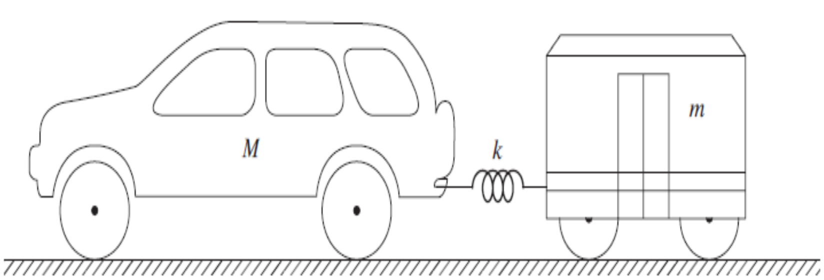
Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11. a) Derive the general equation of motion for Spring-Mass-Damper system under free vibration and the equation for under damped motion. 16 CO1 [K_2]

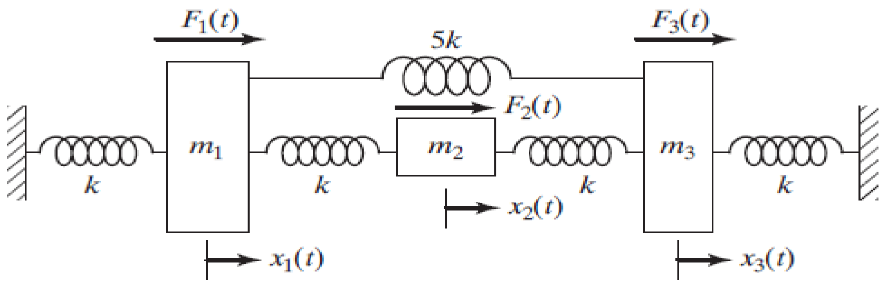
12. a) An underdamped shock absorber is to be designed for a motorcycle of mass 200kg When the shock absorber is subjected to an initial vertical velocity due to a road bump, the resulting displacement-time curve is to be as indicated in Fig. Find the necessary stiffness and damping constants of the shock absorber if the damped period of vibration is to be 2sec and the amplitude x is to be reduced to one-fourth in one half cycle (i.e., $x_{1.5} = x_1/4$). Also find the minimum initial velocity that leads to a maximum displacement of 250 mm. 16 CO2 [K_4]



13. a) Figure shows a 3000-kg car connected to a 2000-kg trailer by a flexible hitch having a stiffness of 1000 N/m. Assuming that both the car and the trailer can move freely on the roadway, determine the natural frequencies of the system. 16 CO3 [K_4]



14. a) Determine the natural frequency of the system, using Newton s second law of motion, for each of the systems shown in Fig 16 CO3 [K_4]



15. a) Derive the governing equation for transverse vibration of a beam and investigate its general solution. 16 CO4 [K_2]

16. a) Derive an expression for the aileron reversal speed of a 2D wing. 16 CO5 [K_2]

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