APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M. TECH DEGREE EXAMINATION

Mechanical Engineering
(Machine Design)
04 ME 6503: THEORY OF VIBRATIONS

Max. Marks: 60 Duration: 3 hrs

PART A

(Answer all questions. Each question carry 3 marks).

1. Derive the equation for natural frequency of a spring mass vibratory system by using Rayleigh's method
2. Differentiate between viscous damping and coulomb damping
3. Explain displacement transmissibility.
4. Differentiate between unit impulse & unit step function
5. Explain Duhamel's integral
6. Differentiate between periodic and non-periodic forcing function.
7. Differentiate between principal mode and normal mode of vibration.
8. Explain Dunkerley's method for multi degree of freedom systems.

PART B

(Each full question carries 6 marks).

9. Develop a vibratory system model of a motorcycle rider considering the weight of the vehicle, rider & wheel, elasticity of the tires, main spring & seats and damping of the seats shock absorbers and tyres.

OR

10. Determine the equivalent spring constant of the system (Fig 1).

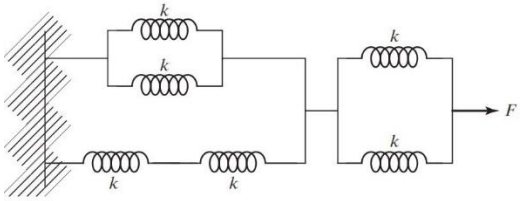

Figure 1

11. A body of 5 kg is supported on a spring of stiffness 200 N/m and has dashpot connected to it which produce a resistance of 0.002 N at a velocity of 1 cm /sec. In what ratio will the amplitude of vibration be reduced after 5 cycles.

OR

12. Consider the system shown in the figure 2. If k_1= 2 N/mm, k_2 = 1.5 N/mm, k_3 =3 N/mm k_4=k_5= 1.5 N/mm. Find mass W if the system has natural frequency of 10 Hz.

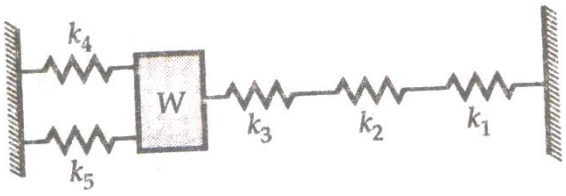

Figure 2

13. The vibration of the platform of the railway station are periodic at the frequency range of 12–50 Hz. A vibration measuring instrument is to be installed on some foundation independent of platform. The small foundation is supported by four identical springs resting on the platform. The total mass of the instrument and foundation is 50 kg. What is the maximum value of spring stiffness if the amplitude of transmitted vibration is to be less than 10 % of the platform vibration over the given frequency range. Take Ɛ=0.20.System is treated as single degree of freedom.

OR

14. A vibrometer having the amplitude of vibration of the machine part as 4mm and Ɛ=0.2, performs harmonic motion. If the difference between the maximum and minimum recorded value is 10 mm, determine the natural frequency of vibrometer if the frequency of the vibration part is 12 rad/sec.

15. A pulse excitation as shown below (fig 3) is given to an undamped spring mass system consider two parts $t<t_1$ and $t>t_1$ and find a response to each part. (Hint : $\int xsin(x)dx = xcos(x) + \sin(x) + C$)

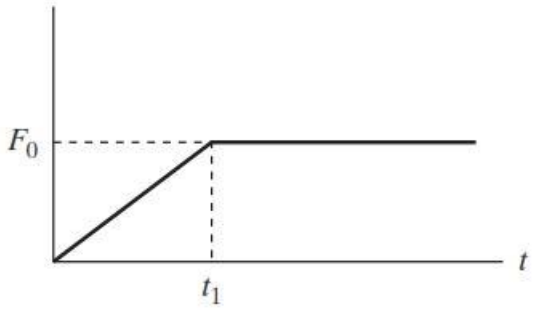

Figure 3

OR

16. Determine the response of an undamped, single degree of freedom spring mass system subjected to triangular impulse as shown in figure 4.

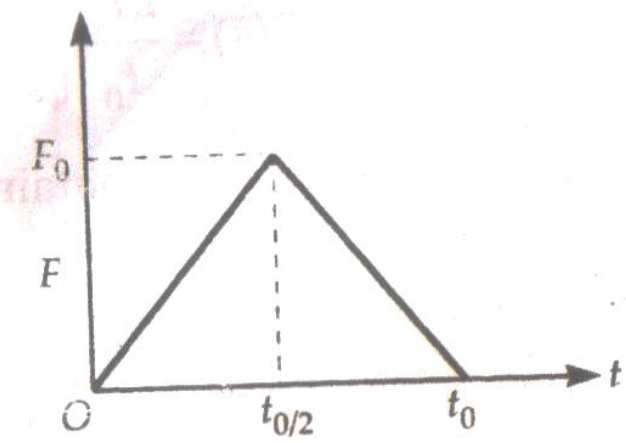

Figure 4

17. An apparatus of mass m is shipped in a container as shown in the figure 5. In the process of unloading, the container is dropped from a height h to a hard floor. Find the response of the system.

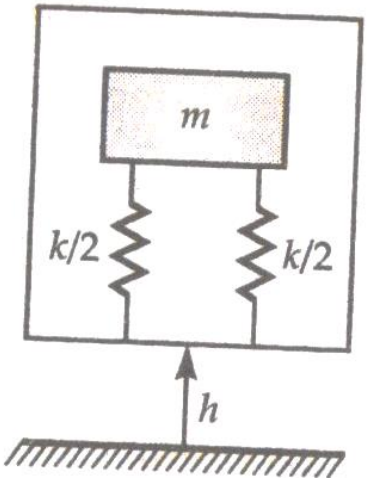

Figure 5

OR

18. A force *F(t)* is suddenly applied to a mass m which is supported by a spring with a constant stiffness k. After a short period of time T, the force is suddenly removed. During the time the force is active, it is a constant, F. Determine the response of the system of $t > T$ .The spring and mass are initially at rest before the force *F(t)* is applied.

19. Determine the natural frequency of the system. (fig 6)

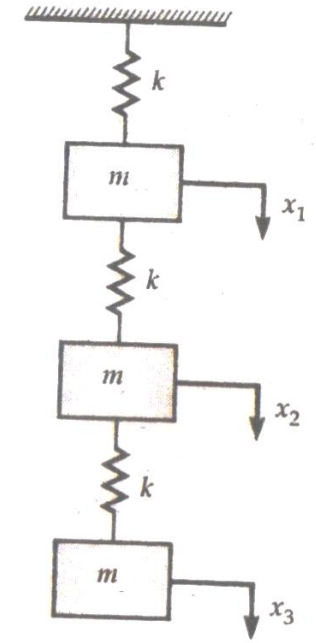

Figure 6

OR

20. A hot air balloon of mass *m* is used to lift a load, Mg, by means of 12 equally spaced and equally inclined ropes, each of stiffness *k*. Find the natural frequency of vibration of the balloon in vertical direction.