APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M. TECH DEGREE EXAMINATION

Mechanical Engineering

(Machine Design)

04 ME 6503 – Theory of Vibration

Max. Marks: 60 Duration: 3 hrs

PART A

Answer all questions.

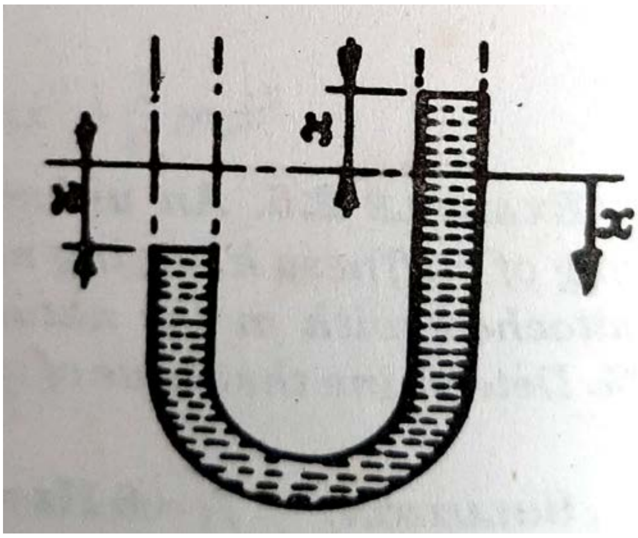
Each question carries 3 marks

1. Define the terms Natural frequency, Resonance and Degrees of Freedom.
2. Explain the addition of two simple harmonic motions.
3. Deduce the torsional equation of motion of a rotor connected to a shaft.
4. Derive the expression for energy dissipated in a viscous damper.
5. Explain logarithmic decrement.
6. Explain the phenomena of beat.
7. Explain Transmissibility.
8. Obtain the response to a reciprocating unbalance.

PART B

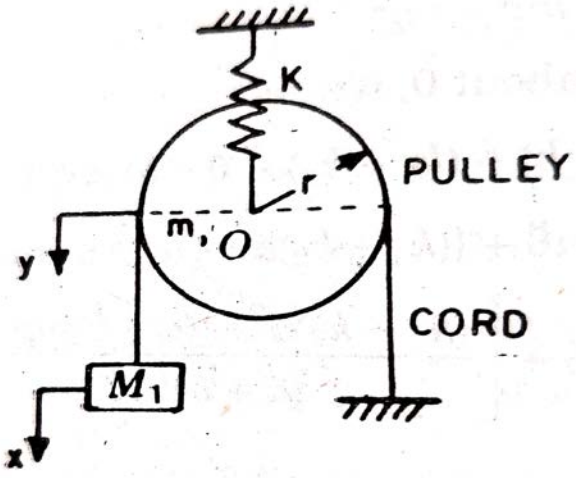
Each full question carries 6 marks

9. Determine the natural frequency of the U-tube manometer system filled with liquid as shown in the figure.



OR

10. Determine the equation of motion and natural frequency of the system shown in the figure.

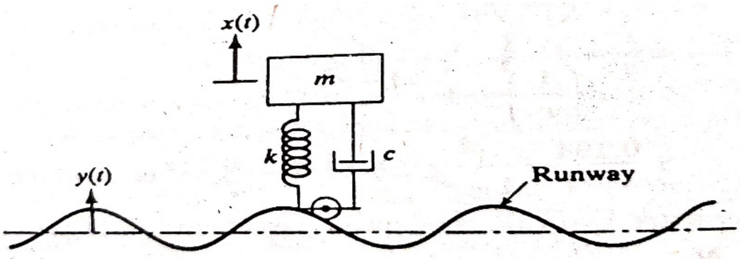


11. A shock absorber is to be designed so that its overshoot is 10% of the initial displacement when released. Determine the damping factor. If the damping factor is reduced to one-half this value, what will be the overshoot?

OR

12. A body of mass 1.25 Kg is suspended from a spring with a scale of 2 KN/m. A dashpot is attached between the mass and the ground, and has a resistance of 0.5 N at a velocity of 50 m./s. Determine the (i) natural frequency of the system, (ii) critical damping factor of the dashpot, (iii) ratio of the successive amplitudes, (iv) amplitude of the body 10 cycles after it was released from an initial displacement of 20 mm and (v) the displacement of the body exactly 1.25 sec after it was released from the initial displacement of 20 mm.

13. The landing gear of an airplane can be idealized as the spring-mass-damper system as shown in the figure. If the runway surface is described as $y(t) = y_0 \cos\omega t$, determine the values of stiffness and damping co-efficient, that the amplitude of vibration of the airplane limits to 0.1m. Assume m = 2000 Kg, y_0 = 0.2 m and ω = 157 rad/sec.



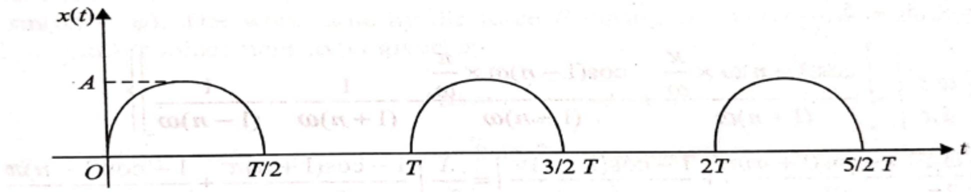
(b)

Modeling of landing gear.

OR

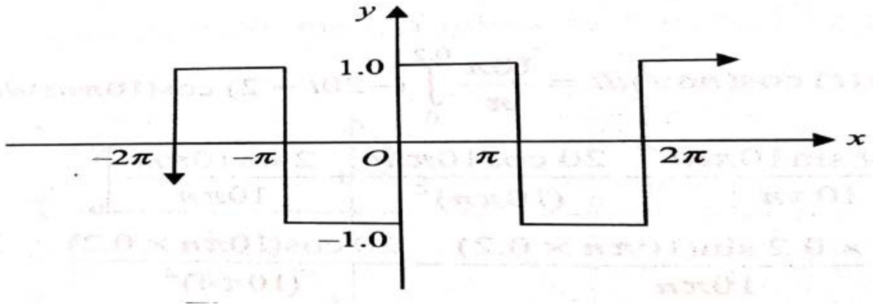
14. A 50 Kg mass is attached to a base through a spring in parallel with a damper. The base undergoes harmonic excitation of $y(t)$ = 0.20 $\sin 30t$. The stiffness of the spring is 30000 N/m and the damping constant is 200 Ns/m. Determine the amplitude of the mass absolute displacement and the amplitude of its displacement relative to its base.

15. Represent the wave in Fourier series.



OR

16. Represent the periodic signal as the sum of harmonic series.

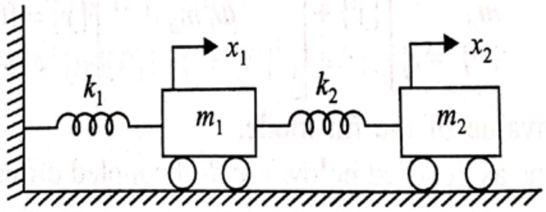


17. Derive the expression for the response to an impulse excitation?

OR

18. A spring mass system is subjected to a harmonic force $F_0\ cos(\omega t)$. Determine the response of the system using Laplace Transform. Given x_0 = 0.01m, v_0 = 0.04m/s, ω = 30 rad/sec, F_0 = 1000N, m = 10 Kg, and k = 500 N/m.

19. For the un-damped two degree of freedom system shown in figure, find the natural frequency and mode shapes. Take $m_1 = m_2 = m$ and $k_1 = k_2 = k$.



OR

20. Determine the lowest natural frequency of the system shown in figure. Assume $k_1 = 7k$, $k_2 = 5k$, $k_3 = 5k$ and $m_1 = 4m$, $m_2 = 3m$, $m_3 = 2m$.