# MECHANICS AND PROPERTIES OF MATTER

## Objective Type (2-Mark)

### PENDULUM

1. What is compound pendulum? Write the expression for its period.
2. Define centre of suspension and centre of oscillation.
3. What is torsional pendulum?
4. What is of Bifilar pendulum?
5. What do you meant by "Equivalent simple pendulum"?.
6. A circular disc is provided at its rim show that for small oscillations its time period is given by

$$T = 2\pi\left(\sqrt{\frac{3R}{2g}}\right)$$

7. What is compound pendulum? Write differential equation of angular SHM.
8. State the condition for maximum time period of a compound pendulum.
9. State the condition for minimum time period of a compound pendulum.
10. What is Bifilar suspension?
11. Draw neat-labeled diagram of Bifilar pendulum with parallel threads.
12. Write the expression for period of Bifilar pendulum with parallel threads. State meaning of each symbol.
13. Write the expression for centre of gravity of Bifilar pendulum with parallel threads. State meaning of each symbol.
14. The bar or cylinder used in Bifilar pendulum executes simple harmonic motion. Justify.
15. Draw neat-labeled diagram of Kater's pendulum.
16. Stating the meaning of each symbol write the equation for the 'g' of Kater's pendulum.

### MOTION UNDER CENTRAL FORCE FIELD.

1. State Newton's law of gravitation.
2. Define constant of gravitation. State its SI and CGS unit.
3. Define a) Gravitational potential, b) Gravitational field.

4. State any two Kepler's laws of planetary motion.
5. Calculate the mass of the earth from the following data
   g = 9.8 $m/s^2$, G= 6.67 X $10^{-11}$ MKS unit, R= 6.38 X $10^6$ m.
6. Obtain an expression for gravitational potential due to a uniform solid state sphere at a point outside the sphere.
7. Define constant of gravitation. State its dimensions.
8. State the value of radial and transverse component of acceleration.
9. Using an expression for gravitational potential obtain an expression for gravitational field in case of spherical shell at a point outside the shell.
10. Using an expression for gravitational potential obtain an expression for gravitational field in case of spherical shell at a point inside the shell.
11. Using an expression for gravitational potential obtain an expression for gravitational field in case of solid sphere at a point inside the sphere.
12. A satellite revolves round a planet in an elliptical orbit. Its maximum and minimum distances from the planet are 1.5 X $10^{-7}$ m and 0.7 X $10^7$ m respectively. If the speed of the satellite at the longest point be 5 X $10^3$ m/s, calculate the speed at nearest point.
13. Assuming the earth's orbit around the sun to be a circular, calculate the angular velocity of the earth about the sun.
14. Assuming the earth's orbit around the sun to be a circular, what is its average linear speed. (Given R = 1.5 X $10^{-11}$ m).
15. Assuming the earth's orbit around the sun to be a circular, what is its centripetal acceleration (Given R = 1.5 X $10^{-11}$ m).
16. Explain the term gravitational potential.
17. Explain the term gravitational field.
18. If G = 6.6 X $10^{-11}$ $Nm^2/kg$. What is the force between two small spheres weighing 2 kg each placed 30 cm apart.
19. No work is done in moving an object from one point to another on the surface of a spherical shell. Explain.

## ELASTICITY

1. What is meant by Elasticity?
2. Distinguish between elastic body and plastic body
3. Define elasticity. Give its examples.

4. Define plasticity. Give its examples
5. Define Bulk Modulus. State its S.I units and dimensions.
6. Define Young's Modulus. State its S.I units and dimensions.
7. Define modulus of rigidity. State its S.I units and dimensions.
8. Define extensibility and compressibility of a material.
9. What do you understand by term "Geometrical moment of inertia"?
10. State the relation connecting the three Elastic constants.
11. Define Bending moment of a beam.
12. Define axis of bending and neutral axis.
13. State the expression for depression of cantilever when the load is fixed at the center. State the expression if the bar is rectangular.
14. State the expression for depression of cantilever when the load is fixed at the center. State the expression if the bar is circular.
15. What is cantilever? State the expression for the depression of free loaded end neglecting weight of cantilever.
16. Define Poisson's ratio. What is its limit?
17. State the relation between Young's modulus Y, Rigidity modulus n and Poisson's ratio $\sigma$.
18. Steel is more elastic than rubber. Justify.
19. Whether it is possible to have a material with negative value of Poisson's ratio? Justify.

**SURFACE TENSION**

1. Define cohesive force & adhesive force.
2. Define range of molecular attraction & sphere of influence.
3. Define surface tension in terms of surface energy.
4. Obtain the dimension of surface tension & state its S.I. unit.
5. What do you know about the angle of contact of liquid, which wets glass & does not wet glass?
6. What does the statement mean that the surface tension of water is 72 dynes per cm?
7. Why needle floats on water surface? Explain.
8. Rise of liquid in a capillary tube is effect of surface tension: Comments.
9. Why is mercury depressed in capillary tube?
10. Define angle of contact. When is it acute?

11. What is the effect of temperature on surface tension?
12. What is the effect of impurity on surface tension?
13. Why is there a difference of pressure on the two sides of a curved surface of a liquid?
14. Why raindrops are spherical?
15. Define radius of curvature of films.
16. State the various factors that affect the surface tension of liquid.
17. State different applications of surface tension.
18. Define surface tension & surface energy.
19. Draw diagrams to illustrate acute and obtuse angle of contact.
20. Why is the pressure from one side of a curved film larger than that of other?
21. Explain why the liquid meniscus is plane, concave or convex for different liquids in contact with glass?
22. Why the blotting paper is able to absorb ink but an ordinary paper is not?
23. What happens when two drops of liquids merge to form a single drop?
24. What is the angle of contact for a liquid, which partially wet the solid? Give example.
25. What is the angle of contact for a liquid, which does not wet solid? Give example.

## FLUID DYNAMICS

1. What is meant by rate of flow?
2. Explain streamline flow.
3. Explain turbulent flow.
4. State the equation of continuity.
5. Explain the kinetic energy of liquid in motion.
6. Explain potential energy of liquid in motion.
7. Explain pressure energy of liquid in motion.
8. State Bernoulli's theorem.
9. What are pressure head & velocity head?
10. What is Venturimeter?
11. State the applications of Venturimeter.
12. Give the application of Bernoulli's theorem.
13. Draw neat-labeled diagram of Venturimeter.
14. What is Pitot tube?

## VISCOSITY

1. Explain the term velocity gradient.
2. What is the meant by viscosity? State the dimensions of coefficient of viscosity.
3. Explain the term coefficient of viscosity.
4. State the factors on which the force of viscosity depends.
5. The layer of castor oil 3mm thick move with the speed of 3cm/sec. What is velocity gradient?
6. Define coefficient of viscosity? State its S.I units.
7. What do you understand by viscosity of liquid & viscous force?
8. In what way is viscosity similar to friction?
9. In what respect does viscous force differ from the force of friction?.
10. Define Poise.
11. Obtain the dimension of coefficient of viscosity? State its S.I unit.
12. Discuss the effect of temperature on viscosity of liquid.
13. Discuss the effect of pressure on viscosity of liquid.
14. What due you understand by viscous fluid?
15. Discuss the effect of temperature on viscosity of liquid.
16. Why an increase in temperature generally results in a decrease in viscosity?.
17. Why Poiseuille's formula fails in case of tubes of wide bores?
18. Discuss the effect of pressure on viscosity of liquid.

## Short Answer Type (4-Mark)

**PENDULUM**

1 Obtain an expression for period of compound pendulum.

2 How the torsional pendulum is used to compare the moment of inertia of two bodies? Explain.

3 Derive an expression for rigidity modulus by torsional oscillations.

4 Describe Kater's pendulum.

5 If the periods of a Kater's pendulum in the erect and inverted positions are equal , prove that the distance between the knife edges is equal to the length of the simple equivalent pendulum.

6 A disc of 10 cm radius and 2 kg mass is suspended in horizontal plane by a vertical wire attached to its center. If the diameter of wire is 1.5 cm and periods of torsional oscillation of disc is 10 sec find rigidity of material of wire.

7 The period of torsional oscillation with a disc suspended from a wire was 2 sec, when uniform ring of mass 0.2 kg and radius 5 cm was placed on disc, the period changed to 3 sec. Find the moment of inertia of the disc about the wire as axis.

8 A heavy uniform rod of length 90 cm swings in a vertical plane about a horizontal axis passing through its one end. Calculate the position at which a concentrated mass may be placed so that of swing remains unaltered.

9 A body of mass 600 gm oscillates about a horizontal axis at distance 45 cm from its center of mass. If the length of pendulum is 50 cm., find the moment of inertia of body about the axis of suspension.

10 Distinguish between simple pendulum and compound pendulum.

11 Show that periodic time of compound pendulum is minimum when the length of compound pendulum equals it's radius of gyration about a horizontal axis passing through its centre of gravity.

12 Derive the differential equation of angular SHM in case of compound pendulum.

13 A uniform circular disc of diameter 20 cm vibrates about a horizontal axis perpendicular to its plane and at a distance of 5 cm from the centre. Calculate the period of oscillation and the length of an equivalent simple pendulum.

14 A uniform square lamina of side 24 cm oscillates in a vertical plane about a horizontal axis perpendicular to the plane of the lamina and within its boundary.

Calculate i.) the minimum time period of oscillation, and ii.) the locus of the point of suspension about which the time period is minimum.

15 Prove that there are four points collinear with the centre of gravity of a compound pendulum about which its times of oscillations are equal, hence obtain the length of an equivalent simple pendulum.

16 A uniform bar of length 96 cm oscillates like a compound pendulum about the horizontal axis, passing through its end. Calculate the period of oscillations and positions of point about it will oscillate with the same period.

17 The length between the knife edges of a Kater's pendulum is 89.26 cm, while the times of oscillations about the two edges are 1.92 sec and 1.933 sec respectively. The centre of gravity of the pendulum is about 54.4 cm from one edge. What is the value of 'g'?

18 In case of compound pendulum, show that centers of suspension and oscillation are reversible (or interchangeable).

19 The centers of suspension and oscillation of a compound pendulum are reciprocal to each other. Justify.

20 Show that the Bifilar pendulum executes simple harmonic motion.

21 A uniform circular rod with a radius of 2 cm oscillates when suspended from a point on its axis at a distance of 4 cm from one end. If the length of the rod is 1m, find the point or points from which if suspended, the periodic time would remain unaltered.

22 Obtain the differential equation in case of Bifilar pendulum.

23 Using the differential equation in case of Bifilar pendulum, derive an expression for its period.

24 A torsional pendulum consists of a solid circular disc of mass 1 kg and radius 10 cm suspended horizontally from a rigid support by means of a metal wire of length 1.5 m and radius 1 mm, with its axis of rotation coinciding with the wire. If the periodic time of the torsional oscillations is 2 sec., calculate the rigidity modulus of the material of the wire.

## MOTION UNDER CENTRAL FORCE FIELD.

1. Define gravitational field and gravitational potential. Obtain expression for gravitational potential.
2. Obtain an expression for gravitational potential and field due to a uniform sphere at a point outside the sphere.

3. If G = 6.66 X $10^{-9}$ CGS units and radius of earth R = 6.36 X $10^{8}$ cm, find the density of the earth.
4. Show that the gravitational potential at the centre of a solid sphere is three and half time the potential at the surface.
5. Assuming the earth's orbit around the sun to be a circle, calculate angular velocity of the earth about the sun. What is the average linear speed and centripetal acceleration w.r.t the sun? Orbital radius of earth = 1.5 X $10^{11}$ m.
6. Obtain an expression for gravitational potential and field due to a uniform sphere at a point inside the sphere.
7. Obtain an expression for gravitational potential at a point inside the spherical shell.
8. State the Kepler's laws of planetary motion.
9. If the distance of the planet Jupitor from the sun is 5.2 times that of the earth, find the period of Jupitor's revolution around the circle.
10. What do you understand by radial and transverse acceleration?
11. Given G = 6.7 X $10^{-8}$ C.G.S. units, the radius of the earth = 6.4 X $10^{8}$ cm and its mean density 5.5 gm / $cm^3$. Calculate the acceleration due to gravity at the earth's surface.
12. The radius of the earth is 6.37 X $10^{8}$ cm. Its mean density 5.5 gm/$cm^3$ and the gravitational constant 6.67 X $10^{-8}$ C.G.S. units. Calculate the earth's surface potential.
13. Calculate the gravitational self energy of the sun. Given: Mass of the sun = 2 X $10^{30}$ kg, Radius of the sun = 7 X $10^{8}$ m, G = 6.67 X $10^{-11}$ $m^3/kgs^2$.
14. Explain the terms gravitational potential and gravitational field.
15. If a frictionless hole is bored from the surface of the centre of the earth and small object dropped down it, with what velocity will it reach the centre? (g = 980 $cm/s^2$ and radius of the earth R = 6.37 X $10^{8}$cm).
16. State and explain Newton's law of gravitation.
17. State Newton's law of gravitation. What is meant by gravitational constant? What are its dimensions?

## ELASTICITY

1. What is meant by elasticity? Differentiate the elastic body from plastic body?
2. Explain why only solid possess all the three constant of elasticity.
3. Define i)Young's modulus ii) Bulk Modulus

4. Define i) Modulus of rigidity ii) Poisson's ratio $\sigma$.
5. Define the terms i) Beam and ii) Bending moment.
6. Describe how the dimension of a beam is altered when the beam is bent.
7. Define the neutral surface, neutral axis, and plane of bending of a beam rigidity fixed horizontally at one end loaded at the other.
8. A force of 2 Kg-wt stretches steel wire having diameter 1mm and length 2 cm. Calculate increase in length of wire and strain ($Y=2 \times 10^{11}$ N/m$^2$).
9. A steel wire of length 1 m and diameter 0.2 mm is elongated by 1 mm due to weight of 3.14 Kg. Determine Young's modulus of steel wire.
10. Bulk modulus of water is $2.05 \times 10^9$ N/m$^2$. What change of pressure will compress a given quantity of water by 0.5 %?
11. A stress wire of 0.5 mm radius is bent to form a circle of 10 cm radius, What is the bending moment & maximum stress if $Y = 2 \times 10^{12}$ dyne/cm$^2$?
12. A steel rod of circular cross section of radius 1 cm is rigidly fixed at one end & a load of 8 kg is at the other end which is 100 cm from the fixed end calculate depression of end (Given: $Y = 20 \times 10^{11}$ dyne/cm$^2$).
13. A rectangular bar 20 mm in breath &10 mm in depth & 1 m in length is suspended at its end & load of 2 kg is applied at its midpoint. Calculate the depression if the Young's modulus of the material bar is $2 \times 10^{11}$ N/m$^2$.
14. A bar 10 m long, 2 mm square in section supported horizontally at its end & looked at the middle is depressed 2 mm by a load of 50 gm. Calculate Young's modulus for the material.
15. A brass bar 1 cm square in cross section is supported on two knife edges 100 cm apart a load of 1 kg at the center of the bar depression that point by 2.51 mm. What is Young's modulus for brass?
16. A cylindrical rod of diameter 14 mm rest on two knife edges 0.8 m apart & a load of 1 kg is suspended from its mid point. Neglecting the weight of the rod calculate depression of the mid point, if Y for its material be $2.04 \times 10^{11}$ N/m$^2$.
17. Calculate the bulk modulus of steel given that Young's modulus is equal to $2.4 \times 10^{12}$ dyne/cm$^2$ and $n = 8.2 \times 10^{11}$ dyne/cm$^2$.
18. Show that the bending moment for a thin uniform bar of rectangular cross-section is $\frac{Ybd^3}{12R}$.

19. What due you understand by the term geometrical moment of inertia? Give its value for rectangular cross-section and circular cross-section.
20. What is bending moment? Show that the bending moment of a beam is $\frac{Yl_g}{R}$.
21. Show that the value of Poisson's ratio lies between -1 & + 1/2.
22. Explain the basic assumptions for the theory of bending.
23. Derive an expression for the depression of free loaded end of the cantilever neglecting the weight of the cantilever.
24. Establish the relation, $\frac{Y}{3K} = (1 - 2\sigma)$.
25. Establish the relation, $\frac{Y}{2n} = (1 + \sigma)$.
26. Poisson's ratio of a material is 0.379 and its rigidity modulus is 2.87 X $10^{11}$ dynes/cm$^2$. Calculate the Young's modulus of the material.
27. A copper wire 3 m long has a diameter of mm, when it is stretched by a weight of 10 kg, it is elongated by 3mm. Calculate the modulus of rigidity if Poisson's ratio for the wire is 0.26.
28. Young's modulus for steel is 20 X $10^{10}$ N/m$^2$ and its rigidity modulus is 8 X $10^{10}$ N/m$^2$. Calculate the Poisson's ratio for steel.
29. Calculate the Poisson's ratio and modulus of rigidity of crown glass given that Young's modulus and bulk modulus for crown glass are 7 X $10^{10}$ N/m$^2$ and 5 X $10^{10}$ N/m$^2$ respectively.
30. A bar of length 1 m and cross section 5 X $10^{-3}$ m$^2$ is supported at its two ends and loaded in the middle is 1.96 X $10^{-3}$ m when a load of 0.1 kg is placed. Calculate the Young's modulus of the material.
31. A uniform rod of length 1m is clamped horizontally at one end. Calculate the depression of the midpoint of the rod. The diameter of the rod is 0.02 m. (Given Y = $10^{10}$ N/m$^2$).

## SURFACE TENSION

1. Define the term angle of contact & surface tension.
2. State any four characteristics of angle of contact.
3. Write a short note on application of surface tension.
4. How molecular attraction forces give rise to surface tension? Explain.

5. Obtain the relation between surface tension & surface energy.
6. Explain the capillarity & angle of contact.
7. Show that the surface tension of a liquid is equal to the mechanical part of its surface energy.
8. Obtain the relation between the radius of a spherical drop of a liquid, the surface tension & pressure.
9. Obtain the relation between the radius of a spherical soap bubble of a liquid, the surface tension & pressure
10. Describe the method of determining the surface tension of a soap bubble. Deduce formula used.
11. The pressure of air in a soap bubble of 0.7 cm, diameter is 8 mm of water above the atmospheric pressure. Calculate the surface tension of the soap solution.
12. Eight droplets of mercury each of radius 1 mm coalesce into a single drop. Find the change in surface energy; surface tension of mercury is 0.465 $J/m^2$.
13. A soap bubble has a diameter 5mm, calculate the pressure inside it, if the atmospheric pressure is $10^5$ $N/m^2$.(S.T.= 30x $10^{-3}$ N/m, $\theta = 0$).
14. The pressure inside a soap bubble of radius 1 cm balances a 1.4 mm column of oil of specific gravity 0.80. Calculate the surface tension of the soap solution.
15. Discuss the behavior of angle of contact at solid- liquid interface.
16. What do you understand by weightability and wet angle?
17. What do you understand by the angle of contact for a liquid, which partially wets to solid?.
18. What do you understand by the angle of contact for a liquid, which does not wet to solid?
19. Explain the various factors that affect the surface tension of a liquid.
20. Calculate the pressure inside a small air bubble of radius 0.1 mm situated just below the surface of water. (Take surface tension of water as 70 dynes/cm). Atmospheric pressure is 1.013 X $10^6$ dyne/cm.
21. Following observations are taken in Jaeger's method.
    Radius of the jet opening = 0.1 cm,
    Density of manometric liquid = 0.7 $gm/cm^3$.
    The opening of the jet is 1 cm below the surface of water.
    Density of water = 1 $gm/cm^3$, level difference in manometer = 3.5 cm.

Find the surface tension of the water.

22. In a soap bubble of diameter 7 mm the pressure of air is 8mm of water column above the atmospheric pressure. What is the surface tension of the soap solution.
23. Determine the difference in air pressure between inside and outside of a soap bubble 8 mm in diameter (Given surface tension of soap solution = 2 N/m).
24. Calculate the radius of a soap bubble for which the internal pressure is $1000.8 \times 10^3$ dyne/cm$^2$. Surface tension of soap solution is 25 dyne/cm.
25. The radius of soap bubble is increased from 7 cm to 10 cm. What is the change in pressure (T = 30 dyne/cm).
26. In Jaeger's experiment a capillary tube of internal diameter $5 \times 10^{-4}$ m dips $3 \times 10^{-2}$ m inside water contained in a beaker. The difference in level of manometer when bubble is released is 0.09 m. Calculate the surface tension of water.
27. A soap bubble is slowly enlarged from a radius of 0.01 m to 0.1 m. Calculate the work done in the process. Surface tension of soap solution is $26 \times 10^{-3}$ Nm$^{-1}$.
28. Why the surface tension of liquid decrease, with the increase in the temperature? Explain.
29. Hoe does the surface tension of liquid changes with soluble impurities added to the liquid? Discuss with examples.

## FLUID DYNAMICS

1. State & explain rate of flow.
2. Discus the equation of continuity?
3. Explain kinetic energy & potential energy of liquid in motion.
4. Explain potential energy & pressure energy of liquid in motion.
5. Explain kinetic energy & pressure energy of liquid in motion.
6. State the Bernoulli's equation? Explain the meaning of each term.
7. State Bernoulli's theorem? What are the conditions under which it is applicable?
8. What is Venturimeter? Derive the formula for the rate of flow of liquid in pipeline.
9. What is Pitot tube? Derive the expression for rate of flow of water through the pipe.
10. Distinguish between streamline flow & turbulent flow.
11. A railway engine is fitted with tube whose one end is inside a reservoir of water in between rails the other end of tube is 4 m above the surface of water in reservoir, calculate the speed with which the water rushes out of upper end if the engine is moving with speed of 108 km/hr.

12. A fire engine pumps water from a hydrant at rate of $10^3$ liter/see. It ejects it from nozzle 5 m above surface of water in hydrant with a velocity of 10 m/s. Calculate the pressure difference between water at pump & nozzle.
13. A Venturimeter has pipe diameter of 0.2 m and throat 0.15 m. The levels of water column in two limbs differ by 0.1 m. Calculate the amount of water discharged through pipe in one hour (density of water $=10^3$ kg/m$^3$).
14. A Venturimeter connected to a pipeline indicates a pressure difference of 75 cm of water column. If the radii associated with the Venturimeter are 30 cm. and 10 cm., calculate the volume rate of flow per minute.
15. A Pitot tube is fixed in a water pipe line of diameter 16 cm. if the range of the instrument indicates a pressure difference of 5 cm. of water column, calculate the rate of flow through pipe.
16. Show that the pressure energy & potential energy can be converted one into the other.
17. Write a short note on dynamic lift and thrust on a rocket.
18. Water flows along a horizontal pipe of varying cross section. Find the difference in pressure between two points where the flow has speeds 35cm/s and 65 cm/s. Express your answer in cm of mercury column.
19. The diameter of the throat of a venturimeter is 4 cm. When it is inserted into a pipeline of diameter 10 cm, the pressure difference between the pipe and the throat is equal to 9 cm of water. Calculate the rate of flow.
20. A pitot tube is fixed on the wing of an aeroplane to measure the speed of an aeroplane. The tube contains a liquid of density 800 kg/m$^3$. The difference in level between the two limbs is 0.5 m. Density of air = 1.293 kg/m$^3$. Calculate the speed of an aeroplane.

## VISCOSITY

1. Discuss the effect of temperature & pressure on viscosity of liquids.
2. Explain in brief the mercury thread method for accurate determination of the radius of the capillary tube.
3. Water flow through a horizontal capillary tube of 1 mm internal diameter & length 70 cm under pressure of a column of water 30 cm in height. Find rate of flow of water through capillary tube.

4. Water is conveyed through of horizontal tube 0.08m in diameter & 4km in length at a rate of 20 liter per see Calculate the pressure difference required to maintain the flow.
5. A plate of metal $10^{-2}$ $m^2$ area rest one layer of castor oil $2*10^{-3}$ m thick where coefficient of viscosity is 1.55 $Ns/m^2$. Calculate horizontal force required to move the plate with a uniform speed of 3 $x10^{-2}$ m/s.
6. Write Poiseuille's equation for the flow of a liquid through a capillary tube. State the assumptions to be made in its derivation.
7. Prove that $v = \frac{p}{4l\eta}\left(r^2 - x^2\right)$ where the symbols have their usual meanings.
8. Define coefficient of viscosity. Describe the way in which the different layers of a liquid move when flowing through a capillary tube. What changes take place if the motion is increased?
9. In an experiment with Poiseuille's apparatus the following figures are obtained :

   Volume of water issuing per minute = 7.08 $cm^3$

   Head of water = 34.1 cm

   Length of the capillary tube = 56.45 cm

   Radius of the capillary tube = 0.0514 cm

   Find the coefficient of viscosity.
10. For liquid having streamline flow through capillary tube, find the velocity of liquid at a distance x from the axis of the tube.
11. Using an expression for the velocity of the liquid flowing through a capillary tube, obtain Poiseuille's equation for the liquid.
12. In an experiment with Poiseuille's apparatus the following observations were obtained: Volume of water flowing per minute = 6 cc,

    Pressure difference across the ends of a capillary tube = 30 cm of water.,

    Length of the tube = 50 cm,

    Radius of the capillary tube = 0.05 cm,

    Find the coefficient of viscosity of water
13. A liquid is steadily flowing at the rate 0.007855 $cm^3$ per sec through a uniform capillary tube of radius 0,5 mm. Find the velocity of the liquid at a point on the axis of the capillary tube.
14. Two tubes A and B of lengths 16 cm and 81 cm have radii 0.2 mm and 0.3 mm respectively. They are joined end to end. If a liquid enters A at a pressure of 86 cm

of mercury and leaves B at a pressure of 76 cm pf mercury, what will be the pressure at the junction of the tube?

15. Water flows through a horizontal capillary tube of 1 mm internal diameter and length 70 cm under pressure of a column of water 30 cm in height. Find the rate of flow of water through the capillary tube. Viscosity of water = $10^{-3}$ N-s/$m^2$.

## Long Answer Type (6-Mark)

### PENDULUM

1 What is compound pendulum? Obtain an expression for its periodic time. Obtain the length of an equivalent simple pendulum.

2 What is Kater's pendulum? Obtain an expression for acceleration due to gravity in terms of two nearly equal periods of oscillation about the two parallel knife edges.

3 Explain Bifilar pendulum. Obtain an expression for period of Bifilar Pendulum when the two suspension threads are parallel.

4 What is torsional pendulum? Derive an expression for rigidity modulus by torsional oscillation.

5 What is meant by simple equivalent pendulum? If the period of Kater's pendulum in the erect and inverted positions is equal, prove that the distance between the knife edges equal to the length of simple equivalent pendulum.

### MOTION UNDER CENTRAL FORCE FIELD.

1. Obtain an expression for gravitational potential at a point outside the spherical shell.
2. Obtain an expression for gravitational field at a point outside the spherical shell.
3. Derive the expression for the gravitational potential and gravitational field due to a uniform sphere at a point inside the sphere.
4. Obtain an expression for the radial component of acceleration and tangential component of acceleration.
5. Define the intensity of gravitational field and gravitation potential. Hence show that the intensity and potential at any point on the surface of earth are 'g' and 'gR' respectively assuming the earth to be a uniform sphere of radius R.

### ELASTICITY

1. Derive the relation between three types of elastic modulii Y, K, n.
2. Derive an expression for the bending moment of beam. Explain its cases.
3. What is cantilever? Derive an expression for the depression of free loaded end of the cantilever neglecting the weight of the cantilever.
4. Considering the weight of the cantilever derive an expression for the depression of free loaded end of the cantilever.

5. Derive an expression for depression of cantilever, when the load is fixed at the center. Discuss the cases: - 1) bar is rectangular 2) bar is circular.
6. Explain neutral surface & internal bending moment for a loaded beam at one end & fixed at other end.
7. Prove the relation, $\frac{9}{Y} = \frac{3}{n} + \frac{1}{K}$. Where the symbols have their usual meaning.

## SURFACE TENSION

1. Show that the excess pressure inside a soap bubble of radius r over the atmospheric pressure outside it is equal to 4T/ r, where T is S.T. of the soap solution. How the S.T of a bubble is determined?
2. Explain the formation of concave & convex surface of liquid on the basis of molecular theory.
3. Explain surface tension on the basis of molecular theory.
4. What is surface energy? Explain the relation between surface tension & surface energy.
5. With the help of molecular forces explain why the free surface of some liquids in contact with a solid is not horizontal?
6. Define surface tension, surface energy & angle of contact. Find the relation between them.
7. Derive an expression for the capillary rise in a tube. Show that it depends on the angle of contact.
8. Explain Jaeger's method of measuring the surface tension of a liquid.
9. Describe Jaeger's method of determining surface tension of a liquid.
10. Define surface tension. Show that the excess pressure acting on the curved surface of a curved membrane is given by $P = 2T(1/r_1 + 1/r_2)$, where $r_1$ & $r_2$ are radii of curvature & T is surface tension of membrane.
11. Calculate the amount of energy needed to break a drop of petrol of volume $10^{-6}$ $m^3$ into a 1000 million drops of equal size. Surface tension of petrol is $26 \times 10^{-23}$ N/m.

## FLUID DYNAMICS

1. State & explain rate of flow of liquid. What is the equation of continuity?
2. With neat diagram describe a Venturimeter. Show how it is used to measure rate of flow of liquid in pipe. Derive the necessary formula.

3. Describe a Pitot tube and explain how it can be used to measure the rate of flow of liquid through a pipe. Derive the necessary expression.
4. State and prove Bernoulli's theorem.
5. Show that kinetic energy, potential energy and pressure energy possessed by a liquid are mutually convertible, one into the other.
6. Explain the types of energy possessed by a liquid on flow. Show that pressure energy and potential energy are convertible, one into the other.

## VISCOSITY

1. For liquid having streamline flow through capillary tube find the velocity of liquid at distance x from axis of tube.
2. Obtain Poiseuille's formula for rate of flow liquid through capillary tube.
3. Describe Poiseuille's method to determine coefficient of viscosity of a liquid.
4. Explain coefficient of viscosity? Describe a laboratory method to determine coefficient of viscosity of water.
5. Explain Poiseuille's method for determination of co-efficient of viscosity of a liquid.

# HEAT AND THERMODYNAMICS

## Objective Type (2-Mark)

### EQUATION OF STATE

1. What do you mean by an equation of state?
2. State the defects of van der Waals' equation.
3. State the conclusions obtained from Amagat's experiments.
4. What is a critical isothermal and critical point ?
5. State the law of corresponding states.
6. What is the advantage of the reduced equation of state over van der Waal's equation of state ?
7. What do you mean by border curve ?
8. Which are the two assumptions of the kinetic theory of gases that were modified by vander Waals' to derive his equation of state for real gases ?
9. What is the Boyle Temperature ?
10. Show that $T_B = (27/8)\, T_C$ ,where the symbols have their usual meanings.
11. What is meant by the critical temperature, critical pressure, and critical volume of a gas ?
12. For the liquefaction of a gas, the knowledge of its critical temperature is necessary . Why?

### THERMODYNAMICS

1. Explain the term isothermal change
2. Explain the term adiabatic change.
3. What is indicator diagram
4. State zeroth law of thermodynamics.
5. What is thermal equilibrium of a system?
6. Explain the term Mechanical equilibrium of a system.
7. What is an internal energy of a system? Give one example.
8. Define reversible and irreversible process?

9. State first law of thermodynamics.
10. State two conditions for reversible process.
11. Give any two examples of reversible process.
12. Give any two examples of irreversible process.

## SECOND AND THIRD LAW OF THERMODYNAMICS

1. Define entropy. Give its SI unit.
2. Give Claussi's statement of second law of thermodynamics.
3. What do you mean by working substance.
4. Give the name of four parts of cornot's heat engine.
5. Draw the P-V diagram for cornot's cycle.
6. State the cornot's theorem
7. State second law of thermodynamics
8. Give the name of different strokes in otto engine.
9. Draw the indicator diagram for otto cycle.
10. Give the name of different strokes in Diesel engine
11. Draw the temperature- entropy diagram.
12. State third law of thermodynamics

## APPLICATIONS OF THERMODYNAMICS

1. Explain enthalpy of a system.
2. Explain Gibb's function G.
3. Give physical significance of Gibb's function.
4. Explain in short Helmholtz's function.
5. Explain Joule-Thomson effect.
6. Explain variation of melting point with pressure.
7. Explain variation of boiling point with pressure.
8. Write first and second latent heat equation.
9. Give the physical significance of Helmholtz function.

## THERMOMETRY

1. How you define temperature.
2. What is natural law of heat flow.
3. On which principle thermometer works?

4. Write the relation between Celsius, Fahrenheit and Rankin scale of temperature.
5. What do you mean by sensitivity of thermometer.
6. Give the classification of thermometer.
7. Which device is used for resistance measurement of platinum resistance thermometer.
8. What do you mean by neutral temperature? On which factor it depends?
9. What is the basis of scale of temperature?
10. What is meant by thermometry?
11. Mention different types of thermometer?
12. State the principle of resistance thermometer and thermoelectric thermometer.
13. State the principle of vapor principle thermometer & radiation thermometer.
14. What is Seebeck effect?
15. What is Peltier effect?
16. State the principle of platinum resistance thermometer.
17. Give the merits of platinum resistance thermometer.
18. What is thermocouple?
19. State the advantages of thermoelectric thermometer.
20. Mention the drawbacks of thermoelectric thermometer.
21. What is pyrometry?
22. Mention the drawbacks of radiation pyrometer.

## Short Answer Type (4-Mark)

### EQUATION OF STATE

1. Explain the method to determine van der Waals' constants.
2. On the basis of van der Waals' equation ,show that the critical coefficient for any gas is 2.67 .
3. With the help of a neat diagram, describe how the critical pressure and temperature are experimentally determined.
4. Describe the method for the determination of the critical volume of a substance.
5. Calculate the van der Waals' constants a and b for helium if the critical temperature and critical pressure of helium are $-268^oC$ and $2.3x10^5$ N/m respectively. Given : $R=8.31x10^3$ J/kmole$^oK$. (Ans. a = $3.16Nm^4$/kmole, b=$2.225x10^{-2}$ $m^3$/kmole )
6. The critical temperature and critical pressure of oxygen are $-119^o$ C and 50 atmospheres respectively. Determine van der Waals' constants a and b for oxygen. Given:$R=8.31x10^3$ J/kmole$^oK$. (Ans. a=$1.36510^5Nm^4$/kmole, b=0.0316 $m^3$/kmole)
7. Find the critical temperature for helium from the following data : Given:$R=8.31x10^3$ J/kmole$^oK$,$a=3.44x10^3Nm^4$/kmole, b=0.0234 $m^3$/kmol (Ans. Tc=$5.25^oK$)
8. Calculate the constants of van der Waals' equation for nitrogen if its critical temperature is -146 $^oC$ and critical pressure is 33 atmospheres. ($R=8.3X10^3$ J/kmole$^oK$) (Ans: a=$1.4X10^5$ N $m^4$ /kmole, b=0.039 $m^3$ /kmole.)
9. Calculate the critical temperature and critical pressure for nitrogen. van der Waals' constants a and b for nitrogen are $2.72x10^{-3}$, $1.73x10^{-3}$ respectively, where pressure is expressed in atmospheres and volume is expressed in terms of volume at N.T.P. (Ans: Pc=33.66 atmos, Tc=$126.9^oK$)

### THERMODYNAMICS

1. The temperature of one mole of a perfect gas undergoing an adiabatic expansion fall from $300^0$ K to $200^0$ K. Calculate the work done by the gas.
2. State and explain zeroth law of thermodynamics.

3. Explain the term a) Adiabatic change b) Isothermal change
4. Derive an expression for work done in an adiabatic expansion of gas.
5. State and explain the first law of thermodynamics.
6. Derive an expression for work done in an isothermal expansion of gas.
7. Distinguish between reversible process and irreversible process.
8. Explain the term thermodynamic state of system.
9. What is thermal equilibrium? Explain thermal equilibrium of the system with its surroundings.
10. Explain the concept of an internal energy of the system.
11. Explain giving one example, what do you understand by an Irreversible Process.
12. Explain an internal energy as a state function.
13. One mole of Van-der waal's gas expands isothermally from $V_1$ to $V_2$. Show that the work done by the gas is expressed by $W= RT \ln ( V_2 – b )/ ( V_1 – b ) +a( 1/ V_2 - 1/ V_1)$.
14. A gas occupying 0.5 $m^3$ at pressure of 2.5 x $10^5$ $N/m^2$ is compressed at constant temperature to a volume of 0.004 $m^3$ . Determine the final pressure of the gas and work done on the gas .
15. A gas occupying a volume of 6 $m^3$ at atmospheric pressure is suddenly compressed to one fifth of its volume. Calculate the work done on the gas ( ٧ =1.4).
16. 0.5 mole of a perfect gas at $27^0$ C is compressed isothermally to 100 times that of its initial pressure. Find the work done by the gas ( R = 8.3 J/mole .deg) .
17. The temperature of one mole of a perfect gas undergoing on adiabatic expansion falls from $27^0$ C to – $73^0$ C. Calculate the work done by the gas (R = 8.3 J/mole .deg, ٧ =1.4 ).
18. An amount of 1 /2.303 mole of a perfect gas expands isothermally at 27 to 10 times that of the original volume . Find the work done ( R = 8.3 J/mole .deg) .
19. Assuming the relation $PV^{٢}$ = constant for an adiabatic change prove the relations
    a) $TV^{٢-1}$ = constant
    b) $T^{٢} P^{٢-1}$ = constant

## SECOND AND THIRD LAW OF THERMODYNAMICS

1. State the second law of thermodynamics in terms of entropy.
2. With the help of an example show that the entropy always increases in natural process.
3. Show how the dissipation of entropy in the universe is related to the increase in entropy.
4. Draw the temperature-entropy diag. for Carnot's cycle and hence find the efficiency of the Carnot's cycle.
5. "Second law of thermodynamics is a universal law of nature". Explain with the help of two examples.
6. Obtain an expression for the maximum efficiency of an Otto engine.
7. Give the difference between Otto engine and Diesel engine.
8. Draw indicator diagram for the Diesel cycle and hence obtain an expression for its efficiency.
9. Calculate the change in entropy when 100gm of water at $10^0$c is converted into ice at $10^0$c. Assume that the specific heat of ice and water is same (Latent heat of ice = 80cal/g)
10. Find the change in entropy when 100gm of steam at $100^0$c is converted into ice at $0^0$c. (Latent heat of fusion of ice = 80cal/g, Latent heat of steam = 540cal/g)
11. Calculate the change in entropy when 40gm of water at $7^0$c is heated to $67^0$c.
12. Calculate the increase in entropy when 200gm of ice at $0^0$c is converted into water at the same temp. (Latent heat of ice = 80cal/g)
13. Calculate the efficiency of Carnot's engine operating between $300^0$c and $100^0$c
14. A Carnot engine have an efficiency of 60% with its sink at $27^0$c. Calculate the temperature of the source.
15. A Carnot engine have an efficiency of 30% with its sink at $27^0$c.What should be the change in the temp. of its source if the engine is to have an efficiency of 50%.
16. Calculate the efficiency of an otto engine in which the working substance is adiabatically compressed to one sixth of its initial volume in each cycle. Assume the engine to operate on the otto cycle ( $\gamma$=1.4).

## APPLICATIONS OF THERMODYNAMICS

1. Explain the term internal energy 'U'. Show that the internal energy U is function of temperature only.

2. Define the enthalpy H. Show that $C_p = \left(\frac{\partial H}{\partial T}\right)_H$
3. Explain Helmholtz function F and prove that F remains constant during isothermal and isochoric process.
4. Discuss the effect of pressure on the boiling point and melting point.
5. Calculate the increase in boiling point of water at $100^0$C, when the pressure is increased by one percent of atmospheric pressure (1 atm = $1.013\times10^5$N/m$^2$). The latent heat of vaporization at $100^0$C is $540^0$kcal/kg. The specific volume of water is $1.00 \times 10^{-3}$m$^3$/kg and that of vapour is $1676 \times 10^{-3}$m$^3$/kg. J = 4200 joules/kcal.
6. Calculate the temperature inside a pressure cooker when the pressure of steam inside is 1.5 kg/cm$^2$. The latent heat of vaporization of water at $100^0$C is 540 kcal/gm and the specific volume of steam is 1600 cm$^3$/gm.
7. Specific heats of water and saturated stream at $100^0$C are 1.013 and -1.040 cal/gm$0^0$K respectively and latent heat at that temperature is 540 cal/gm. Calculate the change in latent heat per degree increase in temperature.
8. Calculate the pressure required to make water freeze at $-1^0$C. Change of specific volume when 1g of water freezes into ice is 0.091cm$^3$. (J = $4.2 \times 10^7$ ergs/cal; 1 atmosphere = $10^6$ dynes/cm$^2$; Latent heat of ice = 80 cal/g).
9. At what temperature will water boil, if the pressure is increased by 0.2 atmosphere. (Latent heat of steam = 540 cal/g; J = $4.2 \times 10^7$ erg/cal, specific volume of steam = 1671cm$^3$) .

## THERMODMETRY

1. On which principle electrical resistance thermometer measures the temperature?
2. Why platinum resistance thermometer is preferred for the measurement of temp?
3. Define thermocouple and draw schematic diag. for the same.
4. On which principle radiation pyrometer works? Which are the types of radiation pyrometer you studied?
5. Mention the demerits of radiation pyrometer.
6. Define temp. coefficient of resistance. What do you mean by PTC & NTC.
7. Calculate the temperature coefficient of temp.$\alpha$, if the resistance of platinum wire at $0^0$c is 8.4ohm and 9.2 ohm at $100^0$c.

8. If platinum temperature corresponding to $75^0$c on the gas scale is $65^0$c. What is the platinum scale? Temperature corresponding to $212.5^0$c on the gas scale?
9. Describe seebeck effect.
10. Describe the working of thermoelectric thermometer. Draw the cct. diag.
11. Describe the platinum resistance thermometer. Explain how it is used to measure unknown temp.
12. Describe Callender & Griffiths bridge for accurate measurement of resistance. How true temp. deduced from measured platinum temperature.
13. The resistance of platinum wire o a platinum resistance thermometer at ice point is 50ohm and at steam point is 5.93ohm When platinum wire is heated in bath its resistance is found to 5.795ohm. Calculate the unknown temperature.

## Long Answer Type (6-Mark)

### EQUATION OF STATE

1. Describe Andrew's experiments on $CO_2$ .
2. Describe Amagat's experiments on $H_2$ ,$N_2$ , and $CO_2$ and discuss his results.
3. Derive van der Waals' equation of state from considerations of finite size of molecules and the intermolecular forces.
4. Starting from van der Waals' equation, derive the reduced equation of state for a gas.
5. What are critical constants? Obtain an expression for the critical constants of a gas in terms of the constants of van der Waals' equation.
6. Show how van der Walls' equation of state can explain the results of Andrew's experiments.

### THERMODYNAMICS

1. Show that the work done by a gas during reversible cyclic process is equal to the area enclosed by the cycle on an indicator diagram
2. Discuss how zeroth law of thermodynamics explain the concept of temperature.
3. Define internal energy of the system. Show that it is a state function
4. Explain thermodynamic equilibrium of the system with its surroundings
5. Obtain the relation between the volume and the pressure of the perfect gas undergoing adiabatic change.

### SECOND AND THIRD LAW OF THERMODYNAMICS

1. Prove that the entropy of the universe is remains constant in a reversible cyclic process while it increases in an irreversible cycle.
2. A liquid of mass m and specific heat c at temperature $T_1$ is mixed with an equal mass of the same liquid at temp.$T_2$. Prove that the entropy of the system increases by

   $$2mc\log_e[(T1+T_2)/ (2\sqrt{T_1T_2})]$$

3. Explain the Temperature-Entropy diag.
4. Describe different parts of Carnot's engine.
5. Explain the working of Carnot's engine. Draw an indicator diagram to represent the different operations in the carnot's engine. Calculate the work performed during the

cycle of operation and hence obtain an expression for the efficiency of Carnot's engine.

6. Draw the indicator diagram for the Otto cycle and interpret the various parts.
7. Explain Diesel cycle with the help of diag.
8. Explain Carnot's heat engine.
9. What is carnot's cycle and obtain efficiency of carnot's cycle.
10. Draw the P-V diagram for carnot's cycle and explain the four operations.

## APPLICATIONS OF THERMODYNAMICS

1. Explain enthalpy of a system. Prove that enthalpy in throttling process remains constant.
2. Derive Maxwell's thermodynamic relation between pressure volume, temperature and entropy of a homogeneous system.
3. Derive the first latent heat equation in the form

$$\frac{\partial P}{\partial T} = \frac{LJ}{T(V2-V1)}$$

4. Obtain second latent heat equation.
5. What is Joule – Thomson effect? Describe Joule-Thomson porous plug experiment.

## THERMOMETRY

1. In case of platinum resistance thermometer,
   Find the relation

$$t = \frac{R_t - R_0}{R_{100} - R_0} \times 100$$

2. Describe the construction of platinum resistance thermometer with neat schematic diagram.
3. Explain in brief Callender and Griffithc bridge.
4. Describe in brief the measurement of temperature using thermoelectric thermocouple.
5. Explain with neat schematic diagram the optical pyrometer.
6. Describe working of platinum resistance thermometer? Explain Callender and Griffiths bridge for accurate measurement of resistance.
7. What is thermocouple? Describe construction and working of radiation pyrometer with neat diagram.

# ELECTRICITY AND MAGNETISM

## Objective Type (2-Mark)

### CURRENT ELECTRICITY

1. State the Kirchhoff's current law.
2. State the Kirchhoff's voltage law.
3. Define current density vector; and give its SI unit.
4. State the Thevenin's theorem.
5. State the Norton's theorem.
6. State maximum Power transfer theorem.
7. Define electric power and give it's unit.
8. State Joule's law of heating effect.
9. Define resistivity and conductivity.
10. Define i) watt and ii) kilowatt-hour.
11. Under what condition power transfer from source to the load is maximum? At that time what is the efficiency of the source.
12. Define the terms i) short circuit current ii) open circuit voltage.
13. Give the symbols of battery and current source.
14. State Ohms law and give it's mathematical form.
15. Give the sign convention used for current and voltage while studying Kirchhoff's laws.
16. Define current and voltage. Give its SI units.
17. Give the microscopic form of the Ohms law. What does each symbol indicate?
18. Explain the Kirchhoff's voltage law on the basis of law of conservation of energy.
19. Explain how the Kirchhoff's current law follow from law of conservation of charges.
20. Give the relation between resistance of a conductor with its length, cross sectional area and resistivity and give the unit of each quantity.
21. What is basic difference between macroscopic and microscopic properties of material?
22. On which factors the resistance of a conductor depends?

23. Define conductor and insulator on the basis of electrical conductivity. Give its examples.
24. What is the basic requirement of a material to be a good conductor? What is the relation between directions of conventional current and direction of (motion of) flow of electrons in a conductor?
25. Define i) ohm ii) joule
26. Obtain the relation between kilowatt-hour and joules.

## ELECTRICAL CIRCUITS D.C.

1. Draw a circuit diagram for growth of current in L-R circuit.
2. Draw a circuit diagram for growth of current the charge of acondenser through resistanse.
3. Define time constant in the growth of current in L-R circuit.
4. Define time constant for decay of current in L-R circuit.
5. Define time constant for growth of charge in R-C circuit.
6. Define time constant for decay of charge in R-C circuit.
7. Draw the curves representing the growth and decay of current in the inductive circuit.
8. Draw the curves representing the growth and decay of charge in the R-C circuit.
9. The S.I. unit of inductance is ….

    a.ohm b.henry

    c.farad d.volt

10. The S.I. unit of capacitance is ….

    a.ampere b.henry

    c.farad d.volt

11. The time constant of inductive circuit is ….

    a.R/L b.R.t

    c. L.t d.L/R

12. The time constant of R-C circuit is ….

    a.R/C b.RC

    c.C/R d.None of these

13. Charged condencer of capacity $5\mu f$ is first charged and then dischargd through a resistace of 0.1 mega ohm. What is the time in which the chrge will decrease 36.8% of its initial value.
14. State the relation between charge and time during the growth of charge in an R-C circuit.

## DIELECTRIC MATERIALS

1 What is a dielectric material?

2 Define dielectric constant K.

3 State different macroscopic dielectric parameters and explain any one in brief.

4 Experimental value for K for hydrogen is

a) 1.00026 b) 1.00260

c) 1.00016 d) 1.00062

5 Dielectric constant is also defined as

a) $K = U_O / U_d$ b) $K = U_d / U_O$

b) $K = U_O / V_O$ d) none of above

6 Dielectric constant is expressed as

a) $K = C/ C_O$ b) $K = C_O / C$

b) $K = C/ V_O$ d) none of above

7 When dielectric material is placed between capacitor, capacitance of capacitor

a) Always increases b) always decreases

c) Remains constant d) none of above

8 In, which circumstances the induced dipole moment, is known as point charges

a) Magnitude of Pi < magnitude of P b) Magnitude of Pi < magnitude of Pu

c) Magnitude of Pi = magnitude of P d) none of above

9 Define internal electric field Ei

10 Internal electric field is also called as

a) Lorentz field b) Newton field

c) Maxwell field d) None of above

11 According to Lorentz , the internal field Ei is

a) $Ei = [( K+2)/3] E$ b) a) $Ei = [( K+3)/2] E$

c) a) $Ei = [( K+3)/3] E$ d) none of above

12 Concept of polarizability introduce

a) Clausis –Mosotti b) Clausis

c) Mosotti d) none of above

13 In induced dipole moment $Pi = \alpha_i E_i$ , $\alpha_I$ is called as

a)Ionic Polarizabilities b) Electronics Polarizabilities

c) dipole Polarizabilities d) none of above

14 Give the example of non-polar dielectric type I material

15 Give the example of non-polar dielectric type II material

16 If p is the dielectric dipole moment of the microscopic unit , the potential energy of the dipole in electric field $E_i$ will be

a) $-p E_i \cos\theta$ b) $-p E_i \sin\theta$

c) $-p E_i D\cos\theta$ d) none of above

17 In non-polar dielectric I polarization of microscopic unit is caused by

a) Electronics Polarizabilities b) Ionic Polarizabilities

c) Electronics & Ionic Polarizabilities d) none of above

18 In non-polar dielectric type II polarization of microscopic unit is caused by

a) Electronics & Ionic polarizabilities b) Ionic polarizabilities

c) Electronics polarizabilities d) none of above

19 When non-polar dielectric I materials are subjected to an electric field E , induced dipole moment is equal to

a) $Pi = \alpha_e E_i$ b) $Pi = \alpha_e D_i$

c) $Pi = \beta_e E_i$ d) $Pi = \beta_e D_i$

20 Total polarizability of the microscopic unit for non-polar dielectric I is

a) $\alpha = \alpha_e$ b) $\alpha = \alpha_e + \alpha_i$

c) $\alpha = \alpha_e + \beta_i$ d) $\alpha = \beta_e + \alpha_i$

21 Total polarizability of the microscopic unit for non-polar dielectric II is

a) $\alpha = \alpha_e + \alpha_i$ b) $\alpha = \alpha_e$

c) $\alpha = \alpha_e + \beta_i$ d) $\alpha = \beta_e + \alpha_i$

22 Displacement current is zero when

a) For steady value of field b) Changing value of field

c) When field is removing d) none of above

23 Which break down is an intrinsic break down

a) Avalanche breakdown b) Thermal break down

c) Electrochemical Breakdown d) Discharge breakdown

24 An ideal dielectric material should have

a) Infinite resistance b) Finite resistance

c) Zero resistance d) none of above

25 Electrical strength of dielectric material is expressed in terms of

a) Voltage per unit thickness b) Voltage per unit area

c) Current per unit thickness d) none of above

26 Dielectric material has very high resistance at

a) Low applied electric field b) High applied electric field

c) Medium applied electric field d) none of above

27 In crystalline solid the microscopic unit is

a) Cell of the crystal b) molecules of a solid

c) Atom of solid c) none of above

28 In $H_2O$, which side of molecule somewhat positive

a) Hydrogen b) Oxygen

c) Hydrogen & Oxygen d) none of above

29 Define electrical dipole moment & states its MKS & CGS unit

## MAGNETIC PROPERTIES OF MATERIAL

1. Magnetic susceptibility has dimensions of---

   a) Wb-m b) dimensionless c) $Wb/m^2$ d) Amp/m

2. The units of magnetic permeability are---

   a) H/m b) $Wb/m^2$ c) A/m d) none of these

3. Magnetic induction B and magnetic field intensity H are related by---

   a) $B = \mu_0 + \mu_0 H$ b) $B = \mu_0 \mu_r H$

   c) $B = \mu_0 H^2$ d) $B = \mu_0 + H$

4. Which one of the following material does not have permanent magnetic diploes?

   a) ferromagnetic b) antiferromagnetic

   c) paramagnetic d) diamagnetic

5. The susceptibility of the paramagnetic substance is—

   a) very large  b) small and +ve  c) zero  d) –ve

6. When substance is placed in a magnetic field, its ability to get magnetized depends upon its---

   a) permeability  b) susceptibility

   c) magnetic viscosity  d) none of these

7. Platinum has permeability greater than unity and a small positive susceptibility, it must be---

   a) paramagnetic  b) diamagnetic

   c) ferromagnetic  d) none of these

8. Diamagnetic substances are attracted by magnetic field. The attraction is---

   a) very strong  b) weak  c) zero  d) –ve

9. The effect of inserting iron core within the current carrying coil is to---

   a) weaken the field  b) change the direction of field

   c) strengthen the field  d)concentrate the magnetic lines in the centre

10. At Curie temperature the spontaneous magnetization for the ferromagnetic material is---

    a) zero  b) infinite  c) remains same  d) none of these

11. Magnetic materials which can be readily magnetized in either direction are called---

    a) Hard magnetic materials
    b) Soft magnetic materials
    c) Low hysteresis materials
    d) High hysteresis materials

12. The magnetic dipole moment is the product of current in the loop and---

    a) flux enclosed by loop
    b) square of area enclosed by current loop
    c) area enclosed by current loop
    d) none of these

13. Relative permeability of a medium is the permeability relative to that of---

    a) water  b) vacuum  c) iron  d) none

14. Magnetic susceptibility $\chi$ equals---
    a) dipole moment per unit volume
    b) torque per unit area
    c) magnetization per unit magnetic field intensity
    d) none of these
15. Hard magnetic materials are used entirely for their---
    a) ability to repel the magnetic fields
    b) ability to retain the magnetic fields
    c) ability to change the magnetic fields
    d) a and c
16. The groups of atomic magnets formed due to interaction are called as –
    a) domains b) resistances c) inductances d) None of these
17. Hysteresis loop is a plot of ---
    a) M Vs. H b) B Vs. H c) M Vs. B d) both a & b
18. An example of diamagnetic material is—
    a) Nickel b) silicon c) aluminum d) sodium.

19. An example of paramagnetic material is—
    a) chromium b) benzene c) magnesium d) gold
20. An example of ferromagnetic material is—
    a) cerium b) oxygen c) nickel d) tungsten
21. Give the important applications of soft magnetic materials.
22. Give the important applications of hard magnetic materials.
23. What are soft magnetic materials?
24. What are hard magnetic materials?
25. What are antiferromagnetic materials? Give example.
26. What are ferrimagnetic materials? Give example.
27. What is Curie – Weiss law?
28. Give the relation between magnetic susceptibility, magnetization and magnetic field with the physical meaning of symbols.
29. Define intensity of magnetization.
30. Define magnetic intensity.

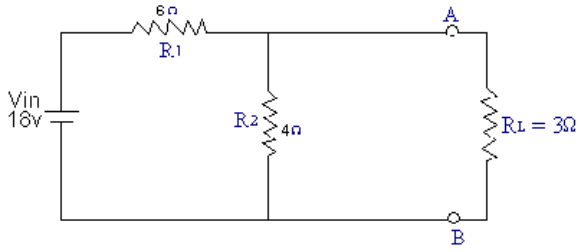
## ELECTROMAGNETIC INDUCTION

1. State faraday's laws of electromagnetic induction.
2. What is electromagnetic induction? State Lenz law of electromagnetic induction.
3. Define self-induction and mutual induction.
4. State the expression for energy stored in an inductor.
5. Define the SI unit of self-induction.
6. Define the SI unit of mutual induction.
7. Define the step up and step down transformer.
8. What is ideal transformer?
9. Define efficiency of transformer.
10. State different losses in transformer.
11. State the principle of the transformer.
12. State the types of transformer.
13. Draw the symbol of the transformer.
14. Distinguish between self and mutual induction.
15. Distinguish between the step up and step own transformer.
16. Explain the iron losses in transformer.
17. State the relation between turns ratio with current ratio.
18. State the relation between turns ratio with voltage ratio.
19. State the relation between turns ratio with current and voltage ratio.
20. Why self induced emf is called as back emf also.
21. For a transformer the turns ratio is 1:2.If 120 volt is applied to the primary, find the voltage at the secondary.
22. Calculate the coefficient of the self-induction of a coil of 100 turns with air core. If a current of 2 ampere produces a magnetic flux of 0.0001weber through the coil.
23. An ideal transformer gives 6 volts output with 220 volts input. Find its turns ratio? If the current in the secondary is 22A,what is the current in primary?
24. What is copper losses in the practical transformer.

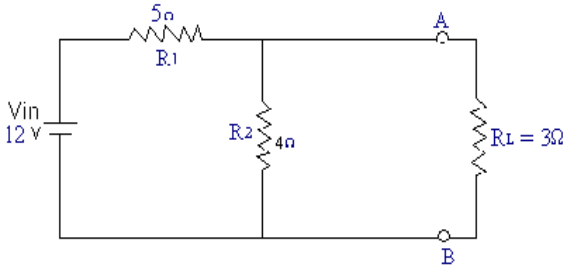
## Short Answer Type (4-Mark)

### CURRENT ELECTRICITY

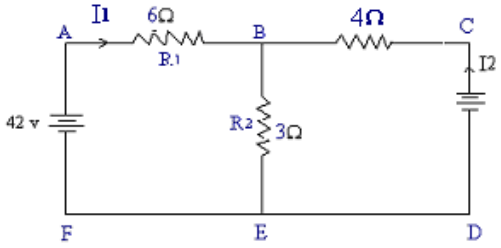
1. Define current density vector; what is it's SI unit? Show how current density is related to current in a conducting wire.
2. Starting from macroscopic form of Ohms law, derive it's microscopic form.
3. Establish the relation $J=\sigma E$ where the symbols have their usual meanings.
4. State and explain the Kirchhoff's laws for an electrical network.
5. The efficiency of the source under maximum transfer condition is 50 % explain. Hence State maximum Power transfer theorem.
6. Explain the terms, i) Electric power, ii) Electrical energy Give their units
7. State and explain the Joule's law of heating.
8. Give the statements of i) Thevenin's theorem and ii) Norton's theorem.
9. State i) maximum Power transfer theorem ii) Kirchhoff's voltage law.
10. Explain the loop current analysis of Maxwell's cyclic current analysis of electrical network by suitable example.
11. Find out the current passing through RL = 3Ω using Thevenin's theorem.



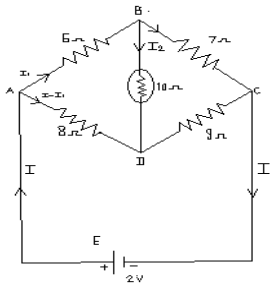

12. Using Norton's theorem find out the current passing through load resistance RL.



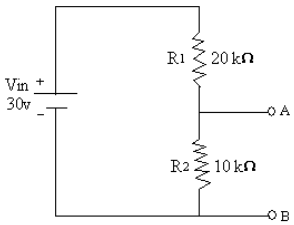
13. Using loop analysis find the values of I1 , I1 and the current passing through the branch BE




14. In a Wheastone's network ABCD, the resistances in the four arm a AB, BC, CD and DA are 6,7,9,8 ohms respectively. A cell of emf 2v is connected between points A and C while a galvanometer of resistance 10 Ω is connected between the points B and D.Calculate the current in galvanometer.

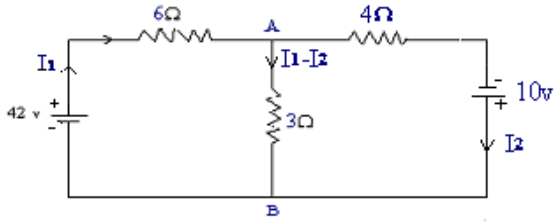



15. Obtain the Thevenin's and Norton's equivalent circuits of the network given below.




16. A lamp is rate at250v, 100W, what is the resistance of the lamp? What current does it takes? What will be the cost of using the lamp for 100 hours, if the B.O.T. unit cost 30 paise per unit?
17. An electric kettle contains an immersion heater rated at 2kW.How long will it take to raise the temperature of 1 liter of water from 15 to 100 degree centigrade, assuming that 90 % of the energy liberated is given to water? (J=4.2 joule/cal)
18. An electric heater having a coil of resistance 1050 ohm and carrying a current of 2 ampere is immersed in 5 liter of water at 20 degree centigrade. How long will it take for water to boil?

19. An electric heater having a coil of 1000 watt was used one hour per day, an electric iron of 1500 watt was used for half hour per day, 4 bulbs of 60 watt ware used for hours per day, a micro oven of 2000 was used for 1 hour per day, a television of 100 watt was used for 5 hour per day. Calculate the bill for the month of Feb. 2008 at the rate of 40 paise for first 30 units then Rs 2 for 31 to 100 units and Rs 3 for 101 to 300 units.
20. Calculate the loop current **I1** and **I2** and then calculate the voltage drop across **3Ω** resister in the given network.




21. State and explain ohm's law .from it define the resistance and give unit.
22. Give the different steps involved in Thevenizing a circuit network.
23. Give the different steps involved in Nortonizing a circuit network.
24. State the difference between Thevenin and Norton theorem.
25. State the sign convention used for current in KCL and potential difference in KVL
26. What do you mean by i)node ii)loop, in a circuit.
27. What do you mean by electrical energy cosumed and give its unit.How you can calculate the number of unit.
28. Define i)1 watt , ii) current density J
29. State Joules law.Give its mathematical form and unit of electric work and heat.
30. Obtain an expression for efficiency of a electric circuit when maximum power is transfer to the load.
31. Write a short note on current density.

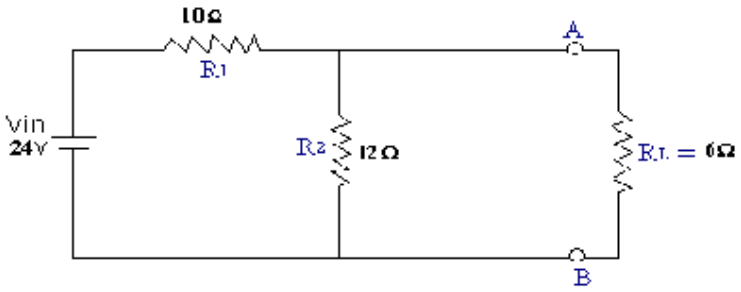
32. State KVL and give the sign convention used for potential difference in the circuit.

33. State and explain KCL, give the sign convention used for current.

34. State Kirchhoff's voltage laws.How it can be explained on the basis of law of conservation Of energy.

35. What do you mean by electric power? Obtain its expression in different forms hence give the different units of electric power.

36. Find the value of current through RL using Norton's theorem.




**ELECTRICAL CIRCUITS D.C.**

1. Obtain an expression for the growth of current in a circuit containing an inductance, a resistance and a steady emf connected in series.

2. Obtain an expression for decay of current in LR circuit.

3. Discuss the growth of charge on a condenser in series with a resistance.

4. Obtain an expression for the discharge of condenser through a resistance

5. Draw a circuit representing growth of current of LR circuit .Define the time constant of LR circuit

6. Draw a circuit representing decay of current of LR circuit . Define the time constant of LR circuit

7. Draw a circuit representing growth of current of RC circuit .Define the time constant of RC circuit

8. Draw a circuit representing decay of current of RC circuit . Define the time constant of RC circuit

9. Draw and explain circuit diagram for decay of current in LR circuit.

10. Draw and explain circuit diagram for growth of current in LR circuit

11. Draw and explain circuit diagram for charge of condenser through the resistance.

12. Draw and explain circuit diagram for discharge of condenser through the resistance.

13. An inductive circuit of resistance 20Ω and inductance10 henry in connected in series with supply 100 volt. Find the value of current at the end of a) half a second and b) one second , after the in switched ON.

14. An inductive circuit contais resistance 200Ω and inductance at 50 henry connected in series to an emf 100 volt. If the source is switched Off , what will be the current at the end of a) one fourth of a second, and b) half a second

15. A potential difference of 10 volt is applied to the coil at 10 ohm and at inductance of 1 henry.what is the current after 1/10 second?

16. Calculate the value of the current at the end of 0.2 second after an emf of 20 volt is applied accros the coil of inductance 1H and a resistance 20 ohm.

17. An inductive circuit containing resistance 100Ω and inductance at 25 henry connected in series to an emf 100 volt. If the source is switched Off , what will be the current at the end of a.1/4 second b. 1/2 second

18. A condenser at 4 μf is first charged and the discharge through a resistance of 0.2 megaohm . Calculate the time ion which a charge will decrease to 36.8% of the initial value.

19. The fully charged condenser at capacity 1 μf is discharge through a resistance of 2 megaohm a) Calculate the time taken by charge to fall 36.8% of its initial value.

b) How long will it take for the charge to fall to half of its initial value.

20. A capacitor of 10 μf is chagred to a potential of 100volts is connected to aseries resistance of 1000000 ohm What is the initial value of current?In what time the potential will fall to 50 volt?

## DIELECTRIC MATERIALS

1. Explain the term
   a) Pure dielectric b) lossy dielectric
2. What result was be obtained from Faraday's two identical capacitor

   experiment , one field with dielectric material & other is empty
3. Explain the difference between bound charges & free charges.
4. Explain microscopic unit with suitable example.
5. Defined electrical dipole moment of a microscopic unit of a dielectric for continuous distribution & discrete charge distribution
6. Define non-polar dielectric? Give the examples of non-polar dielectric materials
7. Distinguish between polar dielectric material & non-polar dielectric material
8. Define polar dielectric? Give the examples of polar dielectric materials
9. Define polarizability. For symmetrical unit cell state the unit for polarazability
10. Define electronic polarizability with example .
11. With a neat diagram explain ionic polarizability
12. Define non-polar dielectric type -I
13. Define non-polar dielectric type -II
14. Explain in brief non-polar dielectric type-I with suitable example
15. Explain in brief non-polar dielectric II with suitable example
16. Distinguish between para-electric & ferro-electric materials.
17. Explain the term induced dipole moment?
18. What is meant by displacement current
19. Give a reason why polar molecules have permanent electrical dipole
20. In absence of external electric field, average dipole moment of the dielectric material is zero. Comment.

21. When slab of a dielectric material is subjected to an electric field, the net dipole moment is increased. Comment.
22. Explain the term dielectric breakdown.
23. Write a note on insulation resistance.
24. Define volume insulation resistance. On what factors volume insulation resistance depends?
25. Insulation resistance is affected by change in temperature. Comment.
26. Write a note on electrical strength of dielectric
27. Find the thickness of air act as dielectric in capacitor when we apply a potential difference of 3 mega volts. Given dielectric strength of air is $3 \times 10^6$V/m
28. find the thickness of polystyrene act as dielectric in capacitor when we apply a potential difference of 20 mega volts. Given dielectric strength of polystyrene is $20 \times 10^4$ V/m.
29. What is the function of insulating dielectric material?
30. What is the function of common dielectric material?
31. Give the application of dielectric material
32. State the unit of permittivity and permeability of free space
33. Match the following

| Dielectric | Dielectric constant |
|---|---|
| Air | 2.25 |
| Paraffin | 1.00059 |
| Pure water | 3.5 |
| Paper | 80 |

34. Write a note on dielectric loss of a material.

## MAGNETIC PROPERTIES OF MATERIAL

1. What is magnetism? Explain the origin of magnetism.
2. What are magnetic materials? Classify magnetic materials. Give one example of each class.
3. What are magnetic parameters? Explain the concept of magnetic susceptibility ($\chi$) and permeability ($\mu$).
4. What are magnetic parameters? Explain magnetization (M) and magnetic Induction (B).

5. What is magnetic moment of atom? Explain the concept of Bohr magneton.
6. What is Internal molecular field? How it is responsible to magnetize the magnetic materials?
7. Distinguish between the characteristics of diamagnetic and paramagnetic materials. Give example of each.
8. Distinguish between the characteristics of diamagnetic and ferromagnetic materials. Give example of each.
9. Distinguish between the characteristics of ferromagnetic and paramagnetic materials. Give example of each.
10. Distinguish between the characteristics of ferromagnetic and antiferromagnetic materials. Give example of each.
11. Describe briefly diamagnetism and paramagnetism.
12. Describe briefly diamagnetism and ferromagnetism.
13. Describe briefly ferromagnetism and antiferromagnetism.
14. Describe briefly paramagnetism and ferromagnetism.
15. Explain effect of temperature on Diamagnetic, paramagnetic and ferromagnetic materials.
16. Explain the domain characteristic of ferromagnetic materials.
17. What are magnetization curves? Explain residual magnetization, and coercive force.
18. What is meant by hysteresis? How it is use to characterize magnetic materials?
19. Write short note on ferrites.
20. Write short note on antiferromagnetism.
21. How could you select the materials for constitution of permanent magnet and transformer core?
22. What are soft magnetic materials? Mention example and their uses.
23. What are hard magnetic materials? Mention example and their uses.
24. Give the relation between magnetic susceptibility, magnetization and magnetic field with the physical meaning of symbols.
25. Compare the properties of diamagnetic and paramagnetic materials.

## ELECTROMAGNETIC INDUCTION

1. Obtain the expression for self induced emf and hence define its SI unit.
2. Obtain the expression for mutual induced emf.And hence define its SI unit.

3. State the relation of magnitude of self induced emf and obtain the expression for energy stored in an inductor.
4. State the principle and types of transformer.
5. Define the electromagnetic induction. State Faraday's laws of electromagnetic induction.
6. What is the coefficient of the self-induction? Hence calculate the coefficient of the self-induction of a coil of 100 turns with air core. If a current of 2 ampere produces a magnetic flux of 0.0001weber through the coil.
7. What must be the primary current so that a flux of 0.08 weber is developed in the secondary? if the mutual inductance is 100 mH if this current reduces by 50% in 10 milli second. What voltage is induced across the secondary?
8. A step up transformer works on 220 volt and gives a current of 2 A to an external resister. The turn ratio between primary and secondary coil is 2:25.Assuming 100% efficiency, find the secondary voltage and primary current.
9. State the relation between turns ratio with current ratio. For a transformer the turns ratio is 1 to 2.5.If 120 volt is applied to the primary, find the voltage at the secondary.
10. State the relation between turns ratio with voltage ratio. For a transformer the turns ratio is 1:2.If 120 volt is applied to the primary, find the voltage at the secondary.
11. A step up transformer works on 220 volt and gives a current of 1 A to an external resister. The turn ratio between primary and secondary coil is 2:25.Assuming 100% efficiency, find the secondary voltage and primary current.
12. A step down transformer connected to the mains supply of 240 V is used to operate a12 V, 36 W lamp. Neglecting power losses, find the turns ratio and the current in primary?
13. Write a note on iron losses in the practical transformer.
14. State different losses in transformer. Hense explain the losses in the practical transformer due to flux leakage.
15. Obtain the expression for energy stored in an inductor.
16. Write a note on self-induction.
17. Write a note on mutual induction.
18. A step up transformer operates on 200 V line. The turn ratio between primary and secondary coil is 1:20.if transformer supplies a current of.5 ampere to a load

connected across the secondary, calculate the secondary voltage, and primary current. Assuming that there are no power losses.

19. Write a note on transformer.
20. If a current I is passing through a coil, obtain the expression for energy stored in the coil.
21. Explain in brief the construction and working of transformer.
22. Explain in brief the losses in the practical transformer.
23. Define coefficient of self-induction and coefficient of mutual induction.
24. State the S.I. unit of coefficient of self-induction and coefficient of mutual induction
25. State different losses in transformer. Hense explain the iron losses in the practical transformer.
26. State the relation between turns ratio with current and voltage ratio. State different losses in transformer.

## Long Answer Type (6-Mark)

### CURRENT ELECTRICITY

1. State and explain the Joule's law of heating due to an electric current. Hence explain the term watt and kilowatt-hour.
2. State maximum Power transfer theorem and derive the necessary condition.
3. State and explain the Thevenin's theorem with suitable example.
4. State and explain the Norton's theorem with suitable example.
5. State the Thevenin's theorem. Give the different steps to Thevenise the circuit; take suitable example.
6. State the Norton's theorem. Give the different steps to Nortonize the circuit; take suitable example.
7. State the Ohms law. Define resistivity, conductivity. Give their SI units. Obtain the microscopic form of Ohm's law from its macroscopic form

### ELECTRICAL CIRCUITS D.C.

1. Discuss the grouth of current in a circuit containing an inductance,a resistance and steady emf connected in series.Define time constant of thiscircuit.
2. .Obtain an expression for the growth at charge on a condenser in series with a resistance. Define the time constant of this circuit
3. Obtain an expression for decay of current in LR circuit. Define the time constant of this circuit.
4. Discuss the discharge of condenser through a resistance. Define the time constant of this circuit.

### DIELECTRIC MATERIALS

1. Prove that
   $E_0 / Ed = K = U_0 / U_d$
   Where $E_0$ field inside the plate without dielectric $E_d$ field inside the plate with dielectric
2. Define displacement vector. Derived the relation between displacement vector & electric field between plates.

3. Define polarization vector (P) and write a relation between polarization vector & area A
4. Explain in brief polarization vector (P).
5. Show that

   $$\varepsilon = \varepsilon_0 + x_e$$

   Where $\varepsilon$ = dielectric permittivity of the dielectric material and

   $x_e$ = electrical susceptibility
6. Prove that the net dipole moment of the microscopic unit in presence of static electric field.

   $P = Pu + Pi$
7. Explain in brief internal electric field Ei
8. What are the different kinds of dielectric material? Explain non-polar dielectric material
9. Prove Clausius –Mosotti equation?
10. prove that

    $$\frac{k-1}{K+2} \cdot \frac{M}{d} = \frac{N\alpha}{3\varepsilon_O}$$

11. What are the different types of polarizability. With a neat diagram explain electronic polarizability
12. State and explain basic requirements and characteristics of insulating material
13. State and explain basic requirements and characteristics of common dielectric material
14. Write a note on Appropriate value of dielectric constant and Appropriate value of dielectric strength
15. Explain the term magnetic
    a) Magnetic susceptibility
    b) Magnetic permeability

## MAGNETIC PROPERTIES OF MATERIAL

1. What are ferromagnetic materials? Discuss the spontaneous magnetization of ferromagnetic materials with domain.

2. What are soft and hard magnetic materials? Discuss essential characteristics. Mention their examples and their uses.
3. Distinguish between Diamagnetic, paramagnetic and ferromagnetic materials. Comment on temperature variation of magnetic susceptibility of all types of materials.
4. Give an account of internal magnetic field theory in ferromagnetism. On the basis of this how will you explain hysteresis and Curie point.
5. Discuss diamagnetism and paramagnetism. Give example of each class.
6. Obtain the relation $B = \mu_0 (H + M)$, where symbols have their usual meanings.

## ELECTROMAGNETIC INDUCTION

1. Describe the construction and working of transformer.
2. Distinguish the various power losses in a transformer. How are they minimized?
3. Explain the self-induction and the mutual induction.
4. Obtain the relation between turns ratio with current and voltage ratio.
5. A step up transformer works on 220 volt and gives a current of 2 A to an external resister. The turn ratio between primary and secondary coil is 2:25.Assuming 100% efficiency, find the secondary voltage, primary current and power delivered.
6. Explain the self-induction? A step up transformer works on 220 volt and gives a current of 2 A to an external resister. The turn ratio between primary and secondary coil is 2:25.Assuming 100% efficiency, find the secondary voltage.
7. State the self-induction and the mutual induction? An ideal transformer gives 6volts output with 220 volts input. Find its turns ratio? If the current in the secondary is 22A, determine the current in primary?

## PARTIAL DIFFERENTIATION

### TWO marks Questions

1) Define Partial Differentiation
2) Define total differential when a Physical quantity is function of only one variable.
3) What is the formula for total differential dF, if F=F(x, y)?.
4) If $F(x,y) = e^{\sin x}$. tan xy ; Find $F_x$ for $x = \pi/4$ & $y = 1$.
5) State the equation of represent the chain rule for obtaining differentiation of function
6) What is an implicit function?
7) State the relations between Cartesian and Polar co-ordinates.
8) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(Fx)y$
9) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(Fy)x$
10) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(Fr)\theta$
11) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(F_\theta)r$
12) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(Fr)x$
13) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(Fx)r$
14) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(Fr)y$
15) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(Fy)r$
16) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(Fx)\theta$
17) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(F_\theta)x$
18) If $F = X^2 - Y^2$ & $X = r\cos\theta$ , $Y = r\sin\theta$; Find $(Fy)\theta$
19) If $F = X^2 - Y^2$ & $X = r\cos\theta$, $Y = r\sin\theta$; Find $(F_\theta)y$
20) If $F(x,y) = x^3 y - x y^3$ ; Find Fx and Fy.
21) If $F(x, y) = x^3y^2 - e^{xy}$, find Fx.

### THREE marks Questions

1) If $u = e^x \cos y$ , verify that $(\partial^2 u / \partial x^2) + (\partial^2 u / \partial y^2) = 0$.
2) If $u = e^x \cos y$ , verify that $\partial^2 u / \partial x \partial y = \partial^2 u / \partial y \partial x$ .
3) Given $x + e^y = y$, find $\frac{dy}{dx}$.
4) If $f(x,y,z) = x^2 y^3 z$ & $x = \sin(u+v)$, $y = \cos(u+v)$, $z = e^{uv}$, find $\partial f / \partial u$ & $\partial f / \partial v$.

5) If $F(x,y) = x^3 y - e^{xy}$ ; find $F_x$ , $F_y$.

6) If $F(x,y) = x^3 y - e^{xy}$ ; show that, $F_{xy} = F_{yx}$.

7) If $u = e^x$, verify that, $(\partial^2 u / \partial x^2) + (\partial^2 u / \partial y^2) = 0$.

8) If $F = \frac{x}{y}$, prove that $x\frac{\partial F}{\partial x} + y\frac{\partial F}{\partial y} = 0$.

## FOUR marks Questions

1) Using the idea of total differentials find the approximate value of $\sqrt{(5.98)^2 + (7.99)^2}$.

2) Using the idea of total differentials find the approximate value of $\sqrt{(4.98)^2 + (3.03)^2}$.

3) Using the idea of total differentials find the approximate value of $\sqrt{(12.013)^2 + (4.987)^2}$.

4) If $F = f(x,y) = x^2 - xy + 2y^2$, find $\Delta f$ & $df$ for $x = 2$, $y = -1$, $\Delta x = 0.01$ & $\Delta y = 0.02$

5) If $f(x,y) = x^2 + y^2$ where $x = r\cos\theta$ & $y = r\sin\theta$, find $df/dr$, & $df/d\theta$

6) If $F(x,y) = x^3y^2 - e^{xy}$, Show that $F_{xy} = F_{yx}$.

7) If $F(x,y) = a \ln (x^2 + y^2)$ show that $F_{xx} + F_{yy} = 0$.

8) If $f = x^2y + xy^2 - 2xy = 1$, show that $\frac{f_{xx}}{y} = \frac{f_{yy}}{x}$.

9) Find the approximate value of $\sqrt{(12.013)^2 + (4.987)^2}$.

10) Explain the term Partial Differentiation.

11) For a perfect gas, PV=RT where R is the gas constant, if T changes from 400 to 402 $^0$ K and V changes from 5 $m^3$ to 5.05 $m^3$, find the approximate change in P.

12) Obtain the partial derivatives $\frac{\partial F}{\partial r}$ and $\frac{\partial F}{\partial \theta}$, if $F = x\,y$, where $x = r\cos\theta$ and $y = r\sin\theta$.

13) Find the approximate value of $\sqrt{(5.98)^2 + (8.01)^2}$.

## SIX marks Questions

1) If $y = e^{-i(\omega t - kx)}$, show that $\frac{\partial^2 y}{\partial x^2} = \frac{k^2}{\omega^2}\frac{\partial^2 y}{\partial t^2}$.

2) What do you meant by Total Differential? If $F(x,y) = x^2 + 2y^2$. Show that $\Delta F = dF$, Given : $x = 2$, $y = -1$, $\Delta x = -0.01$ and $\Delta y = 0.02$.

3) If $F = f(x, y)$, where $x = x(t)$ and $y = y(t)$, then obtain the equation to find out $\frac{dF}{dt}$.

4) The resistance R of a uniform wire of length $\ell$ and radius r with specific resistance of $\rho$ is given by $R = \rho \ell / \pi r^2$. If the percentage errors in measurements of $\ell$ and **r** are 2 and 3 respectively, find the maximum possible relative and percentage errors in resistance.

5) The perfect gas equation is $PV = RT$, where the symbols have their usual meanings Show that $\left(\frac{\partial P}{\partial V}\right)_T \cdot \left(\frac{\partial V}{\partial T}\right)_P \cdot \left(\frac{\partial T}{\partial P}\right)_V = -1$.

6) van der Waal's equation of state is $\left(P + \frac{a}{V^2}\right).(V - b) = RT$, where the symbols have their usual meanings. Show that $\left(\frac{\partial P}{\partial V}\right)_T \cdot \left(\frac{\partial V}{\partial T}\right)_P \cdot \left(\frac{\partial T}{\partial P}\right)_V = -1$.

7) If $F(x,y) = a \ln (x^2 + y^2)$ show that $F_{xx} + F_{yy} = 0$ and $F_{xy} = F_{yx}$.

## VECTOR ALGEBRA

### TWO marks Questions

1) What are the scalar products of rectangular unit vectors **i, j** and **k**?
2) Write formula for **A . (B** x **C**).
3) Define scalar product of two vectors.
4) Define vector product of two vectors.
5) State the geometrical interpretation of scalar triple product.
6) If **A** x **B** = **A** x **C,** is **B** = **C** necessarily? Explain.
7) Are the vector triple products **A** x **(B** x **C**) and **(A** x **B)** x **C** are equal? Explain.
8) If **A** = 3**i-j+k** and **B** = 2**i**+3**j+k** calculate **A .B.**
9) What can you say about **A,** if **A x (B** x **C**)=0 ? (Given: **A≠0, B ≠0, C≠0**)
10) What happens to the scalar triple product if the dot and cross are interchanged?
11) In which plane does the vector triple product lie? Explain.
12) If **A** = 3**i-j+k** And **B**=2**i-**3**j**+4**k** determine l**A**l and l**B**l.
13) If **A** = 3**i-j+k** determine unit vector along **A**.
14) Define the scalar triple product of three vectors.
15) If **A** x **B** = 0, what are possible conclusions thatcan be drawn regarding **A** and **B**?.
16) If **A . B** = 0, what are possible conclusions that can be drawn regarding **A** and **B**?.
17) Define the vector triple product of three vectors.
18) For non-zero vectors **A** and **B** if **A** x **B**=0 show that **A** is parallel to **B**.
19) Find the work done in moving an object along a vector **r** =**i**+2**j-k** if the applied force is **F**=2**i** + 2**j** + 4**k**.
20) What can you say about **A,** if **A .(B** x **C**)=0 ? (Given: **A≠0, B ≠0, C≠0**)

### THREE marks Questions

1) Show that **A** ·(**B** x **C**) = **- C . (B** x **A**).
2) Show that the vectors **A= i** + 2**j** + 3**k** and **B** =2**i** + 4**j** + 6**k** are parallel to each other.
3) Determine the constant 'a' so that the vectors **A**=3**i**+2**j-ak** and **B**=2**i**+**j**+2**k** are perpendicular.
4) Prove that **A** · (**B** x **C**) = **- B.** (**A** x **C**).

5) Prove that $\mathbf{A}\cdot(\mathbf{B}\times\mathbf{C}) = -\mathbf{A}.(\mathbf{C}\times\mathbf{B})$.

6) Show that $\mathbf{A}\cdot(\mathbf{B}\times\mathbf{C}) = (\mathbf{A}\times\mathbf{B})\cdot\mathbf{C}$

7) Find the angle between $\mathbf{A}=3\mathbf{i}+2\mathbf{j}-6\mathbf{k}$ and $\mathbf{B}=4\mathbf{i}-3\mathbf{j}+\mathbf{k}$.

8) If $\mathbf{A}=2\mathbf{i}-3\mathbf{j}+2\mathbf{k}$, $\mathbf{B}=\mathbf{i}+3\mathbf{j}-2\mathbf{k}$ and $\mathbf{C}=3\mathbf{i}-5\mathbf{j}+4\mathbf{k}$, find $\mathbf{A}\cdot(\mathbf{B}\times\mathbf{C})$.

## FOUR marks Questions

1) Using the scalar triple products show that the vectors $\mathbf{A}=\mathbf{i}-\mathbf{j}+\mathbf{k}$, $\mathbf{B}=2\mathbf{i}-\mathbf{j}+4\mathbf{k}$ and $\mathbf{C}=\mathbf{i}-2\mathbf{j}-\mathbf{k}$ are co-planar.

2) Show that the vectors $\mathbf{A}=\mathbf{i}+3\mathbf{j}+\mathbf{k}$, $\mathbf{B}=2\mathbf{i}-\mathbf{j}-\mathbf{k}$ and $\mathbf{C}=7\mathbf{j}+3\mathbf{k}$ are co-planar.

3) If $\mathbf{A}=\mathbf{i}-2\mathbf{j}+2\mathbf{k}$, $\mathbf{B}=3\mathbf{i}+\mathbf{j}-2\mathbf{k}$ and $\mathbf{C}=2\mathbf{i}-\mathbf{j}-\mathbf{k}$, find $(\mathbf{A}\times\mathbf{B})\times(\mathbf{B}\times\mathbf{C})$.

4) Define the Scalar product of two vectors and express it in terms of its components.

5) Show that the vectors $\mathbf{A}=3\mathbf{i}+5\mathbf{j}+2\mathbf{k}$ and $\mathbf{B}=2\mathbf{i}+2\mathbf{j}-8\mathbf{k}$ are perpendicular to each other.

6) Show that, $\mathbf{A}\times(\mathbf{B}\times\mathbf{C}) + \mathbf{B}\times(\mathbf{C}\times\mathbf{A}) + \mathbf{C}\times(\mathbf{A}\times\mathbf{B}) = 0$.

7) If $\mathbf{A}=2\mathbf{i}+2\mathbf{j}-\mathbf{k}$ and $\mathbf{B}=6\mathbf{i}-3\mathbf{j}+2\mathbf{k}$ find angle $\theta$ between $\mathbf{A}$ and $\mathbf{B}$.

8) If $\mathbf{A}=2\mathbf{i}+2\mathbf{j}-\mathbf{k}$ and $\mathbf{B}=6\mathbf{i}-3\mathbf{j}+2\mathbf{k}$ find area of parallelogram whose sides are $\mathbf{A}$ and $\mathbf{B}$.

9) Obtain Scalar triple product of three vectors in the form of a determinant.

10) Find the volume of the parallelepiped whose edges are represented by $\mathbf{A}=2\mathbf{i}-3\mathbf{j}-\mathbf{k}$, $\mathbf{B}=\mathbf{i}+2\mathbf{j}-\mathbf{k}$ and $\mathbf{C}=\mathbf{i}-2\mathbf{j}+3\mathbf{k}$.

11) Find the volume of the parallelepiped whose edges are given by $\mathbf{A}=3\mathbf{i}-\mathbf{j}+2\mathbf{k}$, $\mathbf{B}=2\mathbf{i}-3\mathbf{j}+4\mathbf{k}$ and $\mathbf{C}=\mathbf{i}+2\mathbf{j}-\mathbf{k}$.

12) Show that, $(\mathbf{A}\times\mathbf{B})\cdot(\mathbf{C}\times\mathbf{D}) = (\mathbf{A}\cdot\mathbf{C})(\mathbf{D}\cdot\mathbf{B}) - (\mathbf{A}\cdot\mathbf{D})(\mathbf{B}\cdot\mathbf{C})$.

13) Define the vector product of two vectors and express it in terms of its components.

14) Find the constant $\lambda$ such that the vectors $\mathbf{A}=2\mathbf{i}-\mathbf{j}+\mathbf{k}$, $\mathbf{B}=\mathbf{i}+2\mathbf{j}-3\mathbf{k}$ and $\mathbf{C}=3\mathbf{i}-4\mathbf{j}+\lambda\mathbf{k}$ are coplanar.

## SIX marks Questions

1) Define Scalar triple product. Show how it can be expressed as a determinant.

2) What is scalar triple product? Explain its geometrical interpretation.

3) Show that, $\mathbf{A}\times(\mathbf{B}\times\mathbf{C}) = \mathbf{B}(\mathbf{A}\cdot\mathbf{C}) - \mathbf{C}(\mathbf{A}\cdot\mathbf{B})$

4) If $\mathbf{A}=\mathbf{i}-2\mathbf{j}+3\mathbf{k}$, $\mathbf{B}=\mathbf{i}+2\mathbf{j}-3\mathbf{k}$ and $\mathbf{C}=2\mathbf{i}+3\mathbf{j}+4\mathbf{k}$, find $\mathbf{A}.(\mathbf{B}\times\mathbf{C})$ and $\mathbf{A}\times(\mathbf{B}\times\mathbf{C})$.

5) Show that the scalar triple product represents the volume of parallelepiped, whose edges represents the given three vectors.

6) If $\mathbf{A} = 3\mathbf{i} - \mathbf{j} + 2\mathbf{k}$, $\mathbf{B} = 2\mathbf{i} + \mathbf{j} - \mathbf{k}$ and $\mathbf{C} = \mathbf{i} - 2\mathbf{j} + 2\mathbf{k}$ determine $\mathbf{A} \times (\mathbf{B} \times \mathbf{C})$ and $\mathbf{A} \cdot (\mathbf{B} \times \mathbf{C})$

# VECTOR ANALYSIS

## TWO marks Questions

1) Define vector field, Give two examples of each.
2) Define scalar field, Give two examples of each.
3) What do you mean by differentiation of vectors?.
4) Define del operator.
5) What do you mean by gradient of scalar field?
6) Define the divergence of a vector field.
7) Define the curl of vector field.
8) What do you meant by Solenoidal vector field?
9) What do you meant by irrotational vector field?
10) Define field. State two types of field.
11) What are the possible inferences if the divergence at a point is positive and zero?
12) Under what conditions the vector field is solenoidal and irrotational?.
13) Define Lamellar vector field.
14) What are the possible inferences if the divergence at a point is negative and zero?
15) Show that $\nabla^2 = \nabla \cdot \nabla$.
16) State the physical meaning of grad $\Phi$.
17) State the values of position vector **r** and r.
18) State the three fundamental operations with $\nabla$ which are of physical interest.
19) Define rotational vector Field.
20) What do you meant by directional derivative.

## THREE marks Questions

1) Show that if **r** is position vector of a particle, d**r**/dt is its velocity and $d^2\mathbf{r}/dt^2$ is its acceleration.
2) If $\phi\,(x,y,z) = x^2y + y^2z + z^2x$, find $\nabla\phi$ at a point(1,3,-2).
3) If **r** is position vector, find $\nabla$r.
4) Determine the constant 'a' so that the vector $\mathbf{A} = (x + y)\,\mathbf{i} + (y - z)\mathbf{j} + (x + az)\,\mathbf{k}$ is solenoidal.

5) Show that $\nabla \cdot \nabla\phi = \nabla^2\phi$.

6) If **V** is a function of x, y, z then show that d **V** =**(**d**r** $\cdot \nabla$ **) V**

7) If $\phi = 2x^3y^2z^2$ evaluate $\nabla \cdot \nabla\phi$

8) Prove that $\nabla \cdot \mathbf{r} = 3$ where **r** is position vector

**<u>FOUR</u> marks Questions**

1) Explain the terms i) scalar field ii) vector field give examples of each.

2) Explain the physical significance of gradient of scalar.

3) Explain the physical significance of the divergence of a vector.

4) Explain the physical significance of the curl of vector.

5) Find grad r where r is the distance of any point from the origin.

6) If $\mathbf{A} = x^2 z\,\mathbf{i} + xy^2z\,\mathbf{j} - 3yz^2\,\mathbf{k}$ find curl **A** at the point(1,1,1)

7) Find the constant a, b and c so that a vector

**A** = ( 2x+y+az) **i** +(bx+y+z)**j** +(2x-cy+z) **k** is irrotational.

8) If **r** is position vector find $\nabla \cdot \mathbf{r}$ and $\nabla \times \mathbf{r}$.

9) If **A** and **B** are irrotational, prove that **A**×**B** is solenoidal.

10) Show that $\nabla (1/\mathbf{r}) = -\mathbf{r} / r^3$

11) Show that $\nabla^2 (1/r) = 0$.

12) Prove that $\nabla \times \nabla\phi = 0$**.**

13) Show that divcurl**A** = 0

14) If is **A** irrotational, prove that **A**× **r** is solenoidal where **r** is a position vector.

**<u>SIX</u> marks Questions**

1) Define grad$\phi$ , div **V** and curl **V**.

2) Define gradient of a scalar field, explain its physical significance.

3) Define divergence of vector field, explain its physical significance.

4) Define curl of a vector field, explain its physical significance.

5) Show that, $\nabla \times (\phi\mathbf{A}) = \phi(\nabla \times \mathbf{A}) + (\nabla \phi) \times \mathbf{A}$

6) Show that $\nabla \cdot (\phi\mathbf{A}) = \phi(\nabla \cdot \mathbf{A}) + \mathbf{A} \cdot (\nabla \phi)$

# VECTOR INTEGRATION

## TWO marks Questions

1) Define line integral of a vector.
2) Define surface integral of a vector.
3) Define volume integral of a vector.
4) Define conservative vector field.
5) Define non conservative vector field.
6) Define circulation of a vector field.
7) State Gauss' divergence theorem.
8) State Stoke's theorem.
9) State Green's theorem in plane.
10) Write Green's first and second identities.

## THREE marks Questions

1) Obtain Green's first identity using Gauss's theorem.
2) Obtain Green's second identity using Gauss's theorem.
3) Explain line integral of a vector.
4) Explain surface integral of a vector.
5) Explain volume integral of a vector.

## FOUR marks Questions

1) Evaluate $\mathbf{A} \cdot \mathbf{dr}$ where $A = 3x^2\mathbf{i} + (2xz - y)\,\mathbf{j} + z\,\mathbf{k}$ along the curve $x = 2t^2$; $y = t$, and $z = 4t^2 - t$ from $t = 0$ to $t = 1$.

2) If $\mathbf{R} = (t - t^2)\,\mathbf{i} + 2t^2\,\mathbf{j} + 3t\,\mathbf{k}$, find $\int \mathbf{R}\, dt$.

3) If $\mathbf{F} = 3xy\,\mathbf{i} - y^2\,\mathbf{j}$, evaluate $\int_C \mathbf{F} \cdot \mathbf{dr}$ where C is the curve in the xy plane, $y = x^2$, from (0,0) to (1,2).

4) Find out the volume integral of the divergence of a vector $\mathbf{V} = x\mathbf{i} + y\,\mathbf{j} + z\mathbf{k}$ for the closed surface of a cylinder.

5) Show that, $\int_S \mathbf{r} \cdot \mathbf{dS} = 3V$, where $\mathbf{r}$ is position vector of any point on a closed surface and V is volume bounded by the closed surface.

6) Show that, $\int_S \mathbf{r} \cdot \mathbf{dS} = 4\pi$, where S is surface of sphere of unit radius and centre at origin.

7) Use Green's theorem to evaluate $\int_C ((x^2 + xy)\,dx + (x^2 + y^2)\,dy$ where c is the square formed by the line $y = \pm 1$, $x = \pm 1$.

**SIX marks Questions**

1) Verify Gauss theorem for $\mathbf{F} = 4xz\,\mathbf{i} - y^2\,\mathbf{j} + yz\,\mathbf{k}$ and S is surface of cube bounded by x = 0, x = 1, y = 0, y = 1, z = 0, z = 1.

2) If $\mathbf{A} = (2x + 3y^2)\,\mathbf{i} + 6y^2\,\mathbf{j} - 10\,xyz\,\mathbf{k}$, find the total work done in moving a particle in a force field given by $\mathbf{F} = 7xy\,\mathbf{i} + 2z\,\mathbf{j} + x\,\mathbf{k}$ along the curve $x = 2t^2$

3) Find the total work done in moving a particle in a force field given by $\mathbf{F} = 7xy\,\mathbf{i} + 2z\,\mathbf{j} + x\,\mathbf{k}$ along the curve $x = 2t^2$, $y = t$, and $z = t^2 - 3t$ from $t = 0$ to $t = 1$.

4) If $\mathbf{A} = (x^2 + y)\,\mathbf{i} - 10yz\,\mathbf{j} - 8\,xz^2\,\mathbf{k}$, evaluate $\int_C \mathbf{A} \cdot \mathbf{dr}$ from (0,0,0) to (1,1,1) along the path C : $x = t$, $y = t^2$, $z = t^2$.

5) Verify Stokes theorem for $\mathbf{F} = x^2\,\mathbf{i} - xy\,\mathbf{j}$ integrated around the square in the plane z = 0 and bounded by x = 0, x = a, y = 0, y = a.

# ELECTRONICS

## P-N Junction

## TWO marks Questions

1) What do you mean by a p-n junction diode?
2) What is a depletion layer?
3) What do you mean by a potential barrier?
4) Define zero external voltage.
5) Define the terms (a) Breakdown voltage and (b) Knee voltage.
6) Draw the equivalent circuit of Zener diode.
7) Draw the symbol of photo diode.
8) What is Zener breakdown?
9) Define the terms (a) Maximum power current and (b) Peak Inverse Voltage (PIV).
10) Why a junction diode offers very high resistance in reverse biased mode?.
11) Why a junction diode offers very low resistance in forward biased mode?.
12) What do you mean by photo diode?
13) How a Zener diode differs from an ordinary diode?
14) What do you mean by majority and minority current carriers in Transistors?
15) Draw the symbol of LED.
16) What do you mean by doping?
17) What type of material is used for manufacturing LED?
18) Draw the symbol of p-n junction diode.
19) Draw the circuit showing forward biasing of p-n junction diode.
20) Draw the circuit showing reverse biasing of p-n junction diode.

## THREE marks Questions

1) Explain the majority and minority current carriers in p-type semiconductors.
2) Write a note on photodiode.
3) State the applications of diodes.
4) Give the uses of Zener diode.
5) Discuss the Avalanche breakdown.

## FOUR marks Questions

1) Write a short note on LED.
2) Give the applications of LED.
3) Draw the characteristics of Zener diode and show the following parameters such as $I_z$, $V_z$ and $P_{zmax}$.
4) Draw the circuit diagrams of forward and reverse biased pn junction diode.
5) With a neat diagram, explain the action of pn junction under forward bias.
6) With a neat diagram, explain the action of pn junction under reverse bias.
7) With a neat diagram, explain how depletion layer is formed?
8) Distinguish between forward and reverse biasing of pn junction diodes.
9) Explain the limitations in the operating condition of pn junction.
10) What is photodiode? Give its equivalent circuit.
11) Explain the terms (a) Forward current rating and (b) Power rating.

## SIX marks Questions

1) Explain I-V characteristics of a pn junction with necessary diagram.
2) What is Zener diode? Give its typical I-V characteristics.
3) What is pn junction? Explain the formation of pn junction.
4) Discuss the behavior of a pn junction, under forward and reverse biasing.

## Rectifiers and Filters

### TWO marks Questions

1) What is rectifier?
2) What do you mean by rectification?
3) What do you mean by ripples?
4) Why do you need a rectifier?
5) Do you get direct current from a rectifier?
6) What is ripple factor?
7) What is voltage regulation?
8) Explain the need of filtering circuits in a power supply.
9) Explain the necessity of voltage regulation.
10) Do you connect more than one filter circuit also in series? Why?
11) Draw the circuit diagram of series inductor filter.
12) Draw the circuit diagram of capacitor filter.
13) Draw the circuit diagram of ð filter.
14) What is use of filter in a circuit?

### THREE marks Questions

1) What do you mean by filter circuit? State the types of filters.
2) Why is full wave rectifier more useful than half wave rectifier?
3) Explain how zener diode maintains constant voltage across the load.
4) What is rectifier? State the types of rectifiers.
5) Explain why the output of rectifier is to be stabilized?.

### FOUR marks Questions

1) Describe the action of the capacitor in filter circuit.
2) Explain Zener diode as a voltage regulator.
3) Derive an expression for ripple factor.
4) Find the value of ripple factor for half wave rectifier.
5) Find the value of ripple factor for full wave rectifier.
6) With neat diagram explain series inductor filter

7) Explain the working of ð filter Circuit.

8) Why capacitor input filter is preferred over series inductor filter?

9) Show that ripple factor for full wave rectifier is 0.482.

10) Show that ripple factor for half wave rectifier is 1.21.

## **SIX marks Questions**

1) Define ripple factor. Show that ripple factor for full wave rectifier is 0.482.

2) Define ripple factor. Show that ripple factor for half wave rectifier is 1.21.

3) What is Zener diode? Explain how it can be used for voltage regulation in power Supply.

4) Find the values of ripple factor for half wave and full wave rectifier.

5) In power supply filters are used. Why? What are different types of filters used in power supply? Explain working of any one type of filter.

## Bipolar Junction Transistor

## TWO marks Questions

1) Draw the symbols of pnp and npn Transistors.
2) Enlist the three transistor configurations.
3) Show by means of a diagram, how you normally connect external batteries in pnp / npn transistor.
4) Draw the circuit diagram of CE configuration of npn / pnp transistor.
5) Draw the circuit diagram of CB configuration of npn / pnp transistor.
6) Define the parameters $\alpha$ and $\beta$.
7) In CE configuration, $I_E = 1$ m A, $I_C = 0.95$ mA. Calculate the value of $I_B$.
8) In a transistor, $\beta = 100$ and $I_B = 10\ \mu A$, find $I_C$.
9) Find $\alpha$ if $I_C = 0.95$ mA and $I_E = 1$ mA.
10) Why biasing is needed for transistor?
11) State different methods of biasing.
12) Draw the circuit diagram of fixed bias method.
13) State the requirements of biasing circuit.
14) What do you understand by stabilization of operating point?
15) Define stability factor.
16) Which two points are necessary to draw the d.c. load line?
17) What is the utility of d. c. load line?
18) Explain Q point on load line.
19) Draw the output characteristics of a transistor in CE configuration.

## THREE marks Questions

1) Show by means of a diagram, how you normally connect external batteries in pnp transistor.
2) Show by means of a diagram, how you normally connect external batteries in npn transistor.
3) Explain CB configuration of transistor.
4) Explain CE configuration of transistor.
5) Explain CC configuration of transistor.

6) In CB configuration, the emitter current is 1.5 mA. Find the base and collector currents if $\alpha = 0.94$.

7) Draw the symbols of pnp and npn transistor. Explain the functions of emitter, base and collector.

8) In CE configuration, the emitter current is 1 mA. Find $\beta$ if collector current is 0.95 A.

## FOUR marks Questions

1) Explain the action of pnp transistor with neat diagram.

2) Explain the action of npn transistor with neat diagram.

3) Enlist the three transistor configurations. Explain any one of them.

4) Define $\beta$. Show that $\beta = (\alpha) / (1- \alpha)$.

5) Define $\alpha$. Show that $\alpha = (\beta) / (1+ \beta)$.

6) Define $\alpha$. Show that it is always less than unity.

7) Draw input and output characteristics of npn transistor, in CE configuration.

8) Draw input and output characteristics of pnp transistor, in CE configuration.

9) Explain fixed biasing in case of pnp transistor. Draw the necessary diagram.

10) Explain fixed biasing in case of npn transistor. Draw the necessary diagram.

11) State the advantages and disadvantages of fixed biasing method of a transistor.

12) Write a short note on d. c. load line.

13) Write a note on operating point.

14) In a transistor, $\beta = 45$, the voltage across 5 K$\Omega$ resistance which is connected in the collector circuit is 5 V. Find the base current.

15) In a transistor, $\beta = 440$, $I_B = 68$ $\mu$A and $I_E = 30$ mA. Find $\alpha$. Hence determine the collector current.

## SIX marks Questions

1) Why transistor baising is necessary? Explain the working of pnp transistor.

2) Why transistor baising is necessary? Explain the working of npn transistor.

3) Define the parameters $\alpha$ and $\beta$. Obtain the relation between them.

4) With the help of a circuit diagram of CE configuration, explain the input and

output characteristics.

5) What do you understand by d. c. load line? How will you construct it?

## Transistor circuits

## TWO marks Questions

1) What do you mean by an amplifier?
2) Define current gain and voltage gain.
3) Draw the frequency response characteristics of an amplifier.
4) Define band width of an amplifier.
5) Define cutoff frequencies.
6) What does a dc load line represents?
7) What is the necessity of an amplifier?
8) What does an ac load line represents?
9) What is the difference between ac and dc load lines?
10) What do you mean by feedback in amplifiers?
11) State the types of feedback.
12) State the advantages of negative feedback.
13) State clearly the difference between the regenerative and degenerative feedback.
14) What is Barkhausen's condition?
15) Which basic principle is used in LC Tank circuit oscillator?
16) What should be the input resistance of an ideal amplifier?
17) What should be the output resistance of an ideal amplifier?

## THREE marks Questions

1) What should be the input resistance of an ideal amplifier? Why?
2) What should be the output resistance of an ideal amplifier? Why?
3) Describe the conversion efficiency of an ideal amplifier.
4) What is the main advantage of using CE amplifier?
5) State and explain the condition for sustained oscillation.
6) Why LC Tank circuit is called an oscillator?
7) Draw the circuit diagram of RC coupled amplifier.

## FOUR marks Questions

1) Distinguish between regenerative and degenerative feedback.
2) Describe frequency response curve of an amplifier.
3) Explain saturation and cutoff points.
4) Explain how the operating point is located for CE amplifier.
5) Explain why LC circuit is called as a Tank circuit.
6) Distinguish LC Tank circuit oscillator and Hartley oscillator.
7) Explain Barkhausen's criterion for self sustained oscillations.

## SIX marks Questions

1) With the help of neat diagram, explain the working of small signal single stage RC coupled CE amplifier.
2) Describe the frequency response curve of RC coupled CE amplifier.
3) Describe the Hartley oscillator. Obtain the resonant frequency of Hartley oscillator
4) What do you mean by feedback in amplifiers? Describe the types of feedback.
5) Describe the LC oscillator. Obtain the resonant frequency of LC oscillator

## Number systems

## TWO marks Questions

1) What do you meant by decimal number system?
2) What do you meant by binary number system?
3) Convert the given decimal number 15 into binary number.
4) What do you meant by 1's complement?
5) What do you meant by 2's complement?
6) What is Hexadecimal number system?
7) What is BCD code?
8) Convert the given binary numbers 1101 and 1110 into decimal numbers.
9) Convert $(0.75)_{10}$ into its binary equivalent.
10) Subtract the given binary number 1010 from 1101.
11) Convert $(29)_{10}$ into its binary equivalent.
12) State the radix for decimal and binary number systems.
13) Convert $(11)_2$ into its decimal equivalent.
14) Convert $(10)_2$ into its decimal equivalent.
15) Convert C2 into decimal number.
16) What do you mean by end around carry?

## THREE marks Questions

1) Explain BCD code.
2) Explain binary number system in detail.
3) Explain Hexadecimal number system in detail.
4) Convert C5E3 into decimal number.
5) Explain 1's complement subtraction.
6) Explain 2's complement subtraction.
7) Subtract (0101) from (1111) by 2's complement method.
8) State 2's complement of 1010, 1110 and 1111.

## FOUR marks Questions

1) Explain the conversion of decimal to binary number by taking a suitable example.

2) Explain the conversion of binary to decimal number by taking a suitable example.
3) Describe end around carry.
4) Convert the given decimal number (5.125) into its binary equivalent.
5) How would you convert decimal fraction into its binary equivalent? Explain.
6) What do you mean by 1's complement and 2's complement?
7) State 2's complements of 0011, 10100, 111001 and 10011.
8) Convert the given decimal number 63718 in to hexadecimal number.
9) Perform the following arithmetics: (a) (10010) - (01101) and (b) (111111111) – (110101011).
10) Convert the given binary number (0101.0010) into its decimal equivalent.

## **SIX marks Questions**

1) Convert the following hexadecimal numbers into decimal numbers: (i) 7EB2, (ii) C5EC and (iii) 1B3D.
2) Explain the conversion of decimal to binary number by taking a suitable example.
3) Explain the conversion of binary to decimal number by taking a suitable example.
4) Explain the conversion of decimal number to hexadecimal number by taking a suitable example.
5) Explain the conversion of hexadecimal number to decimal number by taking a suitable example.

## Digital Circuits

## TWO marks Questions

1) Define Logic gate.
2) Enlist the basic Logic gates.
3) Give the symbol and logical expression of AND gate.
4) Give the symbol and logical expression of NOT gate.
5) Give the symbol and logical expression of OR gate.
6) Give the symbol and logical expression of NAND gate.
7) Give the symbol and logical expression of NOR gate.
8) Give the symbol and logical expression of Ex-OR gate.
9) State De-Morgan's first theorem.
10) State De-Morgan's second theorem.
11) What is multivibrator?
12) State the types of multivibrator.
13) What do you mean by Flip-Flops?
14) State the types of Flip-Flops.
15) Draw the symbols of AND and OR gates.
16) Draw the symbols of NOT and Ex-OR gates.
17) Draw the symbols of NAND and NOR gates.
18) State the logical expressions of of AND and OR gates.
19) State the logical expressions of NOT and Ex-OR gates.
20) State the logical expressions of NAND and NOR gates.

## THREE marks Questions

1) Explain AND gate with logical expression. Write its truth table.
2) Explain OR gate with logical expression. Write its truth table.
3) Explain NOT gate with logical expression. Write its truth table.
4) Explain NAND gate with logical expression. Write its truth table.
5) Explain NOR gate with logical expression. Write its truth table.
6) Explain Ex-OR gate with logical expression. Write its truth table.
7) State and explain De-Morgans $1^{st}$ theorem.

8) Distinguish between astable and monostable multivibrators.

9) State and explain De-Morgans 2nd theorem.

## FOUR marks Questions

1) Construct AND gate using NAND gate.

2) Construct OR gate using NAND gate.

3) Construct NOT gate using NAND gate.

4) Explain the working of R-S FF.

5) Explain the working of J-K FF.

6) Explain the working of D FF.

7) Distinguish between R-S FF and J-K FF.

8) Define Logic gate. Explain with examples positive and negative logic.

9) What do you mean by multivibrator? Define astable, monostable and bistable multivibrators.

10) Calculate the frequency of astable multivibrator using transistor if $C_1=C_2=100$ pF and $R_1=R_2= 100$ KΩ.

## SIX marks Questions

1) Explain why NAND gate is called as universal building block.

2) Explain why NOR gate is called as universal building block.

3) Verify De Morgan's theorems.

4) What do you mean by a multivibrator? Explain monostable multivibrator using transistors.

5) What do you mean by a multivibrator? Explain astable multivibrator using transistors.

6) What do you mean by a multivibrator? Explain bistable multivibrator using transistors.

7) Draw the J-K FF using NAND gate and explain its working.

# OSCILLATIONS AND MATTER WAVES

## FREE AND DAMPED OSCILLATIONS

### Questions for 2 marks

1 What do you meant by free oscillations? Give suitable example.

2 What do you meant by damped oscillations? Give suitable example.

3 What do you meant by undamped oscillations? Give suitable example.

4 Define damping coefficient. Give its unit.

5 Define force constant. Give its unit.

6 State different forces acting on the system if it executes the damped oscillations.

7 Write down the differential equation of the damped oscillations. Explain the meaning of each term involved in it.

8 Show graphically the concept of over-damped motion, critically damped motion and damped harmonic motion.

9 Due to damping effect the frequency of oscillations decreases. Comment.

10 Write down an equation of damped oscillatory motion. How amplitude decreases?.

11 Define 'logarithmic decrement.'

12 Write the formula of log decrement. State the factors on which it depends.

13 Write down the equation of energy of the damped harmonic oscillator.

14 Define quality factor of a damped harmonic oscillator.

15 Draw the circuit diagram of damped oscillatory series LCR circuit.

16 Give the concept of restoring force with suitable example.

17 Give the concept of damping force with suitable example.

18 Show graphically the variation in Q factor according to the damping coefficient, R.

19 State the factors on which damping depend in the series LCR circuit.

### Questions for 3 marks

1 Define the following terms: i) Undamped oscillations ii) Damped oscillations

2 Explain the terms: i) Force constant ii) Damping coefficient

3 Define quality factor of a damped harmonic oscillator. Sketch the graph showing Q- factor varies in accordance with the damping coefficient, R.

4 Define 'logarithmic decrement.' It is found that in water medium the decrement factor is larger than in the air medium. Comment.

5 Draw the circuit diagram of damped oscillatory series LCR circuit. Write down the differential equation for the same.

6 Write down the differential equation of the damped oscillations. State only all the three cases.

7 By giving suitable formulae, compare the frequencies of undamped oscillations and damped oscillations. Give suitable examples.

8 The equation of critically damped motion of an oscillator is, $4\frac{d^2y}{dt^2} = R\frac{dy}{dt} + 9y = 0$, Determine the value of R.

9 In a logarithmic decrement experiment, following observations were made: coefficient of damping =0.5 Ns/ m, mass of the oscillator =50 gm, and period = 0.25 S. Find the logarithmic decrement λ.

10 The equation of critically damped motion of an oscillator is, $3\frac{d^2y}{dt^2} = R\frac{dy}{dt} + 48y = 0$. Determine the value of R.

**Questions for 4 marks**

1 Distinguish between damped oscillations and undamped oscillations.

2 What is logarithmic decrement? Give its physical significance.

3 Obtain an expression of logarithmic decrement.

4 Define Q factor of a damped harmonic oscillator. Give its formula. State the factors on which it depends.

5 Write down the differential equation of the damped oscillations. Also write its solution. Hence discuss the condition of critical damping.

6 Write down the differential equation of the damped oscillations. Also write its solution. Hence discuss the condition of over damped motion.

7 Write down the differential equation of the damped oscillations. Also write its

solution. Hence discuss the condition of damped harmonic motion.

8 Write down the differential equation of the damped oscillations. State all the three cases. Compare them graphically.

9 Define :-i) Undamped oscillations ii) Damped oscillations,
iii) Decrement factor iv) Q factor

10 Draw the circuit diagram of damped series LCR circuit. Set up the differential equation of the motion for the same.

11 Obtain an expression of Q factor for the damped oscillations.

12 The frequency of a damped oscillator of mass 5 gm is 2 Hz. If the coefficient of damping is 0.157 dyne.s/cm, what is its Q factor? Also determine the logarithmic decrement.

13 A damped harmonic oscillator of mass 0.5 kg is oscillating in a medium having coefficient of damping is 1.0 N.s/m. If the period of oscillations is 0.5 second, find the logarithmic decrement.

14 The restoring force per unit displacement of magnitude 7 N/m acts on an oscillator of mass 30 gm. The coefficient of damping is 0.5 Ns/m. Determine whether the motion is over damped or critically damped or damped oscillatory.

15 The restoring force per unit displacement of magnitude 2 N/m acts on an oscillator of mass 25 gm. The coefficient of damping is 1.0 Ns/m. Determine whether the motion is over damped or critically damped or damped oscillatory.

16 The equation of motion of damped oscillator is of the form, $4\frac{d^2y}{dt^2} = 20\frac{dy}{dt} + 25y = 0$ Determine the values of mass an oscillator, the coefficient of damping and force constant. Also find the nature of the motion whether the motion is over damped or critically damped or damped oscillatory.

## Questions for 6 marks

1 Set up the differential equation of damped harmonic oscillator. Hence obtain its solution.

| | |
|---|---|
| 2 | Write down the differential equation of the damped oscillations. Also write its solution. Hence discuss any one case. |
| 3 | Set up the differential equation of damped harmonic oscillator. Also write its solution. Hence discuss the condition of damped harmonic motion. |
| 4 | Define logarithmic decrement. Give the physical significance of logarithmic decrement. Hence show that, $\lambda = RT/4m$ |
| 5 | Set up the differential equation for the damped motion of series LCR circuit. Discuss the case, damped oscillatory motion. Hence find the frequency of the circuit. |
| 6 | Obtain an expression for the energy of a damped harmonic oscillator. What should be the energy of the oscillator, in the absence of damping? |
| 7 | Show that the average energy of a damped harmonic oscillator decreases exponentially as time increases. |

## Forced Oscillations

### Questions for 2 marks

1 What do you mean by the forced vibrations?

2 What is resonance?

3 State the four types of resonance in forced oscillation.

4 State the differential equation of motion for the forced oscillations.

5 What is amplitude resonance?

6 What is sharpness of resonance?

7 Define bandwidth of power resonance curve.

8 Define half-width of resonance curve?

9 Define Quality factor.

10 What is the relation between quality factor & bandwidth.

11 Draw a series L-C-R circuit for forced oscillatory system.

12 Draw a curve of variation of amplitude resonance as a function of driving frequency.

13 State the differential equation of forced oscillations in series L-C-R circuit.

### Questions for 3 marks

1 What is resonance? Explain any one type.

2 Explain Barton's pendulum to demonstrate mechanical pendulum.

3 Distinguish between forced oscillations & damped oscillations.

4 What is amplitude resonance in case of forced vibrations? State it's condition.

5 Define bandwidth. State the relation between bandwidth & half width.

6 Define Quality Factor. State the relation between quality factor & bandwidth.

7 The equation of forced vibration is expressed in the form $4\frac{d^2y}{dt^2}+2\frac{dy}{dt}+12y=30\sin 2t$, where the qualities are in S.I. units. If the motions stands from the origin , find a) Amplitude & b)Period.

8 An alternating emf of 200V is applied in series with circuit containing a resistance of 10Ω, an inductance of 20mH & a condenser of capacity 0.5μF. Calculate a) the resonant frequency b) Current at resonance & c) Q-value of

the circuit.

9 Draw a series L-C-R circuit for forced oscillatory system. State the differential equation for the electrical oscillations.

**Questions for 4 marks**

1 What is resonance? Explain any two types of resonance occuring in Physics.

2 Show that the average power absorbed by a forced oscillator is equal to the average power dissipated.

3 Explain mechanical resonance with suitable example.

4 What is amplitude resonance? Obtain its condition for amplitude resonance.

5 Define quality factor? Obtain its expressions in terms of bandwidth.

6 Using a power resonance curve show that bandwidth $\Delta q = \frac{R}{m}$

7 Obtain the differential equation of forced oscillations.

8 What is the sharpness of resonance? Hence show that $\Delta w = \frac{R}{2m}$

9 The equation of forced vibrations of a body is given as $\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 8y = 20\sin 2t$, where the quantities are in S.I. units. If the motion starts from the origin, find, a)amplitude b)period & c)frequency of the steady state vibrations

10 The amplitude of forced oscillator increase from 0.005cm at very low frequencies to 1cm at the resonant angular frequency at 500rad/sec. Calculate its quality factor & bandwidth.

11 In case of the forced vibrator, the amplitude of vibrations increases from 2mm at very low frequencies to 100mm at the amplitude resonant angular frequency. What is the quality factor of the forced vibrator?

12 A damped harmonic oscillator has m=0.2kg,R=4m-s/m, k=80N/m. Suppose that this oscillator is driven by a force fsinqt, where F=2N, & q=30rad/sec. Determine a) the value of A & δ in the steady-state response given by y=Asin(qt - δ), b)energy dissipated against the damping forced in one cycle & c)the average power input.

13 A series LCR ckt with L=0.05H, c=50μF & R=10Ω is connected to an alternating supply at 230V & 50Hz.Find , a) the resonant frequency , b) current at resonance, c)Q-value of the ckt & d) the bandwidth.

14 The equation of forced vibration of a body is given as ,

$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 400y = 16\sin 2t$ ,where the quantities are in S.I. units. If the motion stands from the origin find a) amplitude b) period & c)frequency of steady-state vibrations.

**Questions for 6 marks**

1 Set up the differential equation of forced oscillation & discuss its solution.

2 Derive an expression for amplitude of forced oscillations.

3 In case of forced vibrations show that the total average energy( $\overline{E}$ ) of the system is constant.

4 An alternative emf is applied to a series LCR circuit. Setup the differential equation for the electrical oscillations. Considering its analogy with the mechanical system, find instantaneous value of charge & current.

5 In case of amplitude resonance, show that, $q = \sqrt{\frac{k}{m} - \frac{R^2}{2m^2}}$ . Hence show that, $A_{\max} = \frac{F}{Rw}$

6 What is the half width of the resonance curve? Discuss sharpness of resonance curve.

## MATTER WAVES

### TWO marks Questions

1. What are matter waves?
2. What is wave particle duality?
3. Explain the de-Broglie's concept of matter waves.
4. Calculate the de-Broglie wavelength of an electron moving with velocity $10^7$m/s.
5. Calculate the de-Broglie wavelength of neutron of energy 28.8eV. (Given mass of neutron= $1.67 \times 10^{-27}$ Kg, Plank's constant=$6.62 \times 10^{-34}$ J.S).
6. What do you meant by group velocity?
7. Define phase velocity.
8. State the importance of Davisson and Germer Experiment.
9. Calculate the de-Broglie wavelength associated with electrons accelerated from rest by potential difference of 200V.
10. What are different forms of Heisenberg's uncertainty relation?
11. Give the statement of Heisenberg's uncertainty principle.
12. Deduce an expression for the de-Broglie wavelength 'λ' of moving particle.
13. Explain the term wave packet.
14. What do you mean by thought experiment?
15. Show that for particle moving with relativistic velocity, group velocity is equal to the particle velocity.
16. State various formulae for group velocity.
17. Show that de-Broglie wavelength $\lambda = h/mv$.
18. If the uncertainty in position of an electron is $4 \times 10^{-10}$ m, calculate the uncertainty in its momentum.
19. If the uncertainty in the location of a particle is equal to its de-Broglie wave length, what is the uncertainty with velocity?
20. State different formulae for de-Broglie wave length.
21. State the time-energy uncertainty principle.
22. Draw the neat diagram of Davisson and Germer experimental set-up.

23 Find the expression of group velocity in the form of $v_g = \frac{dE}{dp}$

24 What are the conclusions of Davisson and Germer Experiment?

25 Discuss the importance of Heisenberg's uncertainty relation.

**Questions for 3 marks**

1 State and explain de-Broglie hypothesis of matter waves.

2 Show that the wavelength associated with electron accelerated from rest by potential difference of 'V' volts is given by, $\lambda = \frac{12.2}{\sqrt{V}}$

3 The velocity of ocean is $\sqrt{g\lambda/2\pi}$, Show that group velocity of these waves is half the phase velocity.

4 Obtain the relation, $v_g = w - \lambda \frac{dw}{dk}$, where $v_g$ is the group velocity and w the phase velocity.

5 Deduce the uncertainty relation in the form, $\Delta E.\Delta t \geq h$ where the symbols have their usual meanings.

6 Deduce the uncertainty relation in the form, $\Delta L.\Delta \theta \geq h$ where the symbols have their usual meanings.

7 State and explain Heisenberg's uncertainty principle.

8 Show that the group velocity is always equal to the particle velocity.

9 Velocity of the ripple waves in a water tank is equal to $\sqrt{2\pi s/\rho\lambda}$, where 'S' is the surface tension, 'λ' is the wavelength and 'ρ' is the density of the liquid. Find out the group velocity.

10 Find out the wavelength of wave associated with a marble ball of mass 20gm moving with a velocity 30m/s.

11 Define the term: i) Phase velocity ii) Wave packet iii) Group velocity.

12 Calculate the energy in electron volt of an electron wave of de-Broglie wavelength $3\times10^{-2}$m. (Given Plank's constant=$6.62\times10^{-34}$ J.S).

13 Find the energy of neutron in eV whose de-Broglie wavelength is $1A^{o}$. (Given mass of neutron= $1.674\times10^{-27}$ Kg, Plank's constant=$6.60\times10^{-34}$ J.S).

14 Using de-Broglie hypothesis, calculate the wavelength associated with an electron with K.E. of 100 eV. (Given mass of electron= $9.1 \times 10^{-31}$ Kg, Plank's constant=$6.625 \times 10^{-34}$ J.S).

**Questions for 4 marks**

1 Velocity of light in a dispersive medium is equal to $\sqrt{\mu / k}$ ,where μ is refractive index. What is the group velocity?

2 Deduce an expression for the de-Broglie wavelength 'λ' of the moving particle.

3 Deduce the expression for the de-Broglie wavelength in the form of $\lambda = \frac{h}{\sqrt{2mev}}$

4 Derive uncertainty relation $\Delta x . \Delta p \geq h$

5 Estimate the size of the atom using uncertainty relation.

6 Show that uncertainty relation does not allow presence of electrons in the nucleus.

7 Derive the relation between group velocity and particle velocity.

8 Write note on de-Broglie hypothesis of matter waves.

9 Obtain the relation between group velocity and phase velocity.

10 Explain the wave particle duality.

11 Describe the Davisson and Germer Experiment to prove that electrons posses wave nature.

12 Explain one of the applications of Heisenberg's uncertainty principle.

13 Find the de-Broglie wavelength of a electron having 5keV energy.

14 Discuss the phase velocity and group velocity.

15 Write note on particle and wave aspect of matter.

16 Illustrate Heisenberg's uncertainty relation by thought experiment.

17 Define group velocity and show that the expression of group velocity is, $v_g = w + k \frac{dw}{dk}$

18 Write note on wave group.

19 State de-Broglie hypothesis of matter waves. Show that the de-Broglie

wavelength is $\lambda = h/mv$.

20 Using the Heisenberg's uncertainty principle, show that electron cannot be a particle inside the nucleus.

**Questions for 6 marks**

1 Discuss the wave particle duality. Derive an expression for the de-Broglie wavelength.

2 What is the de-Broglie hypothesis? Show that the wavelength $\lambda$ associated with an electron of mass m and kinetic energy E is given by $\lambda = \frac{h}{\sqrt{2mE}}$

3 State and explain Heisenberg's uncertainty principle and show that $\Delta x.\Delta p_x \geq h$

4 Describe in detail, Davisson and Germer experiment and explain its result.

5 State and establish Heisenberg's uncertainty relation by thought experiment.

6 Obtain an expression for the ground state energy of H-atom using Heisenberg's uncertainty principle.

7 What do you mean by wave velocity and group velocity? Show that the group velocity is always equal to the particle velocity.

8 Establish different forms of Heisenberg's uncertainty relation from position-momentum uncertainty relation

9 Obtain the relations, $v_g = w - \lambda \frac{dw}{dk}$ and $v_g = w + k \frac{dw}{dk}$, where $v_g$ is the group velocity and w the phase velocity.

## Wave Mechanics

### Questions for 2 marks

1. Prove that $\psi\psi^*$ is always a positive and real quantity?
2. State condition for the normalization of the wave function.
3. Define probability density.
4. Write Schrödinger time dependent and time independent equation?
5. Sketch probability curves and wave function curve for n=2& n=3 .
6. Write the solution for the Schrödinger equation for the particle moving in one dimensional rigid box.
7. Write simple form of wave function & express it in terms of exponential function.
8. What is mean by wave function $\psi$?
9. What is Eigen value equation?
10. Can $\psi\psi^*$ be an imaginary? Explain.
11. Define Hamiltonian operator.
12. For a particle in a box state the potential energy when it is inside box & out side the box?
13. Write the expression for $\hat{H}$ & $\hat{E}$ of the equation $\hat{H}\psi = \hat{E}\psi$ .
14. What is Schrödinger wave equation?
15. State what will be the probability for large quantum number n ?

### Questions for 3 marks

1. Show that $\psi$=sin x is acceptable wave function.
2. X, P & E are the dynamical variable in classical mechanics states their corresponding operator in quantum mechanics.
3. What is meant by eigen function & eigen values?
4. The wave function for a particle confined to move in a line of length 'L' only is given as $Y = A\sin(n\pi x/L)$, find out the value of normalization constant A?
5. Show that the wave function $\psi = Ae^{ikx}$ for a free particle can not be normalized.
6. Calculate the ground state energy of an electron in a one dimensional rigid box of length $3\times10^{-10}$ m
7. Sketch $\psi$ & $\psi^2$ for the state n=1, n=2 & n=3 of a particle in one dimensional box.

## Questions for 4 marks

1. Give the physical significance of wave function $\psi$.
2. Give the condition of a well behaved wave function for n=1, n=2, n=3. Sketch the nature of probability curve & wave function curve
3. Show that energy of particle inside the box is quantized.
4. Obtain the Schrödinger equation for a particle in a rigid box.
5. Starting from Schrödinger time dependent equation set up the time independent equation.
6. Set up the Schrödinger time independent equation.
7. Show that wave functions are different for different values of quantum number n.
8. Show that the energy of a particle in a box is directly proportional to square of the quantum number n.
9. An electron is constrained to move between two rigid wall separated by $1.0\times10^{-9}$m, calculate the energies of lowest states (m = $9.1\text{x}10^{-31}$ Kg).
10. A particle is confined between rigid walls separated by a distance a. What is the probability that it will be found within a distance a/3 of one wall (i)n=1 (ii)n=2.
11. Starting with wave function $\psi = \sin \sqrt{2mE/h^2}\ x$ obtain the normalized wave function.

## Questions for 6 marks

1. Obtain Schrödinger's time dependent wave equation for the free particle moving along X- axis . What is eigen value equation?
2. Apply Schrödinger equation for motion of a particle in 1- Dimensional rigid box and Show that the energy is quantized ?
3. Set up Schrödinger time dependent equation .What is the condition that the wave function $\psi$ to be well behaved?
4. Show that the wave function $\psi$ for a particle in a one dimensional rigid box is square integrable. Hence write the normalized wave function in the first three quantum states.

## Geometrical optics

### TWO marks Questions

1) Name the phenomena which can be studied with the help of geometrical optics.
2) What do you mean by aberration? Give names of different aberrations.
3) Give the different types of chromatic aberrations.
4) Define spherical aberration. Name any two methods to reduce spherical aberration.
5) Draw the ray diagram to explain axial chromatic aberration.
6) State the two conditions for achromatism.
7) Draw the ray diagram to calculate equivalent focal length of two thin lenses separated by a distance.
8) Define power of a lens? Give its unit.
9) Calculate the power of combination of two thin lenses each of focal length 10cm and placed 10cm apart.
10) What do you mean by lateral chromatic aberration?
11) What do you mean by achromatism & achromatic doublet?
12) What do you mean by thin lens? On which factors the deviation produced by a thin lens depends?
13) Two thin lens in a contact forming an achromatic converging doublet of focal length 30cm have their dispersive power in the ratio 1:2.Calculate their focal lengths.
14) Represent lateral spherical aberration diagrammatically.
15) Represent axial chromatic aberration diagrammatically.

### THREE marks Questions

1) What are causes of chromatic aberration?
2) Explain any two methods of minimizing the spherical aberration?
3) What do you mean by equivalent length? Give the expression for equivalent focal length of two thin lenses separated by a distance in air.
4) At what distance the two lenses and focal length +12cm and +15cm are to be kept so that the spherical aberration reduces to a minimum? What should be the

distance to make the combination achromatic?.

5) What are the assumptions in studying the formation of image by lens?. Define aberration.

6) What do you mean by geometrical optics? Give the postulates in study of geometrical optics.

**FOUR marks Questions**

1) What do you meant by power and lens? Obtain an expression for power of a system of lenses separated by a distance 'x'.

2) Two thin lenses of focal length 10 cm and 20 cm are placed 5cm apart. Calculate the power of their combination.

3) Discuss spherical aberration in detail and name any four methods to minimize spherical aberration.

4) Two lenses of focal length 100 cm and 100/3 cm are co-axially kept at distance 200/3 cm apart. Find the focal length of the combination.

5) Describe longitudinal chromatic aberration? How it can be minimized?

6) Two lenses form an achromatic doublet of focal length 60 cm. The focal length of one lens is 12 cm and its dispersive power of second lens.

7) Compare spherical aberration and chromatic aberration?

8) Explain Achromatism? Give the conditions for achromatism when lenses are in contact and separated by a distance 'x'.

9) Obtain an expression for deviation produced by a thin lens.

10) Dispersion power of crown & flint glasses are 0.0163 and 0.0243 respectively, design achromatic contact doublet of focal length 50cm.

**SIX marks Questions**

1) Two thin lenses of focal lengths $f_1$ and $f_2$ are separated by a distance x. Prove that the focal length 'f' of the combination is given by $1 / f = 1 / f_1 + 1 / f_2 - x / f_1 f_2$.

2) What is spherical aberration? Give its types. Explain how spherical aberration is minimized?

3) What do you mean by chromatic aberration? What is achromatism and achromatic doublet? Give the two conditions for achromatism.

4) Derive the formula for equivalent focal length of system of two thin lenses in

contact?

5) Define aberration, chromatic aberration What do you mean by longitudinal and lateral chromatic aberration. Explain how it can be minimized?

6) i) Explain axial spherical aberration diagrammatically ii) Can you have an achromatic combination of convex and concave lenses of same focal length and same material. If yes how? If no why?

## Interference and Diffraction

### TWO marks Questions

1) Interference in thin films occurs by-

   a) Division of wavelength  b) Division of wave front

   c) Division of amplitude  d) None of these

2) To get bright fringes (Constructive interference) in the reflected part, the path difference must be-

   a) Odd multiple of $\lambda/2$  b) Even multiple of $\lambda/2$

   c) Odd multiple of $\lambda$  d) None of these

3) An extremely thin film when seen in white light, it appears in the reflected part-

   a) Dark  b) Bright

   c) Equally bright  d) Coloured

4) The Diameter $D_n$ of the $n^{th}$ dark Newton's ring is given by the formula-

   a) $Dn^2 = (2n+1)\lambda R$  b) $Dn^2 = 4\lambda Rn$

   c) $Dn^2 = 2(2n+1)\lambda R$  d) $Dn = 4\lambda Rn$

5) The bending of waves at the corners is called-

   a) Interference  b) Diffraction

   c) Polarization  d) None of these

6) Interference fringes are generally of –

   a) equal width  b) unequal width

   c) None of these

7) Write the wavelength formula for Newton's ring.

8) The optical path difference in a wedge-shaped film is –

   a) $\mu t \cos(\beta + \gamma)$  b) $2\mu t \cos(\beta + \gamma) + \lambda/2$

   c) $2\mu t \cos(\beta + \gamma) - 3\lambda/4$  d) $2\mu t \cos(\beta + \gamma) - \lambda/2$

9) Interference in Newton' ring experiment based on the principle –

   a) Division of Amplitude  b) Division of wave front

   c) Path of light  d) None of these

10) On taking Cylindrical Lens instead of spherical Lens in Newton's ring experiment,

then the shape of fringes is –

a) Circular

b) Straight lines perpendicular to the tangent

c) Parallel to tangent but straight lines of varying width

d) None of these

11) Two waves of intensities 9:1 interfere to form fringes. The ratio of maximum and minimum intensities is –

a) 10:8 b) 9:1 c) 4:1 d) 2:1

12) Interference is possible-

a) Only by longitudinal waves
b) Only by transverse waves
c) Both by longitudinal and transverse waves
d) None of these

13) The essential condition for Fraunhoffer class diffraction is that-

a) The incident wave front must be plane
b) The incident wave front must be spherical
c) Both the incident and diffracted wave fronts be plane
d) All the above

14) The correct statement is –

a) In the phenomenon of diffraction, waves obtained from the coherent light sources superpose.
b) In the diffraction pattern, the intensity of light at each minima is zero
c) In the diffraction pattern, the intensity of light at each maxima is the same
d) In the diffraction pattern, fringes are not of equal width.

15) The Fraunhoffer diffraction due to a single slit can be seen if the slit width is-

a) $10^{-5}$ cm b) $10^{4}$ cm c) 1 cm d) 1 m

16) The condition of minima in the diffraction pattern due to a single slit (width e) is

a) $(e + d) \sin\theta = n\lambda$ b) $e \sin\theta = n\lambda$ c) $e \sin\theta = 1/ n\lambda$

17) The expression for the area of a half period zone is

a) $\pi b/\lambda$ b) $\pi b\lambda$ c) $\lambda/\pi b$ d) $2\pi b\lambda$

18) The shape of the fringes obtained in a wedge-shaped film is-

a) circular b) elliptical c) straight d) curved

19) Diffraction of light is observed when the size of obstacle is

a) very large b) very small c) comparable with wavelength of light d) howsoever large or small

20) The condition of maxima in two slit diffraction is

a) $a \sin\theta = n\lambda$ b) $(a+b) \sin\theta = n\lambda$ c) $(a+b) \sin\theta = \lambda/n$ d) $a \sin\theta = \lambda/n$

21) Give only the formula of diameter $D_n$ of the $n^{th}$ dark Newton's ring?

22) A grating has 5000 lines per cm. Find the wavelength for n=1 and $\sin\theta = 1$?

23) Give the formula to obtain the maximum number of spectrum by a grating?

24) Give the condition of minima in the diffraction pattern due to a single slit ?

25) Give the condition of maxima in the diffraction pattern due to a single slit ?

26) A grating has 15000 lines per inch. What is its grating element?

27) Write down the condition of formation of spectrum by a grating?

28) What is the total angular width of central maxima in diffraction due to a single slit?

29) What is diffraction?

30) What will be the order of spectrum for normal incidence ($\theta = 90^0$) of parallel beam of light of wavelength 5000 $A^0$ on a grating having 7000 lines per cm?

31) What should be the minimum number of lines per cm on a grating to be used in second order with light of wavelength 5000 $A^0$?

32) What will be $e_{min}$ in the equation $e\sin\theta = n\lambda$, if $(\sin\theta)_{max}=1$ and n=2

33) Explain the symbol used in the equation $e\sin\theta = n\lambda$?

34) What is interference?

35) What is constructive & destructive interference?

## **THREE** marks Questions

1) What is diffraction of light? Name the type of diffraction.

2) Distinguish between Fresnel and Fraunhoffer diffraction?
3) Due to interference of two waves, the energy becomes zero at some points, Is this energy is dissipated? Explain in short.
4) What are the differences between Newton's ring and Wedge-film fringes?
5) Two light waves of equal intensity interfere. How many times is the intensity at a bright fringe as compared to the intensity of other wave?
6) What are the conditions to obtain interference of light?
7) Write down only the conditions for the constructive and destructive interference in the reflected and transmitted parts due to a film of thickness t and refractive index $\mu$ ?
8) Write down the Stoke's law?
9) Draw the ray diagram of experimental setup to obtain Newton's ring.
10) Write down the expression for the area of a half period zone for- a) plane wave front b) spherical wave front? Explain the meaning of the symbols used.
11) A grating has 20,000 lines per cm. Can it be used to measure the wavelength of X- rays? Give a reason to your answer.
12) Describe the intensity distribution in Fraunhoffer diffraction due to a single slit?
13) Two waves of amplitudes 3 mm and 4 mm respectively travel in the same medium and in the same direction. If the phase difference between these waves at a point in their path is $\pi/2$, what will be the resultant amplitude at that point due to this waves?
14) Explain the statement 'Newton's rings are the fringes of equal thickness.'

**FOUR marks Questions**

1) What is meant by interference of light? State the fundamental conditions for the production of interference fringes.
2) Obtain an expression for the intensity at a point in the interference pattern?
3) Obtain the conditions for maximum and minimum intensity distribution in the interference pattern?
4) Explain analytically the interference of light in the form of wave theory?
5) Discuss the phase change on reflection of light on the basis of stokes treatment?
6) Write short note on phase change on reflection?

7) Write a short note on ‘ Stoke’s treatment’?

8) Prove the relation $\lambda = [D_m^2 - D_n^2] / 4(m - n)R$, where the symbol have their usual meaning.

9) What are Newton’s rings? Describe the experimental arrangement for producing Newton’s rings.

10) Explain the formation of Newton’s Rings.

11) Explain clearly the theory of the experimental arrangement of Newton’s ring experiment.

12) How will you determine the wavelength of sodium light by Newton’s ring?

13) How will you determine the refractive index of liquid using Newton’s ring?

14) Discuss the formation of Newton’s ring by transmitted light.

15) Discuss the formation of Newton’s ring by reflected light.

16) In a Newton’s ring experiment the diameter of the $10^{th}$ ring changes from 1.40 cm to 1.27 cm when a liquid is introduced between the lens and the plate? Calculate the refractive index of the liquid.

17) Distinguish between Fresnel’s diffraction and the Fraunhoffer diffraction.

18) Explain Fresnel’s assumption.

19) Show that the area of each half period zone is equal to $\pi b\lambda$.

20) Explain in brief the concept of Fresnel’s half period zones.

21) Derive an expression for the angular dispersion of a plane diffraction grating?

22) Explain the phenomenon of diffraction.

23) In a Newton’s ring experiment, the Diameter of the $15^{th}$ ring was found to be 0.590 cm and that of the $5^{th}$ ring was 0.336 cm and radius of the plano-conex lens is 100 cm, calculate the wavelength of light used?

24) In a Newton’s ring experiment, find the radius of curvature of the lens surface in contact with the glass plate when with a light of wavelength $5890 \times 10^{-8}$ cm, the diameter of the third dark ring is 3.2 mm. The light is falling at such an angle that it passes through the air film at an angle of zero degree to the normal.

25) Write short notes on the following- **( INCOMPLETE)**

**<u>SIX</u> marks Questions**

1) Obtain the condition $2\mu t\cos(\beta + \gamma) = n\lambda$ for destructive interference in a thin

wedge shaped film?

2) What is Newton's ring and how are they formed? How can the refractive index of a liquid be determined using these fringes?
3) Explain necessary theory of the Newton's ring method for the measurement of wavelength of light.
4) Describe Newton's ring experiment and explain how it is used to determine the wavelength of Sodium light.
5) Discuss the formation of Newton's ring by i) reflected light ii) transmitted light.
6) Describe the method for determination of- 1) Wavelength of light 2) Refractive index of liquid, using Newton's ring.
7) Give the theory of Fraunhoffer diffraction due to single slit and discuss the intensity distribution on the screen.
8) Give the theory of plane transmission grating.
9) What is Fresnel diffraction? Explain rectilinear propagation of light using Fresnel diffraction.
10) Give the theory of Fraunhoffer diffraction due to double slit.

## Optical Instruments

### TWO marks Questions

1) In photographic camera, on what factors the opening time of shutter depends?
2) What is f-ratio or f-number?
3) What is angular magnification in telescopes?
4) How will you compare human eye with a fine camera?
5) Describe in short accommodation as a part of process of vision.
6) What do you know about presbyopia?
7) What is an important feature of a good camera?
8) What is a fovea in human eye? What is its use?
9) State and explain the fundamental principle of camera.
10) On what factors, the light entering a camera depends?
11) What is the direct measure of speed of a camera lens?
12) A converging lens has a focal length of 27cm.What is its power in diopter?
13) State the type & nature of two lenses used in simple astronomical telescope.
14) In a photographic camera, what is the size and nature of image on photographic film?
15) In a photographic camera for f-ratios 5.6,8,11,16,22 what are the respective correct exposures in seconds?
16) In the case of human eye, what are the functions of lens system and iris?
17) What is the role of crystalline lens and lens capsule in human eye?
18) Why a telephoto lens is used in camera?

### THREE marks Questions

1) What is depth of focus? Describe its importance in camera.
2) State the construction, working & use of telephoto lens in a camera.
3) Describe three main uses of telescopes.
4) In photography, define the terms brightness (or luminance B) and illuminance E. On what factors illuminance E depends?
5) In the case of human eye, explain the concept of visual angle, & angular magnification.

6) Explain the utility of depth of focus and telephoto lens in a photographic camera.

7) In the case of astronomical telescope, draw a neat labeled diagram showing formation of image at infinity and magnification as a ratio of image field angle and a object field angle.

**FOUR marks Questions**

1) Write a short note on 'photographic camera'?

2) What are entrance and exit pupils of an astronomical telescope? Hence show that the magnification is equal to the ratio of the diameter of the objective to the diameter of exit pupil.

3) A telescope with an objective of focal length 50cm is used to bring into view an object 150cm distant. When the eyepiece is adjusted to form an image at infinity, the magnifying power is 5. (a) Calculate the focal length of eyepiece and (b) Calculate the magnifying power of telescope, if the eyepiece is adjusted to view objects at infinity.

4) What are hypermetropia and myopia? Show diagrammatically, these defects can be corrected by spectacle lenses?

5) What is retina? What is its function? How do cones & rods work?

6) Define power of lens. State its unit. State the values of power of the cornea of the human eye and the entire system of the eye.

7) Define 'visual angle'. Give its short account. What is angular magnification with reference to human eye?

8) Derive an expression for depth of focus in a camera.

9) A person has his near point at 15.0cm and a range of distinct vision of 85cm. What is his range of distinct vision when he wears close fitting spectacles having a power of -0.8diopter?

10) Write a short note on telephoto lens.

11) Describe with suitable diagram, the working principle of photographic camera.

12) Derive an expression for magnifying power of an astronomical telescope when the final image is formed at near point. Draw the necessary ray diagram.

## **SIX marks Questions**

1) Describe a simple photographic camera with suitable diagram.
2) What do you know about refracting astronomical telescope? Explain its normal adjustment and hence prove that magnification is the ratio of focal lengths of objective & the eyepiece.
3) Draw the necessary ray diagram and show that angular magnification is greater than when the final image is formed at the near point.
4) Describe an internal structure of human eye, by drawing a cross sectional diagram showing principle optical components & the retina.

## Michelson Interferometer

### TWO marks Questions

1) State the principle of operation of Michelson Interferometer.
2) Which are the conditions to obtain circular fringes in Michelson-Interferometer?
3) Which are the conditions to obtain localized fringes in Michelson-Interferometer?
4) Under which conditions fringes are obtained by using white-light source in Michelson-Interferometer?
5) What are the fringes of equal inclination?
6) What is meant by fringes of equal thickness?
7) What are the fringes of equal chromatic order?
8) In Michelson-Interferometer the planes of the mirrors M1 and M2 are exactly perpendicular to each other. State the nature of air-film and nature of fringes.
9) In Michelson-Interferometer the planes of the mirrors M1 and M2 are not exactly perpendicular to each other. State nature of air film and nature of fringes.
10) In a Michelson interferometer experiment zoo fringes cross the field of view when the movable mirror is displaced through 0.0589 mm. Calculate the wavelength of monochromatic light used.
11) A shift of 'n' circular fringes is observed when the movable mirror of Michelson-Interferometer is shifted by 0.0295 mm Calculate the value of n, if the wavelength of light used is 5900$A^{o}$.
12) Write an expression fro visibility of fringes in case of Michelson-Interferometer. What is its value for monochromatic light?
13) Write an expression for minimum visibility (Vmin). What will be the value of Vmin, if the two interfering beams have equal intensities?

### THREE marks Questions

1) Explain the function of semi-silvered glass plate in Michelson-Interferometer.
2) Explain why compensating glass plate is used in Michelson Interferometer.
3) State at least three applications of Michelson interferometer.
4) What is meant by 'fringes of equal thicknesses? State an example (experiment) where these fringes are formed.

5) What is meant by fringes of equal inclination? State an example (experiment) where these fringes are observed.
6) Write an expression relating intensity and path difference in case of Michelson interferometer. Interpret the relation.
7) "The displacement of mirror in Michelson interferometer causes shifting of fringes". Comment.

**FOUR marks Questions**

1) Describe the construction of Michelson interferometer.
2) Explain the formation of circular and localized fringes in Michelson interferometer.
3) Explain the formation of localized and white light fringes in Michelson interferometer.
4) Explain the formation of white light fringes and circular fringes in Michelson interferometer.
5) Explain how wavelength of monochromatic light is determined by Michelson interferometer.
6) Describe the working of Michelson interferometer.
7) Describe the difference between the two glass-plates used in Michelson interferometer.
8) Write a short note on Michelson interferometer

**SIX marks Questions**

1) Explain the term visibility of fringes in case of Michelson interferometer. Also explain the dependence of visibility on path difference with the help of necessary equations.
2) Write the constructional details of Michelson interferometer. Explain, how circular fringes are obtained.
3) Explain the working of Michelson interferometer and describe how wavelength of monochromatic light is determined.
4) State the applications of Michelson interferometer. Describe the procedure to determine the wavelength monochromatic light.

# LASER

## **TWO** marks Questions

1) What is spontaneous emission?
2) What is stimulated emission?
3) What is indused absorption?
4) What do you maen by metostable state?
5) What do you mean by pumping?
6) What do you mean by active system?
7) What do you mean by population inversion?
8) What do you mean by optical pumping?
9) Sketch the energy level diagram of ruby laser.
10) Sketch the well labelled diagram of exprimental set up of ruby laser.
11) Sketch the well labelled diagram of exprimental set up of He-Ne laser.
12) Sketch the energy level digram of He-Ne Laser.
13) Enlist the applications of LASER.
14) What is LASER ? Name the differents types
15) Sketch the energy level digram for papulation inversion ?
16) What is holography ?
17) What is hologram ?
18) Sketch experimental arrangement to optian hologram
19) What are the charactristics of LASER?

## **THREE** marks Questions

1) What do you mean by laser ? explain the meaning of spontaneous and stimulated emission
2) With engery level diagram explain the term population inversion
3) With neat diagram explain the operation of laser
4) Explain the population inversion in ruby laser
5) Explain the population inversion in He-Ne laser
6) Explain the operation of He-Ne laser
7) Explain the operation of ruby laser

8) What are the requirements of laser ?

**FOUR marks Questions**

1) With neat diagram explain the construction of ryby laser.
2) With neat diagram explain the construction of He-Ne laser
3) With engery level diagram explain the operation of ruby laser .
4) With enegry level diagram explain the operation of He-Ne laser.
5) In brief explain any four uses of laser .
6) Explain what are the requirements of laser ?
7) With neat diagram explain the principle of operation of laser
8) Give the comparision between spontaneous and stimuleted emission .
9) With enegry level diagram explain population inversion in laser
10) With enegry level diagram explain what is the need of metastable state.
11) A laser beam has a wavelength of 8000 $A^0$ and aperature 0.005 m . the laser beam is sent to moon . the distance of the moon from the earth is 400000 km . i) caluate the angular spread of the beam . ii) the areal spread whent it reaches the moon .
12) A laser beam of wavelegnth 6000 $A^0$ on earth is focused by a tens of diameter 200 cm . on to a creater on the moon . The distance of the moon from the earth is 400000 km . How big is spot on the moon ? neglect the effect of earth atmosphere.
13) A laser beam has a power of 50mw (milliwatt) . It has an apearture of $5*10^{-3}$ m and it emits light of wavelegnth 7200 $A^0$ . The beam is focused with a tens of fowl length 10 cm. Calculate the area and the intensity of the image.
14) The coherence length for sodium light is $2.945*10^{-2}$ m. The wavwelength of sodium light is 5890 $A^0$. Calculate the number of oscillations corresponding to the coherence length and the coherence time.

**SIX marks Questions**

1) What do mean by the following terms. a) Population inversion b) Pumping c) Metastable state.
2) Explain in detail the process of stimulated emission? Draw a neat diagram of ruby laser. Explain its operation.
3) Explain in detail the process of stimulated emission. Draw a neat diagram of ruby

laser. Explain its operation

4) Explain the operation of He-Ne gas laser. Draw its schematic diagram. Describe how stimulated emission takes place with the exchange of energy between the Helium and Neon atoms.
5) Write notes on Ruby LASER?
6) Compare spontaneous emission and stimulated emission.