FREE VIBRATION

PART-A

1. What are the causes and effect of vibration?
2. Define frequency, cycle, period and free vibration.
3. What are the different types of vibrations?
4. State different method of finding natural frequency of a system.
5. What is meant by free vibration and forced vibration?
6. Define resonance.
7. at is meant by degrees of freedom in a vibrating system?
8. What is the natural frequency of simple spring mass system?
9. Determine the natural frequency of mass of 10kgsuspended at the bottom of two springs (of stiffness: 5N/mm and 8N/mm) in series.
10. What is the effect of inertia on the shaft in longitudinal and transverse vibrations?
11. State the expression for the frequency of simple pendulum.
12. Give the expression for natural frequency of water, which oscillates in a 'U'tube manometer?
13. What are the different types of damping?
14. Draw the schematic diagram of a free damped vibration system and write the governing differential equation of the system.
15. Sketch the Time Vs Displacement for under-damped and over-damped systems.
16. What is the limit beyond which damping is detrimental and why?
17. What is meant by critical damping?
18. What type of motion is exhibited by a vibrating system when it is critically damped?
19. Define critical or whirling speed.
20. What are the factors that affect the critical speed of a shaft?
21. What are the causes of critical speed?
22. Differentiate between transverse and torsional vibrations.

PART-B

1. Derive an expression for the natural frequency of the free longitudinal vibration by
    - Equilibrium method
    - Energy method
    - Rayleigh's method
2. In a single degree of damped vibration system a suspended mass of 8kg makes 30 oscillations in 18 seconds. The amplitude decreases in 18 seconds. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine
    a. The spring stiffness
    b. Logarithmic decrement
    c. Damping factor
    d. Damping coefficient.
3. Determine equation of motion when a liquid column vibrating in a 'U'tube by
    a. Newton's method

b. Energy method and hence find its natural frequency.

4. (i)Deduce the expression for the free longitudinal vibration in terms of spring stiffness, its inertia effect and suspended mass.
   (ii)A spring mass system has spring stiffness ‘s’N/m and has a mass of ‘m’kg. It has the natural frequency of vibration as 12Hz.An extra 2kg mass is coupled to ‘m’ and natural frequency reduces by 2Hz.Find the value of ‘s’ and ‘m’.
5. A vibrating system consists of a mass of 8kg, spring of stiffness 5.6N/m and dashpot of damping coefficient of 40N/m/s. Find,
   - Critical damping coefficient
   - The damping factor
   - The natural frequency of damped vibration
   - The logarithmic decrement
   - The ratio of two consecutive amplitude
   - The number of cycle after which the original amplitude is reduced to 20 percent.
6. An instrument vibrates with a frequency of 1Hz when there is no damping. When the damping is provided, the frequency of damped vibration was observed to be 0.9Hz. Find,
   a. Damping factor
   b. Logarithmic decrement.
7. Find the equation of notion for the spring mass-dashpot system for the cases when
   a. $\zeta=2$,
   b. $\zeta=1$ and
   c. $\zeta=0.3$.

   The mass ‘m’is displaced by a distance of 30mm and released
8. Between a solid mass of 0kg and the floor are kept two slabs of isolates, natural rubber and felt, in series. The natural rubber slab has a stiffness of 3000N/m and equivalent viscous damping coefficient of 100 N-sec/m. The felt has a stiffness of 12000N/m and equivalent viscous damping coefficient of 330N-sec/m. Determine undamped and the damped natural frequencies of the system in vertical direction.
9. A cantilever shaft 50mm diameter and 300mm long has a disc of mass 100kg at its free end. The young’s modulus for the shaft material is 200GN/m2.SDetermine the frequency of longitudinal and transverse vibration of the shaft. (ii)Explain the sketches different cases of damped vibrations.
10. The barrel of a large gun recoils against a spring on firing. At the end of the firing, a dashpot is engaged that allows the barrel to return to its original position in minimum time without oscillation. Gun barrel mass is 400kg and initial velocity of recoils 1m.Determine spring stuffiness and critical damping coefficient of dashpot.
11. A steel shaft 100mm in diameter is loaded and support in shaft bearing 0.4m apart. The shaft carries three loads: first mass 12kg at the centre, second mass 10kg at a distance 0.12m from the left bearing and third mass of 7kg at a distance 0.09m from

the right bearing. Find the value of the critical speed by using Dunkerley’s method. E=2X1011N/m2