DAV PUBLIC SCHOOS ODISHA-ZONE-II
QUESTION BANK (PHYSICS)
UNIT-1 (Electrostatic)
SECTION-A (1 MARK)

1. Why do the equipotential surfaces donot intersect to each other?
2. Define dielectric constant of a medium. What is its unit?
3. A proton is placed in a uniform electric field directed along the positive x- axis. In which direction will it tend to move?
4. What is the work done in moving a test charge q through a distance 1cm along the equatorial axis of an electric dipole?
5. Define the term electric dipole moment of dipole. State its S.I unit?
6. Three point charges +2q, -q and + 3q are enclosed within a surface S .What is the electric flux due to this configuration?
6. Why the electric field inside a dielectric decreases when it is placed in an external electric field?
7. A hallow metal sphere of radius 5 cm is charged such that the potential on it surface is 10V. What is the potential at the center of the sphere ?
8. A metal plate is introduced between the plates of a charged parallel plate capacitor. What its effect on the capacitance of the capacitor?
9. How does the Coulomb force between two point charges depend upon the dielectric constant of the intervening medium?
10. Show graphically the variation of charge q with time t when a condenser is charged.
11. Name the physical quantity whose SI unit is JC^{-1}.Is it a scalar or a vector quantity?
12. If the radius of the Gaussian surface enclosing a charge is halved, how does the electric flux through the Gaussian surface change?
13. Two equal balls having equal positive charge 'q' coulombs are suspended by two insulating strings of equal length. What would be the effect on the force when a plastic sheet is inserted between the two?
14. Two charges of magnitudes -2Q and + Q are located at point (a, 0) and (4a, 0) respectively. What is the electric flux due to these charges through a sphere of radius '3a' with its centre at the origin?
15. What is an electro static potential due to an electric dipole at an equatorial point?
16 .An electrostatic field line cannot be discontinuous, why?
17. An electric dipole is held in uniform electric field. (i) Show that the net force acting on it is zero
18 The dipole is aligned parallel to the field .Find the work in rotating it through the angle of 180 degree.
19. In which orientation ,a dipole placed in a uniform electric field is in (i) stable , (ii) unstable equilibrium ?

SECTION-B (2-MARKS)

1. Draw three equipotential surfaces corresponding to the field that uniformly increases in magnitude but remain constant along -z direction. How is the surface different from that of a constant electric field along the Z- direction?
2. Prove that a closed equipotential surface with no charge within itself must enclose an equipotential volume.
3. Two fixed point charges +4e and +e units are separated by a distance "a" .Where should the third point charge be placed for it to be in equilibrium?
4. Let two conducting spheres of radii r_1 and r_2 be joined by thin wire and total charge q be given to them .Prove that the charges on the spheres will be in the ratio of their radii.
5. A conductor with capacity C has a charge Q in it .Show that the entire charge must appear on the outer surface of the conductor.
6. Derive an expression for the electric potential at any point along the axial line of an electric dipole?
7. A spherical Gaussian surface encloses a charge of 8.85 x10 $^{-10}$ C (i) Calculate the electric flux passing through the surface (ii) How would the flux change if the radius of the Gaussian surface is doubled and why?
8. Why should electrostatic field be zero inside a conductor?
9. Two charges -q and + q are located at points A(0, 0, - a) and B(0, 0, + a) respectively. How much work is done in moving a test charge from point P (7, 0, 0) to Q (-3, 0, 0)?
10. Plot a graph showing the variation of Coulomb's force(F) versus(1/r2),where r is the distance between two charges of each pair of charges:(1μC,2μC)and (2μC,-3μC).Interpret the graphs obtained.
11. Net capacitance of three identical capacitors in series is 1μ F. What will be their net capacitance if connected in parallel? Find the ratio of energy stored in the two configurations if they are both connected to the same source.
12. A conducting slab of thickness 't' is introduced without touching between the plates of a parallel plate capacitor , separated by a distance 'd' (t<d) . Derive an expression for the capacitance of the capacitor.

13. A slab of material of dielectric constant K has the same area as that of the plates of a parallel plate capacitor but has the thickness d/3, where d is the separation between the plates. Find out the expression for its capacitance when the slab is inserted between the plates of the capacitor.

14.A metallic spherical shell has radius of 20 cm having charge of 5 μc in it. What is its potential at a distance of 15 cm from centre

15. Derive the energy stored in a capacitor of capacitance C when connected to a potential V of a cell.

16 .Consider a uniform electric field $E = 3 \times 10^3$ i N/C. what is the net flux passing through a cube of side 20 cm oriented so that its faces are parallel to the coordinate plane ?

17. Draw a plot showing the variation of (i) electric field (E) and (ii) electric potential (V) with distance r due to a point charge Q .

18 .Derive an expression for the potential energy of an electric dipole of dipole moment **P** in an electric field **E .**

19. Two fixed point charges +4e and +e units are separated by a distance 'a'. Where should the third charge be placed for it to be in equilibrium ?

20. Define 'dielectric constant' of a medium .Briefly explain why the capacitance of a parallel plate capacitor increases ,on introducing a dielectric medium between the plates .

21. State Gauss's law in electrostatics. Use this law to derive the expression for the electric field intensity due to a uniformly charged infinite thin plane sheet.

22.A parallel plate capacitor is charged to a potential difference V by a dc source. The capacitor is then disconnected from the source. If the distance between the plates is doubled ,state with reason how the following will change

;i) electric field between the plates ii) capacitance iii) energy stored in the capacitor

23. A positive point charge (+ q) is kept in the vicnity of an uncharged conducting plate. Sketch electric field lines originating from the point on to the surface of the plate. Derive the expression for the electric field at the surface of a charged conductor.

24. Calculate the electric field intensity due to an electric dipole at a point on its equatorial plane.

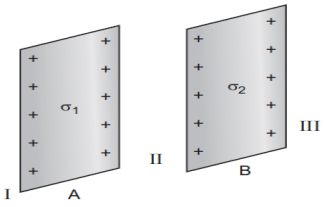
SECTION-C [3 MARKS]

1. A capacitor of 200 pF is charged by a 300V battery. The battery is then disconnected and the charged capacitor is connected to another uncharged capacitor of 100 pF. Calculate the difference between the final energy stored in the final energy stored in the combined system and the initial energy stored in the initial kinetic energy stored in single capacitor,

2. Define term electric dipole moment is it a scalar or vector? Deduce an expression for the electric field at a point on the equipotential plane of an electric dipole of length 2a.

3. Two point charge 3 micro coulomb and -3 micro coulomb are located 20cm a part in vacuum (i) Calculate the electric field at the midpoint O of the line AB joining two charges (ii) What is the force experienced by negative test charge of magnitude 1.5×10^{-9} C placed at this point.

4. A point charge (+Q) is kept in the vicinity of uncharged conducting plate. Sketch electric field lines between the charge and the plate. Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and σ_2 ($\sigma_1 > \sigma_2$) are shown in the figure. Write the magnitudes and directions of the net fields in the regions marked II and III.

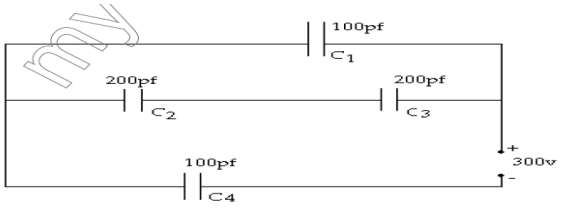


5. Two parallel plate capacitors X and Y, have the same area of plates and same separation between them. X has air between the plates while Y contains a dielectric medium of $\epsilon_r = 4$.
   (i) Calculate capacitance of each capacitor if equivalent capacitance of the combination is 4 mF.
   (ii) Calculate the potential difference between the plates of X and Y.
   (iii) What is the ratio of electrostatic energy stored in X and Y?

6. A parallel plate capacitor is charged by a battery. After sometime the battery is disconnected and a dielectric slab with its thickness equal to the plate separation is inserted between the plates. How will (i) the capacitance of the capacitor, (ii) potential difference between the plates and (iii) the energy stored in the capacitor be affected? Justify your answer in each case.

7. Two similarly and equally charged identical metal spheres A and B repel each other with a force of 2×10^{-5} N. A third identical uncharged sphere C is touched with A and then placed at the midpoint between A and B. Calculate the net electric force on C .

8. Obtain the equivalent capacitance of the network in adjoining figure. For a 300V supply, determine the charge and voltage across each capacitor.



9.. Derive an expression for the torque on an electric dipole in a uniform electric field.

10. Derive an expression for the effective capacitance when capacitors are connected in (a) series and (b) parallel

11. Explain the principle of a capacitor and derive an expression for the capacitance of a parallel plate capacitor.

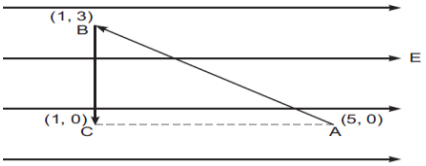
12. State Coulomb's law and express it in vector form. Derive it using Gauss theorem.

13. A parallel plate capacitor is changed to a potential difference , 'V' by a dc source. The capacitor is then disconnected from the source. If the distance between the plates is doubled. State with reason how the following will change : electric field between the plates, capacitance and energy stored in the capacitor.

14.A test charge 'q' is moved without acceleration from A to C along the path from A to B,then from B to C in electric field E as shown in the figure.

(i) Calculate the potential difference between A and C.

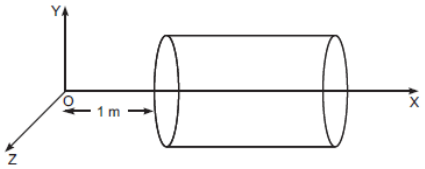
(ii) At which point (of the two) is the electric potential more and why?



15. A hollow cylindrical box of length 1 m and area of cross-section 25 cm^2 is placed in a three dimensional coordinate system as shown in the figure. The electric field in the region is given by E = 50 x , where E is in NC^{-1} and x is in meters. Find

(i) Net flux through the cylinder.

(ii) Charge enclosed by the cylinder.



16.A 4μF capacitor is charged by a 100V supply. The supply is then disconnected and the charged capacitor is connected to another uncharged 2μF capacitor. What is common potential .How much electrostatic energy of the first capacitor is lost in the process of attaining the steady situation?

SECTION-D (4 MARKS)

1.While travelling back to his residence in the car, Dr. Pathak was caught up in a thunderstorm. It became very dark. He stopped driving the car and waited for thunderstorm to stop. Suddenly he noticed a child walking alone on the road. He asked the boy to come inside the car till the thunderstorm stopped. Dr. Pathak dropped the boy at his residence. The boy insisted that Dr. Pathak should meet his parents. The parents expressed their gratitude to Dr. Pathak for his concern for safety of the child.

Answer the following question based on the above information:

(a) Why is it safer to sit inside a car during a thunderstorm?

(b) Which two values are displayed by Dr. Pathak in his actions?

(c) Which values are reflected in parents' response to Dr. Pathak?

(d) Give an example of a similar action on your part in the past from everyday life.

SECTION-E [5 MARKS]

1. Define electric flux. Write its S.I units .Using Gauss's, Prove that the electric field at a point due to uniformly charged infinite plane sheet is independent of distance from it. How is the field directed if (i) the sheet is positively charged (ii) negatively charged.

2 .Derive an expression for the energy stored in a parallel plate capacitor. On charging a parallel plate capacitor to a potential V , The spacing between the plates is halved , an dielectric medium relative permittivity is 10 introduced between the plates without disconnecting the d.c source . Explain using suitable expression, how the capacitance, electric field and energy density of the capacitor change.

3. What is dielectric? Why does the capacitance of a parallel plate capacitor increase on introduction of a dielectric in between its two plates ?Derive an expression for the capacitance of such a capacitor having two identical plates each of area A and separated by a distance x .The space between the plates medium of dielectric constant k.

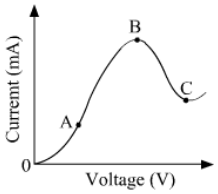
4. Using Gauss' law deduce the expression for the electric field due to a uniformly charged spherical conducting shell of radius R at a point (i) outside and (ii) inside the shell. Plot a graph showing variation of electric field as a function of r > R and r < R. (r being the distance from the centre of the shell)

5. State Gauss Theorem. Use it to find electric field due to (a) A metallic spherical shell of charge having charge density σ. (i) outside (ii) on the surface (iii) inside it (b) Due to a sheet of charge (c) Due to a linear charge distribution.ss

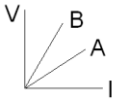
6. Two capacitors with capacitance C_1 and C_2 are charged to a potential V_1 and V_2 respectively and then connected in parallel. Calculate (i) Common potential across the combination (ii) The charge in each capacitor (iii)The electrostatic energy stored in the system (ii) Amount of heat energy produced

UNIT-II [CURRENT ELECTRICITY]
SECTION-A [1 MARKS]

1. Define resistivity of a conductor. Write its S. I unit.
2. A steady current flows in a metallic conductor of non-uniform cross-section .Which of these quantities is constant along the conductor , current , current density, Drift speed, Electric field?
3, Sketch the graph showing variation of resistivity of carbon with temperature.
4. Two wires of equal length, one of copper and the other of manganic have the same resistance. Which wire is thicker?
5. Why resistance becomes less in parallel combination?
6. How can we increase the sensitivity of a potentiometer?
7 .Under what conditions the terminal potential difference of a cell be greater than its e.m.f.
8. Why Wheatstone bridge method is considered unsuitable for the measurement of a very high resistance?
9. How does drift velocity of electrons in a metallic conductor vary with the rise in temperature?
10. Show the variation of resistivity of Si with temperature in a graph.
11 The graph shown in the figure represents a plot of current versus voltage for a given semiconductor. Identify the region, if any, over which the semiconductor has a negative resistance.



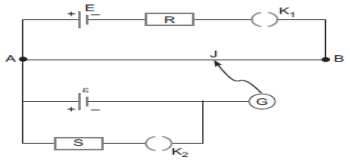
12 The V-I graph of two metallic conductor of same material and same thickness with different length are as shown. Which is of greater length?



13. Show on a graph ,the variation of resistivity with temperature for a typical semiconductor.
14 .What happens to the drift velocity V_d of electron and to the resistance R, if the length of the conductor is doubled (keeping potential difference unchanged).
15.Under what condition maximum current can be drawn from a cell?

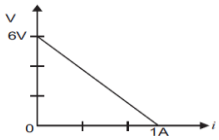
SECTION-B [2 MARKS]

1. Using the mathematical expression for the conductivity of material, explain how it is varies with temperature for (i) semiconductor (ii) good conductors,
2. Two metallic wires of the same material have the same length but cross -sectional area is in the ratio 1:2 ,They are connected (i) in series and (ii) in parallel , compare the drift velocity of electrons in the two wires in both the cases .
3. Derive an expression for drift velocity of free electrons in a conductor in terms of relaxation time.
4. Define ionic mobility. Write its relationship with relaxation time. How does one understand the temperature dependence of resistivity of a semiconductor?
5. Explain how electron mobility changes for a good conductor when ; (i) the temperature of the conductor is decreased at constant potential difference and (ii) applied potential difference is doubled at constant temperature
6. Establish a relation between current and drift velocity.
7. A storage battery of emf 12V and internal resistance of .5 ohm is to be charged by a 120 v d.c supply of negligible resistance. What resistance is required in the circuit for the charging current to be 3A? What is the terminal voltage of the battery during charging?
8. Define the term Resistivity of a conductor, give its SI Unit. Show that the resistance R of a conductor is given by $ml/ne^2\tau A$ where symbols has their usual meanings.
9. A conductor of length l is connected to a DC source of potential V. If the length of the conductor is triple by stretching it keeping V constant, explain how the following factors vary in the conductor (i) Drift speed of electron (ii)resistance .
10. State underlying principle of potentiometer. Describe briefly, giving the necessary circuit diagram, how a potentiometer is used to measure the internal resistance of a given cell.
11. A potential difference of V volts is applied to a conductor of length L and diameter D. How will the drift velocity of electrons and the resistance of the conductor change when (:i.) V is double (ii.) L is halved an iii. D is halved, where, in each case, the other factors remain same. Give reason in each case.
12, Draw V ~ I graph for Ohmic and non-ohmic materials. Give one examples of each.
13. State the principle of working of a potentiometer. Define Potential gradient and write its SI unit.
14. Two students 'X' and 'Y' perform an experiment on potentiometer separately using the circuit given. Keeping other parameters unchanged, how will the position of the null point be affected it



(i) 'X' increases the value of resistance R in the set-up by keeping the key K_1 closed and the K_2 open?
(ii) 'Y' decreases the value of resistance S in the set-up, while the key K_2 remain open and the key K_1 closed? Justify.

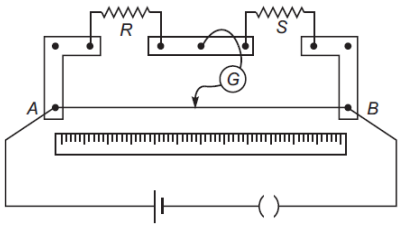
15. Wheatstone bridge method is considered unsuitable for the Measurement of very small resistances. Why?
16. First a set a n equal resistors of R each are connected in Series to a battery of emf E and internal resistance R. A Current I is observed to flow. Then the n resistors are connected in parallel to the same battery.
It is observed that the current is increased 10 times. What is 'n' ?
17 .The plot of the variation of potential difference across a combination of three identical cells in series, versus current is as shown below. What is the emf of each cell ?



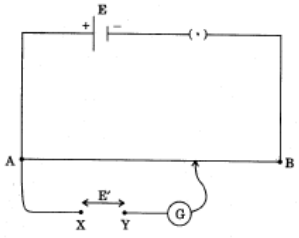
18. A wire has resistance of 10 Ω. It is drawn to increase its length by three times. What is new resistance?
19 .Two wires one of managing and other is copper have equal length and equal resistance .Which one of these wires will be thicker?
20. State the principle of working of a potentiometer. Define Potential gradient and write its SI unit.
21. In a meter bridge , the null point is found to be at a distance of 40 cm from A. if a resistance of 12Ω is connected in parallel with S then balancing point shifted to 50 cm. Find the value of R.
22. Define resistivity of the conductor. Plot a graph showing the variation of resistivity with temperature for a metallic conductor.

SECTION-C (THREE MARKS)

1. Two heating elements of resistances R_1 and R_2 when operated at a constant supply of voltage V, consume powers P_1 and P_2 respectively. Deduce the expressions for the power of their combination when they are in turn connected in (i)series and (ii) parallel across the same voltage supply.
2. Prove the current density of a metallic conductor is directly proportional to the drift speed of electrons.
3. A number of identical cells, n each of emf E , Internal resistance r connected in series are charged by d.c source of emf E' , Using a resistor R . (i) Draw the circuit arrangement (ii) Deduce the expression for (a) the charging current and (b) the potential difference across the combination of the cells.
4. On what principle does meter bridgework? Draw a circuit diagram and explain how this device can be used for determination of an unknown resistance?
5. A number of identical cells ,n, each of emf E and internal resistance r connected in series are charged by a d.c. source of emf E′ using a resistor R i) Draw the circuit arrangement. ii)Deduce the expressions for (a) the charging current and (b)the potential difference across the combinations of the cells.
6. Define the term current density of a metallic conductor. Deduce the relation connecting current density (J) and the conductivity of the conductor, when an electric field E , is applied to it .
7. Two conductors are made of the same material and have the same length. Conductor A is solid wire of diameter 1mm .Conductor B is a hallow tube of outer diameter 2mm and inner diameter 1mm. Find the ratio of résistance R_1 and R_2.
8. State and explain the principle of Wheat Stone's principle. Deduce it using Kirchhoff's laws.
9. Describe how you will determine the resistance of a given wire using Meter Bridge.
10 Explain the principle of a potentiometer. Describe how will you determine the ratio of emf s of two primary cells using Potentiometer.
11 .Explain the variation of resistance and resistivity with temperature and hence define temperature coefficient of resistance and resistivity.
1 2. Derive an expression for conductivity in terms of mobility
1 3. Explain the colour coding of carbon resistors.
1 4. Derive an expression for the current in a circuit with external resistance R when
(a) n identical cells of emf E and internal resistance r are connected in series
(b) m identical cells are connected in parallel



15 .In a meter bridge, the null point is found at a distance of 60.0 cm from A. If now a resistance of 5 ohm is connected in series with S, the null point occurs at 50 cm. Determine the values of R and S.
16. A 10 m long wire of uniform cross-section and 20Ω resistance is used in a potentiometer. The wire is connected in series with a battery of 5 V along with an external resistance of 480Ω. If an unknown EMF E is balanced at 6.0 m length of the wire, calculate (i) potential gradient of the potentiometer (ii) Unknown emf E



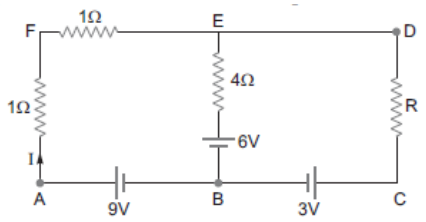
17. Explain giving reasons how the internal resistance of a cell Changes in the following cases :
    (a) When concentration of the electrolyte is increased
    (b) When area of the anode is decreased
    (c) When temperature of the electrolyte is increased

18 .For the potentiometer circuit shown in the given figure, points X and Y represent the two terminals of an unknown emf E'. A student observed that when the jockey in moved from the end A to the end B of the potentiometer wire, the deflection in the galvanometer remains in the same direction. What may be the two possible faults in the circuit that could result in this observation? If the galvanometer deflection at the end B is (i) more, (ii) less, than that at the end A, which of the two faults, listed above, would be there in the circuit ?Give reasons in support of your answer in each case.

19. A potentiometer of 10 meter long having resistance of 2 ohm/m is connected to a cell of 3V with a resister of 30 ohm in series..Find potential gradient. If a cell of 1.5 V is used to compare find the position of balancing point.

20. A cell, of emf 4V and internal resistance of. 5 ohm is connected across of a load of resistances i) 7.7 ohm ii) 11.5ohm. Calculate the ratio of the difference in the emf of the cell and the potential drop across the load, and the ratio of the current in the two cases.

21. State and explain Kirchhoff's laws. Using Kirchhoff's rules determine the value of unknown resistance R in the circuit so that no current flows through 4Ω resistance. Also find the potential difference between A and D.



(SECTION-D) (4 MARKS)

1. Rahul and Rohit bought an electric iron. They had a 2 pin plug. Rahul was keen to start using the new iron with the 2 pin plug. However, Rohit insisted that they buy a 3 pin plug before using it. Rahul got angry. Rohit patiently explained the importance of using a 3 pin plug and the earthing wire. He said that if the metallic body of the iron came in contact with the live wire at 220 volts, they would get an electric shock. If earthed, the current would go to the earth and the potential of the metallic body would not rise. The iron would then be safe to use. Hearing Rohit, Rahul calmed down and agreed.
   • What values did Rahul and Rohit have?
   • Which has greater resistance – 1 K watt electric heater or 100 watt electric bulb, both marked 220 volts?

UNIT -3 [MAGNETIC EFFECT OF CURRENT]
SECTION-A [1 MARKS]

1. Write two factors by which voltage sensitivity of a galvanometer can be increased.
2. In hydrogen atom, if the electron is replaced by a particle which is 200 times heavier but has the same charge, how would its radius change.
3. A proton is moving along +ve x- axis in the presence of uniform magnetic field along + ve Y - axis .What is the direction of the force acting on it?
4. An electron does not suffer any deflection while passing through a region of uniform magnetic field what is the direction of the magnetic field?
5. Under what condition will the force exerted by the magnetic field on a charged particle be (i) maximum (ii) minimum.
6. What are the advantages of radial magnetic field on a moving coil galvanometer?
7. Write two properties of material used as suspension wire in a moving coil galvanometer?
8. Write condition under which an electric charge does not experience a force in a magnetic field .
9. In certain arrangement a proton does not get deflected while passing through a magnetic field region .Under what condition is this possible.
10. Magnetic field lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?
11. Which has greater resistance (i) millimeter or ammeter and (ii) milivoltmeter or voltmeter?
12. What is the direction of the force acting on a charge particle q, moving with a velocity 'v' in a uniform magnetic field B?
13. .In a certain region of space, electric field E and magnetic field B are perpendicular to each other. An electron enters in the region perpendicular to the directions of both B and E and moves un deflected. Find the velocity of the electron.
14. What is the angle of dip at a place where the horizontal and vertical components of earth magnetic field are equal?

15 .Two identical charged particles moving with the same speed enter a region of uniform magnetic field. If one of these enters normal to the field direction and the other enters along a direction at 30^0 with the field, what would be the ratio of their angular frequencies?

16. Where on the surface of Earth is the angle of dip zero?

17 What is angle of Dip at North pole of the Earth.

18. The vertical component of earth's magnetic field at a place is $\sqrt{3}$ times the horizontal component.What is the value of angle of dip at that place.

19 .A narrow beam of proton and deuterons has same momentum, enter s the uniform magnetic field perpendicularly . Find the ratio of radius of circular path described by them.

20. Give two essential characteristics of a material used for preparing an electromagnet.

21.How does angle of dip change as one goes from magnetic pole to magnetic equator of the Earth?

SECTION-B (TWO MARKS)

1. Draw magnetic field lines when a (i) diamagnetic (ii) paramagnetic substance is placed in an external magnetic field. Which magnetic property distinguishes this behavior of field lines due to the two substances?

2. Define the terms' Magnetic Dip' and 'Magnetic Declination' with the help of relevant diagrams.

3. How do you convert a galvanometer into an ammeter? Why an ammeter is always connected in series?

4. A circular coil of closely wound N turns and radius r carries a current I. Write the expression for the following : (i) the magnetic field at the centre (ii) the magnetic moment of the coil

5.A charge 'q' moving along the x-axis with a velocity **v** is subjected to a uniform magnetic field B along the z-axis as it crosses the origin O. (i) Trace its trajectory. (ii) Does the charge gain kinetic energy as it enters the magnetic field? Justify your answer.

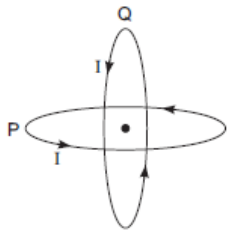
6. A circular coil of N turns and diameter "d" carries a current I. .It is rewound to make another coil of diameter "2d", current I remaining the same . Calculate the ratio of magnetic moments of the new coil and the original coil

7. A straight wire of length L is bent into semicircular loop. Use biot -savart law to deduce an expression for the magnetic field at its center due to current I passing through it .

8. Two long parallel straight wires X and Y separated by a distance of 5 cm in air carry currents of 10A and 5A respectively in opposite direction. Calculate the magnitude and direction of the force on a 20 cm length of the wire Y.

9. If the current sensitivity of a moving coil galvanometer is increased by 20% , its resistance also increased by 1.5 times,. How will the voltage sensitivity of galvanometer be affected.

10. Two identical circular wires P and Q each of radius R and carrying current 'I' are kept in perpendicular planes such that they have a common centre as shown in the figure. Find the magnitude and direction of the net magnetic field at the common centre of the two coils.



11. An alpha particle and a proton are moving in the plane of paper in a region where there is a uniform magnetic field B directed normal to the plane of paper. If the particle have equal momenta. What would be the ratio of the radii of their trajectories in the field?

12. What are permanent magnets? What is an efficient way of preparing a permanent magnet? Write two characteristic properties of materials which are required to select them for permanent magnets.

13. Two wires of equal lengths are bent in the form of a circle and a square. These are suspended in a uniform magnetic field and the same current is passed through them. Which loop will experience greater torque?

14. An electron and a proton moving with the same speed enter the same magnetic field region at right angles to the direction of the field. Find the ratio of their radius of circular path.

15. The magnetisation curve is irreversible .Explain

16. A long straight wire carries a current of 10A from east to west. What is the magnitude and direction of the field B at a point 50 cm above the wire?

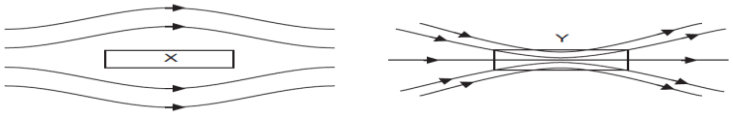
17. Diffentiate between Para and ferro magnetic materials. (at least four points)

18 .Explain, why a wire of irregular shape turning into a circular shape, when suddenly a magnetic field applied perpendicular to its plane.

19. A particle of mass m and charge q moves at right angle to a uniform magnetic field . Plat a graph showing the variation of the radius of circular path described by it with increase of in its charge q.

20.A charged particle having a charge q , moving with a speed v , parallel to wire , at a distance d from it in a direction opposite to the current. What is the force experienced by the charge and what is its direction ?

21. A uniform magnetic field gets modified as shown below when two specimens X and Y are placed in it. Identify whether specimens X and Y are diamagnetic, paramagnetic or ferromagnetic.

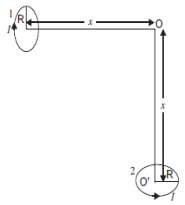


(iii) How is the magnetic permeability of specimen X different from that of specimen Y?

22.A wire AB is carrying a steady current of 10 A and is lying on the table. Another wire CD carrying 6 A is held directly above AB at a height of 2 mm. Find the mass per unit length of the wire CD so that it remains suspended at its position when left free. Give the direction of the current flowing in CD with respect to that in AB. [Take the value of g = 10 ms^{-2}]

SECTION-C [3 MARKS]

1. Draw a labeled diagram of a moving coil galvanometer and explain its working, what is the function of radial magnetic field inside the Coil and soft iron core?
2. Draw a schematic sketch of the cyclotron. State its working principle. Show the cyclotron frequency is independent of the velocity of the charged particles.
3. Derive an expression for the torque experienced by a rectangular loop carrying a steady current I and placed in a uniform magnetic field B .Indicate the direction of the torque acting on the loop.
4. Derive an expression for force per unit length between two long straight parallel current carrying conductors .Hence define one Ampere
5. Using Biot -savat law derive an expression for the magnetic field of at a distance x along the axis from the center of a current carrying circular loop.
6. Define the term: Magnetic Dipole moment of a current loop. Write the expression for the magnetic moment when an electron revolves at a speed 'v', around an orbit of radius 'r' in hydrogen atom
7. In a cyclotron, a magnetic field induction of 0.4 T is used to accelerate protons. How rapidly should the electric field between the dee be reversed? The mass and charge of proton are 1.67 X 10^{-28} kg and 1.6 X 10^{-19} C respectively.
9. A solenoid 60 cm long and of radius 4.0 cm has 3 layers of winding of 300 turns each. A 2.0 cm long wire of mass 25 g lies inside the solenoid (near its centre) normal to its axis: both the wire and the axis of the solenoid are in the horizontal plane. The wire is connected through two leads parallel to the axis of the solenoid to an external battery which supplies a current of 6.0 A in the wire. What value of current (with appropriate sense of circulations) in the windings of the solenoid can support the weight of the wire ?
10. Depict the field-line pattern due to a current carrying solenoid of finite length.
(i) In what way do these lines differ from those due to an electric dipole (ii) Why can't two magnetic field lines intersect each other.
11. How will a dia-, para- and a ferromagnetic materials behave when kept in a non-uniform external magnetic field ? Give one example of each of these materials .
12 .Consider the plane S formed by the dipole axis and the of earth. let P be the point on the magnetic equator and in S. Let Q be the point of intersection of the geographical and magnetic equators. Obtain the declination and dip angles at P and Q.
13. Derive an expression for the torque on a current carrying loop in a uniform magnetic field.



14. Two small identical circular coils marked 1 and 2 carry equal currents and are placed with their geometric axes perpendicular to each other as shown in the figure. Derive an expression for the resultant magnetic field at O.

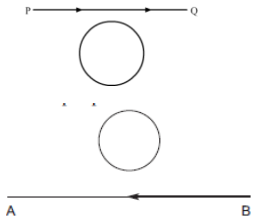
SECTION-D) [FOUR MARKS]

1. Kamal's uncle was advised by his doctor to undergo an MRI scan test of his chest and gave him an estimate of the cost. Not knowing much about the significance of this test and finding it to be too expensive he first hesitated. When Kamal learnt about this, he decided to take help of his family, friends and neighbors and arranged for the cost. He convinced his uncle to undergo this test so as to enable the doctor to diagnose the disease. he got the test done and the resulting information greatly helped the doctor to give him proper treatment.
(a) What, according to you, are the values displayed by Kamal, his family, friends and neighbors?
(b) Assuming that the MRI scan test involved a magnetic field of 0.1 T, find the maximum and minimum values of the force that this field could exert on a proton moving with a speed of 104 ms–1. State the condition under which the force can be minimum.

UNIT-IV [ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENTS]

SECTION-A [1 MARK]

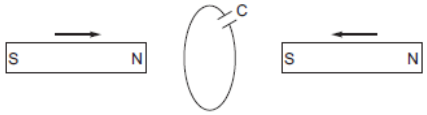
1. Define the term 'wattles current'
2. What is the function of step -up transformer?
3. When alternating current is passed through a moving coil galvanometer, it shows no deflection, why?
4. How can the power factor of a series LCR circuit be improved? Suggest any one method.
5. The power factor of an a.c circuit is 0.5. What will be the phase difference between voltage and current in this circuit?
6. When a lamp is connected to an alternating voltage supply, it lights with the same brightness as when connected to a 12V DC battery .What is the peak value of alternating voltage source?
7. A bulb and a capacitor are connected in series to an a.c source of variable frequency .How will the brightness of the bulb change on increasing the frequency of the a.c source? Give reason.
8. A conducting loop is held above a current carrying wire 'PQ' as shown in the figure. Depict the direction of the current induced in the loop when the current in the wire PQ is constantly increasing.



9. The electric current flowing in a wire in the direction from B to A is decreasing.Find out the direction of the induced current in the metallic loop kept above the wire as shown.
10. The peak value of emf in a.c. is E_o. Write its (i) rms and (ii) average value over a complete cycle.
11. Define the self-inductance of a coil. Write its SI units.
12. State Faraday's law of electromagnetic induction.

(SECTION-B) (TWO MARKS)

1. State the underlying principle of a transformer. How is the large scale transmission of electric energy over long distance done with the use of transformers?
2. What are eddy currents ? Write any two applications of eddy currents.
3. Two identical loops ,one of copper and other of aluminum, are rotated with the same angular speed in the same magnetic field. Compare (i) the induced emf and (ii) the current produced in the two coils. Justify your answer.
4. Prove that an ideal inductor does not dissipate power in an a.c. circuit.
5. Write the expression for frequency of an ideal LC circuit. In an actual circuit, why do the oscillations ultimately die away?
6. Define mutual inductance between two long co-axial solenoid .Find out the expression for the mutual inductance of inner solenoid of length l having the radius r_1 and r_2 and the number of turns n_1 per unit length due to the second outer solenoid of same length and n_2 number of turns per unit length.
7. A current induced in coil c_1 due to the motion of current carrying coil c_2 (a) write any two ways by which a large deflection can obtained in the galvanometer G .(b) Suggest an alternative device to demonstrate the induced current in place of galvanometer.
8. Magnetic flux of 5 μWb is linked with a coil, when a current of 1mA flows through it .What is the self-inductance of the coil.
9. Explain the principle in which a metal detector used at airports for security reasons works.
10. Write two advantages of a.c over d.c
11. An inductor `L' of reactance $X_L$, is connected in series with a bulb `B' to an a.c. source. Briefly explain how does the brightness of the bulb change, when (i) numbers of turns of the inductor is reduced and (ii) a capacitor of reactance $X_C = X_L$ is included in series in the same circuit.
12. Two bar magnets are quickly moved towards a metallic loop connected across a capacitor 'C'as shown in the figure. Predict the polarity of the capacitor.



13. A rod of length 50 cm moving horizontally at a speed of 10m/s at a place where earth vertically component is 0.4G. Find the potential difference produced at the end of rod
14. Prove that an ideal capacitor, in an a.c. circuit does not dissipate power.
15. Derive an expression for the impedance of an a.c. circuit consisting of a capacitor and a resistor.
16. Define mean value of AC(over a half cycle) and derive an expression for it.
17. Define RMS value of AC and derive an expression for it.
18. Show that the average value of AC over a complete cycle is zero.

(SECTION-C) [3 MARKS]

1. An inductor of unknown value, a capacitor of 100mF and a resistor of 10W are connected in series to a 200 V, 50 Hz a.c. source. It is found that the power factor of the circuit is unity. Calculate the inductance of the inductor and the current amplitude.
2. How are eddy currents produced? In what sense are eddy currents considered undesirable in transformer and how are these reduced in such device?

3. A coil of number of turns N , area A , is rotated at a constant angular speed ω, in a uniform magnetic field B, and resistor R .Deduce expression for ;(i) Maximum emf induced in the coil (ii) power dissipation in the coil .
4. Define self inductance ? Find self inductance of coil of N number of turns having radius R. Derive the energy stored in a inductor.
5. State Faraday's laws of electromagnetic induction. Hence show that the magnitude of motional e.m.f across a straight wire is | e | = B lv, where e, B ,l ,v have their usual meanings.
6.A square loop of side 12 cm with its sides parallel to X and Y-axes is moved with a velocity of 8 cm/s in positive x-direction in an environment containing a magnetic field in the positive z-direction. The field is neither uniform in space nor constant in time. It has a gradient of 10^{-3} T/cm along negative x-direction,. Find the emf and magnitude of the induced current in the loop if its resistance is 4.5 m Ω.
7. With the help of phase diagram derive the expression for impedance in a a.c circuit containing a resistor and an inductor. Find the phase difference of emf and current.
8..A metallic rod of length l is rotated at an angular speed ω ,normal to uniform magnetic field B. Derive expressions for the (i) emf induced in the rod (ii) heat dissipation , if the resistance of the rod is R.
9. .A series LCR circuit is connected to an a.c. source. Using phasor diagram , derive the expression for the impedance of the circuit. Plot a graph to show the variation current with the frequency of the source, explaining the nature of its variation.
10. How is the mutual inductance of a pair of coils affected when: (i) separation between the coils is increased (ii) the number of turns of each coil is increased (iii) a thin iron sheet is inserted between the two coils ,other factors remaining the same. Explain your answer in each case.
11. Show that energy remains conserved during LC oscillations in an ideal LC circuit.
12. State Lenz' Law and show that it is in accordance with the law of conservation of energy.
13. Use Lenz' law to find the direction of induced emf in a coil when (a) a north pole is brought towards the coil (b) north pole taken away from the coil (c) A south pole is brought towards the coil and (d) a south pole is taken away from the coil, Draw illustrations in each case.
14. Explain the working of (a) Electromagnetic Brakes (b) Induction Furnace
15. Which physical quantity is called the INERTIA OF ELECTRICITY? Why is its called so?
16. Show that the current and voltage are in phase in an ac circuit containing resistance only.
17. Deduce the phase relationship between current and voltage in an ac circuit containing capacitor only.
18. Distinguish between resistance, reactance and impedance.
19. Define quality factor (Q factor) of resonance and derive an expression for it.
20. Describe the various losses in a transformer and explain how the losses can be minimized.
21. Draw a plot showing the variation of the current I as a function of angular frequency 'ω' of the applied ac source for the two cases of a series combination of (i) inductance L_1, capacitance C_1 and resistance R_1 and (ii) inductance L_2, capacitance C_2 and resistance R_2 where $R_2 > R_1$. Write the relation between L_1, C_1 and L_2, C_2 at resonance. Which one, of the two, would be better suited for fine tuning in a receiver set? Give reason
22 Explain the term 'Inductive reactance'. Show the graphically the variation of inductive reactance with the frequency of the applied alternating voltage. An a.c. voltage E=Eosin ωt is applied across a pure inductor of inductance L. Show mathematically that the current flowing through it lags behind the applied voltage by a phase angle of $\pi/2$.
23. Describe briefly, with the help of a labelled diagram, working of a step-up transformer. A step-up transformer converts a low voltage into high voltage. Does it not violate the principle of conservation of energy? Explain.

SECTION-D (4 MARKS)

1 .Pooja went to the market with her mother and decided to come back home by metro. At Metro station they were made to pass through a gate way for security check. Pooja passed through it and was waiting for her mother to come. She heard a long beep when her mother passed through metal detector. Pooja was confused why metal detector beeped in case of her mother. She asked the duty staff, who explained her in detail. Both were satisfied with the security system.

- What values are displayed by pooja ?
- What is cause of sound through metal detector?
- Write the Principle on which a Metal detector works.

SECTION-E (5 MARKS)

1. (a)Derive an expression for the average power consumed in a series LCR circuit connected to a.c. source in which the phase difference between the voltage and the current in the circuit is Φ.
(b) Define the quality factor in an a.c. circuit. Why should the quality factor have high value in receiving circuits? Name the factors on which it depends.

2. An inductor 200 mH, capacitor 500 mF, resistor 10W are connected in series with a 100 V, variable frequency a.c. source. Calculate the (i) frequency at which the power factor of the circuit is unity. (ii) current amplitude at this frequency. (iii) Q-factor.
3 .Describe briefly, with the help of a labelled diagram, the basic elements of an AC generator. State its underlying principle. Show diagrammatically how an alternating emf is generated by a loop of wire rotating in a magnetic field. Find the expression for the instantaneous value of the emf induced in the rotating loop.

4. A series LCR circuit is connected to an ac source having voltage $v = v_m \sin \omega t$. Derive the expression for the instantaneous current and its phase relationship to the applied voltage. Obtain the condition for resonance to occur. Define 'power factor'. State the conditions under which it is (i) maximum and (ii) minimum.
5.(a) What do you understand by sharpness of resonance in a series LCR circuit ? Derive an expression for Q-factor of the circuit.
(b) Three electrical circuits having a.c. sources of variable frequency are connected to a capacitor, inductor and resistor independently. If the frequency of the a.c. source is increased, how will the current flowing in these circuits be affected? Give reason for your answer.
6. When an alternating voltage of 200V is applied across a device X, a current of 0.5A flows through the circuit and is in phase with the applied voltage. When the same voltage is applied across another device Y the same current flows through the circuit but it leads the applied voltage by π/2 rad. (a) Name the devices X and Y. (b) Calculate the current flowing in the circuit when same voltage is applied across the series combinations of X and Y.

Unit-V (E.M.WAVES)

SECTION-A[1MARKS]

1. How are X- rays produced.
2. Write the following radiations in ascending order in respect of their frequencies ; X-ray , microwave , UV rays and radio waves .
3. Name the electromagnetic radiations which can be produced by klystron or a magnetron valve.
4. Which part of electromagnetic spectrum is used in radar system?
5. How micro waves produced. Name the part of the electromagnetic spectrum of wavelength 10^{-2} m and mention its one application.
6. Welders wear special goggles or face masks with glass windows to protect their eyes from electromagnetic radiations. Name the radiations and write the range of their frequency.
7. Rearrange the following radiation in order of decreasing frequency. UV,X ray and Microwave Which radiation is used to (i) check currency (ii) TV communication.
8. A plane electromagnetic wave of frequency 25 MHz travels in a free space along the X- direction. At a particular point in space and time the electric field is E=6.3 J V/m .Calculate B at this point.
9. Draw sketch of a plane electromagnetic wave propagating along the z-direction .Depict clearly the directions of electric and magnetic fields varying sinusoidally with z.
10. What are the directions of electric and magnetic fields vectors relative to each other and relative to the direction of propagation of electromagnetic waves ?
11. How are radio waves produced ?
12. What is common between different types of e.m. radiations ?

SECTION-B [2 MARKS]

1. List any four characteristics of an electromagnetic wave .
2. Draw a sketch of a plane electromagnetic wave propagating along z-direction . Depict clearly the directions of electric and magnetic fields varying sinusoidal with z.
3. When an ideal capacitor is charged by a dc battery, no current flows. However when an a.c. source is used, the current flows continuously. How does one explain this, based on the concept of displacement current?
4. A parallel plate capacitor is being charged by a time varying current. Explain briefly how Ampere's circuital law is generalized incorporate the effect due to the displacement current.
5. What is meant by the transverse nature of electromagnetic waves ? Draw a diagram showing the propagation of an electromagnetic wave along the x-direction, indicating clearly the directions of the oscillating electric and magnetic fields associated with it.

SECTION-C [3MARKS]

1. Write order of frequency range and one use of each of the (i) Micro waves (ii) Ultra –violet rays(iii)Gamma rays.
2. Give reason of the following (i) The small ozone layer on top of the stratospheric is crucial for human survival.
(ii) Long distance radio broadcasts use short wave bands (iii) Satellites are used for long distance TV transmission .

3. The oscillating electric field in a plane electromagnetic wave is given by $E_Y = 30 \sin (2\times10^{11} t + 300 \pi x)$ V m^{-1}

(i) Calculate the wavelength of the electromagnetic wave. (ii) Write down the expression for the oscillating magnetic field.

4. Name the following constituent radiations of electromagnetic spectrum which

(i) produce intense heating effect. (ii) is absorbed by the ozone layer in the atmosphere.

(iii) is used for studying crystal structure. Write one more application for each of these radiations.

5. Name the constituent radiation of electromagnetic spectrum which: (i) Produce intense heating.

(ii) Is similar of the radiations emitted during decay of a radioactive nucleus, (iii) Is absorbed from sunlight by ozone layer.

6(a) Draw a diagram showing the propagation of an electromagnetic wave along X-direction indicating clearly the directions of oscillating electric and magnetic fields associated with it.

(b) Name the constituent radiation of electromagnetic spectrum which: (i)Produce intense heating

(ii) Is similar of the radiations emitted during decay of a radioactive nucleus, (iii) Is absorbed from sunlight by ozone layer.

7: Give one use of each of the following:

(a) Microwave (b) Infrared waves (c) ultra-violet radiations (d) Radio-waves (e) X-ray (f) √-rays

8 Give reasons for the following: a) Long distance radio broadcasts use short wave bands. b) Satellites are used for long distance TV transmission c) The small ozone layer on the top of the stratosphere is crucial for human survival.

.9. Explain the inadequacy of Ampere's circuital law

10. Describe Hertz experiment to demonstrate the production of electromagnetic waves

11. Write the properties of electromagnetic waves.

12. Write any five electromagnetic waves in the order of decreasing frequency and write any two properties and uses of each

13. Deduce an expression for velocity of em waves in vacuum

14 Establish the transverse nature of electromagnetic waves.

15 Compare the properties of electromagnetic waves and mechanical waves

UNIT-VI:OPTICS

(SECTION-A) [1 MARK]

1.A glass lens of refractive index 1.5 is placed in a through of liquid. What must be the refractive index of the liquid in order to make the lens disappear.

2. If the angle between the pass axis of polariser and the analyser is 45°, write the ratio of the intensities of original light and the transmitted light after passing through the analyzer.

3. Unpolarized light is incident on a plane surface of refractive index μ at angle i. If the reflected light gets totally polarised, write the relation between the angle i and refractive index μ.

4. At what angle of incidence should a light beam strike a glass slab of refractive index $\sqrt{3}$, such that the reflected and the refracted rays are perpendicular to each other?

5. A concave lens of focal length -20 cm is cut into two identical plano concave lens . What is the focal length of each part?

6. Violet light is incident on a thin convex lens. If this light is replaced by red light, explain with the reason how the power of the lens would change?

7. Under what condition two rays will converge by a convex mirror ?

8. Why does the bluish colour predominate in a clear sky ?

9. Differentitate between a ray and a wave front .

10. State with reason why two independent sources of light cannot be considered as coherent sources .

11. State the criteria for the phenomenon of total internal reflection of light to take place.

12. How does focal length of a lens change when red colour light incident on it is replaced by violet light ? Give reason for your answer.

13. Which of the two main parts of an optical fiber has a higher value of refractive index?

14.Can absolute value of refractive index of a medium be less than unity ?

SECTION-B [TWO MARKS]

1. Using the lens formula show that an object placed between its optical centre and the focus of a convex lens produces a virtual and enlarged image .

2. A person looking at a person wearing a shirt with a pattern comprising vertical and horizontal lines is able to see the vertical lines more distinctly than the horizontal lines .What is this defect due to ? How is such defect of vision corrected?

3. What type of wave front will emerge from a (i) point source, and (ii) distant light source?

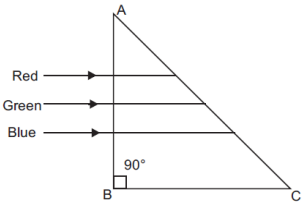
4. How is the pattern in a double slit experiment related to diffraction from each slit ?

5. How does diffraction limit the resolving power of an optical instrument ?

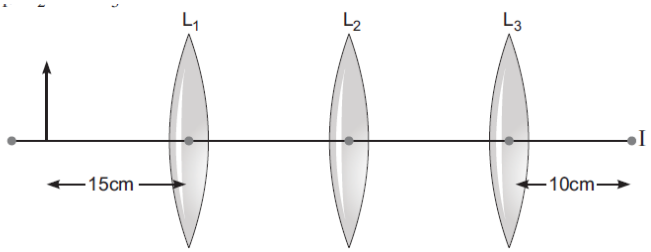
6. How does the angular separation of interference fringes change, in Young's experiment, if the distance between the slits is increased?
7. Two Polaroid's P_1 and P_2 are 90° to each other. A third Polaroid P_3 is placed between P_1 and P_2 bisecting the angle between them. If the intensity of un Polaroid beam is I_0 then find the intensity of transmitted beam through P_3 and P_2.
8. A concave lens of focal length 15 cm in air is immersed in water whose refractive index is 1.4. Find the apparent change in the focal length of the lens.
9. For a ray of light travelling from a denser medium of refractive index n_1 to a rarer medium of refractive index n_2 , Find the critical angle for the pair of media.
10 .What are coherent sources of light? State two conditions for two light sources to be coherent.
11. What is plane polarised light? Two polaroids are placed at 90° to each other and the transmitted intensity is zero. What happens when one more polaroid is placed between these two, bisecting the angle between them ? How will the intensity of transmitted light vary on further rotating the third Polaroid ?
12. If a light beam shows no intensity variation when transmitted through a polaroid which is rotated, does it mean that the light is unpolarised ? Explain briefly
13.A ray is to be deviated through 90^o by a right angled isosceles prism . What should be the minimum refractive index of the material of the prism.

SECTION-C (THREE MARKS)

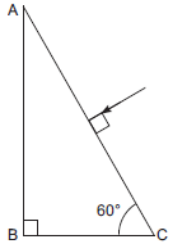
1. Draw a ray diagram of a reflecting type telescope. State two advantages of this telescope over a refracting telescope.
2 .A ray of light passing through an equilateral triangular glass prism from air undergoes minimum deviation When angle of incidence is 3/4th of the angle of prism. Calculate the speed of light in the prism.
4 .A convex lens of focal length 20 cm is placed coaxially with a convex mirror of radius of curvature 20 cm. The two are kept 15 cm apart. A point object is placed 40 cm in front of the convex lens. Find the position of the image formed by this combination. Draw the ray diagram showing the image
5. In the figure given below, light rays of blue, green, red wavelengths are incident on an isosceles right-angled prism. Explain with reason, which ray of light will be transmitted through the face AC. The refractive index of the prism for red, green, blue light is 1.39, 1.424, 1.476 respectively.



6. You are given three lenses L_1, L_2 and L_3 each of focal length 10 cm. An object is kept at 15 cm in front of L_1, as shown.



The final real image is formed at the focus 'I' of L_3. Find the separations between L_1, L_2 and L_3.
7.A parallel beam of monochromatic light of wavelength 500 nm falls normally on a narrow slit and the resulting diffraction pattern is obtained on a screen 1 m away. It is observed that the first minimum is at a distance of 2.5 mm from the centre of the screen. Find (a) the width of the slit. (b) the distance of the second maximum from the centre of the screen. (c) the width of the central maximum.
8. A beam of light consisting of two wavelengths, 650 nm and 520 nm, is used to obtain interference fringes in a Young's double slit experiment. What is the least distance from the central maximum where the bright fringes due to the both the wavelengths coincide? The distance between the slits is 2 mm and the distance between the plane of the slits and screen is 120 cm.
9. (a) Show, with the help of a diagram, how unpolarised sunlight gets polarised due to scattering
10. With the help of a suitable ray diagram , derive mirrors formula for a concave mirror.
11. Trace the path of a ray of light passing through a glass prism (ABC) as shown in the figure. If the refractive Index of glass is 3, find out of the value of the angle of emergence from the prism.



12 .Define the term 'resolving power' of an astronomical telescope. How does it get affected on (i) increasing the aperture of the objective lens ? (ii) increasing the wavelength of the light used ? Justify your answer in each case.

13.A parallel beam of light of 600 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1.2 m away. It is observed that the first minimum is at a distance of 3 mm from the centre of the screen. Calculate the width of the slit.
14. Draw a labelled ray diagram of a refracting telescope. Define its magnifying power and write the expression for it.
15. Name the device for producing polarised light .Draw a graph showing the dependence of intensity of transmitted light on the angle between polarized and analyser.
16. Explain Polarization of light. Give any one method to produce plane polarized light.
17. A parallel beam of light of wavelength 600 nm is incident normally on a slit of width a .If the distance between the slit and the screen is 0.8 m and the distance of 2nd order maximum from the centre of screen is 1.5 mm, calculate the width of slit.
18. What is a Polaroid? How are they constructed? Mention their important applications.
19. A small bulb is placed at the bottom of tank containing water to a depth of 80 cm. What is the area of the surface of water through which light from the bulb can emerge out? Refractive index of water is 1.33.
20. Derive the lens formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ for a concave lens using the necessary ray diagram
21. How does the resolving power of a compound microscope change when:
(i) Refractive index of the medium between the object and objective lens increases? (ii) Wavelength of radiation used is increased
22. (i) If f = +0.5m,what is the power of the lens ? (ii)The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. Its focal length is 12 cm. what is the refractive of the glass ?(iii) A convex lens has 20 cm focal length in air. What is the focal length in water ? (R.I of air-water = 1.33, air-glass = 1.5.)
23. Using Huygens principle draw a ray diagram showing how a plane wave front gets refracted when it is incident on the surface separating a rarer medium from a denser medium. Hence verify Snell's law of refraction.
24. In a single slit diffraction experiment, the width of the slits made double the original width. How does it affect the and the intensity of the central diffraction pattern ? Explain. Draw a graph showing variation of intensity (I) with the angle (Θ) in single slit diffraction.
25. Why are coherent sources necessary to produce a sustained interference pattern?
In young's double slit experiment using monochromatic light of wavelength λ , the intensity of light at a point on the screen where path difference is λ ,is k units. Find out the intensity of light at a point where path difference is λ/3.
26. Define power of a lens .Write its units. Deduce the relation $1/f = 1/f_1 + 1/f_2$ for two thin lenses kept in contact coaxially.
27. Deduce Lens Maker's formula for a thin biconvex lens .
28. State the essential condition for Rayleigh scattering to occur. Compare the intensity of scattering of light of wavelength 400 nm and 600 nm in the earth's atmosphere. State the reason why the sun looks reddish at sunset and sunrise.
29 .In many experimental set-ups the source and the screen are fixed at a distance say D and the lens is movable. Show that there are two positions for the lens for which an image is formed on screen. Find the distance between these points and the ratio of the image sizes for these two points.
30. Derive an expression for lateral shift and normal shift. On what factors these depend.
31. Define TIR and write the conditions for TIR. Derive a relation between critical angle and the refractive index of the medium. Also explain the working of isosceles prism and optical fiber.
32. Derive the following relation for a real image formed by a convex refracting surface when the object is placed in rarer medium. Also write the assumptions and sign convention used. $-n_1/u + n_2/v = \frac{n2-n1}{R}$
33. Derive the lens formula for concave lens.
34 .Draw a ray diagram to show the image formation in refracting type astronomical telescope in the near point adjustment (when image is formed at LDDV i.e. D=25 cm). Derive an expression for its magnifying power. Why the diameter of objective of telescope should be large
35. Draw a ray diagram to show the image formation in refracting type astronomical telescope in the normal adjustment (when image is formed at infinity). Derive an expression for its magnifying power. How does the magnifying power get affected on increasing the aperture of the objective lens and why?
36. State Brewster's law and prove that the reflected and refracted rays are mutually perpendicular at the angle of polarization.
37. State law of Malus and draw an intensity V/s angle between the plane of transmission of polariser and analyser.

SECTION-D (4 MARKS)

1. One day Chetan's mother developed a severe stomach ache all of a sudden. She was rushed to the doctor who suggested for an immediate endoscopy test and gave an estimate of expenditure for the same. Chetan immediately contacted his class teacher and shared the information with her. The class teacher arranged for the money and rushed to the hospital. On realizing that Chetan belonged to a below average income group family, even the doctor offered concession for the test fee. The test was conducted successfully. **Answer the following questions based on the above information:**

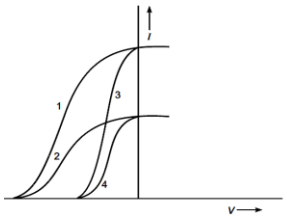
a) Which principle in optics is made use of in endoscopy? (b) Briefly explain the values reflected in the action taken by the teacher. (c) In what way do you appreciate the response of the doctor on the given situation?

SECTION-E [5 MARKS]

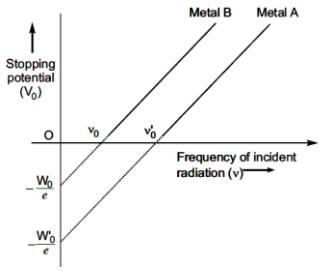
1. (a) In Young's double slit experiment, describe briefly how bright and dark fringes are obtained on the screen kept in front of a double slit. Hence obtain the expression for the fringe width. What is the effect on the fringe width if the whole apparatus (YDSE) is completely immersed in a liquid of refractive index μ?
   (b) The ratio of the intensities at minima to the maxima in the Young's double slit experiment is 9 : 25. Find the ratio of the widths of the two slits.
2. (a) Describe briefly how a diffraction pattern is obtained on a screen due to a single narrow slit illuminated by a monochromatic source of light. Hence obtain the conditions for the angular width of secondary maxima and secondary minima.
   (b) Two wavelengths of sodium light of 590 nm and 596 nm are used in turn to study the diffraction taking place at a single slit of aperture 2×10^{-6} m. The distance between the slit and the screen is 1.5 m. Calculate the separation between the positions of first maxima of the diffraction pattern obtained in the two cases. Draw a plot of intensity distribution and explain clearly why the secondary maxima become weaker with increasing order (n) of the secondary maxima..
3. Draw a ray diagram to show the working of a compound microscope. Deduce an expression for the total magnification when the final image is formed at the near point. Why the diameter of objective of microscope should be small.In a compound microscope, an object is placed at a distance of 1.5 cm from the objective of focal length 1.25 cm. If the eye piece has a focal length of 5 cm and the final image is formed at the near point, estimate the magnifying power of the microscope.
4. (i) Analytically find the condition of maxima and minima when two wave from coherent source overlap with each other.
   (ii)find the ratio of intensities at two point on a screen in young's double slit experiment when waves from the two slits have a path difference wave (a) 0 and (b) $\frac{\lambda}{4}$.

UNIT-VII: DUAL NATURE OF MATTER AND RADIATIONS
SECTION-A [1-MARK]

1. An electron and alpha particle have the same de Broglie wavelength associated with them. How are their kinetic energies related to each other ?
2. The given graph shows the variation of photo-electric current (I) versus applied voltage (V) for two different photosensitive materials and for two different intensities of the incident radiation. Identify the pairs of curves that correspond to different materials but same intensity radiation.



3. The graph shows variation of stopping potential V_0 versus frequency of incident radiation v for two photosensitive metals A and B. Which of the two metals has higher threshold frequency and why?



4. Two metals A and B have work functions 4 e V and 2 e V respectively. Which of them has lower threshold wavelength?
5. A proton and an electron has same kinetic energy. Which one has smaller de Broglie wavelength and why?
6. Define the term 'threshold frequency' in relation to photoelectric effect.
7. The maximum kinetic energy of a photoelectron is 3 e V. What is its stopping potential?
8. If the intensity of incident radiation on a photosensitive surface is doubled, how does the kinetic energy of the emitted electrons get affected.
9. Plot a graph between de Broglie wavelength (λ) of the electrons and accelerating potential (V).
10. Find out work function of the metal, if the kinetic energies of the photoelectrons are E_1 and E_2, with wavelengths of incident light λ_1 and λ_2.
11. Can non metals show photoelectric effect?

SECTION-B [TWO MARKS]

1. Calculate the momentum and de Broglie wavelength of the electrons accelerated through a potential difference of 56 V.
2. An alpha particle and a proton are accelerated from rest by the same potential. Find the ratio of their de-Broglie wavelength.
3. Light of wavelength $2500A^0$ falls on a metal surface of work function 3.5 e v. What is the K.E of (i) Fastest and (ii) slowest electro from the surface n emitted

4. What is maximum kinetic energy of a photoelectron whose Work functions is 2.5 e v if a radiation of 5.2 e v incident on it?
5. Two metals A and B have work function 2 e V and 5 e V respectively .which metal has lower threshold wave length?
6. A proton and an electron have same de-Broglie wavelength which of them moves fast and which possesses more K.E. Justify your answer
7. Sketch a graph between frequency of incident radiations and stopping potential for a given photosensitive material. what information can be obtained from the intercept on the potential axis ?
8 .An electron and a proton are accelerated through the same potential. Which one and the two has greater value of de-Broglie wavelength associated with it and (ii) less momentum? Justify your answer.
9. Point out the two curves for which the incident radiations have same frequency but different intensities.
10. An deuteron and proton have same KE. Which of these particles has the shortest de-Broglie wavelength?
11. Work function of Sodium is 2.3 e V. Does Sodium show photoelectric emission for light of wavelength $6800A^0$?
12. Electrons are emitted from a photosensitive material when it is illuminated by green light but electron emission does not take place by yellow light. Will the electrons be emitted when the surface is illuminated by (i) Red (ii) Blue light? Explain.
13. Ultraviolet radiations of different frequencies v_1 and v_2 are incident on two photosensitive materials having work functions Φ_1 and Φ_2 ($\Phi_1 > \Phi_2$) respectively. The KE of the emitted photoelectrons are same in both cases. Which of the two will be of higher frequency?

SECTION-C [3 MARKS]

1. Plot a graph showing the variation of stopping potential with the frequency of incident radiation for two different photosensitive materials having work functions W_1 and W_2 ($W_1 > W_2$). On what factors does the slope and (ii) intercept of the lines depend?
3. The work function of cesium metal is 2.14 e V. When light of frequency 6×10^{14} Hz is incident on the metal surface, photoemission of electrons occurs. What is the (a) maximum KE of the emitted photoelectrons (b) Stopping potential and (c) Maximum speed of emitted photoelectrons?
4. Write two characteristic features observed in photoelectric effect which do not support the wave picture of electromagnetic radiation.
5. Draw a graph between the frequency of incident radiation (v) and the maximum kinetic energy of the electrons emitted from the surface of a photosensitive material. State clearly how this graph can be used to determine (i) Plank's constant and (ii) work function of the material.
6. In a plot of photoelectric current versus anode potential, how does (i) the saturation current vary with anode potential for incident radiations of different frequencies but same intensity? (ii) the stopping potential vary for incident radiations of different intensities but same frequency?(iii) Photoelectric current vary for different intensities but same frequency of incident radiations? Justify your answer.
7. Write Einstein's photoelectric equation and point out any two characteristic properties of photons on which this equation is based. Briefly explain the three observed features which can be explained by this equation
8. Explain the laws of Photoelectric effect on the basis of Einstein's photoelectric equation i) Define the term stopping potential. (ii) Find the de-Broglie wavelength associated with an electron when accelerated under a potential difference of V volts.
9. A source of light of frequency greater than the threshold frequency is placed at a distance of 1m from the cathode of a photocell. The stopping potential is found to be V. If the distance of the light source from the cathode is reduced ,explain giving reasons, what change will you observe in the (i) photoelectric current, (ii) stopping Potential.
10. Draw the graphs showing the variation of photocurrent with anode potential of a photocell for (i) the same frequencies but different intensities I 1> I 2 > I 3 of incident radiation ,(ii) the same intensity but different frequencies $u_1 > u_2 > u_3$ of incident radiation. Explain why the saturation current is independent of the anode potential.
11. A particle A with a mass m_A is moving with a velocity v and hits a particle B (mass m_B) at rest (one dimensional motion).Find the change in the de Broglie wavelength of the particle A. Treat the collision as elastic.
12. Describe Hertz and Lenard's experiment to demonstrate photoelectric effect.
13. Explain Einstein's photoelectric equation and explain the laws of photoelectric effect using it.
14. State and explain de Broglie relation for matter waves.
15. Draw experimental set up for Davisson- Germer experiment which provided experimental evidence for wave nature of matter . Discuss its result.
16. Write the characteristics of Photon.

UNIT-8: ATOMS AND NUCLEI

SECTION-A [1-MARK]

1.How will the distance of closest approach change when(i) the K.E. of the projectile is doubled (ii) velocity of the projectile is halved ?
2. Define the activity of a given radioactive substance. Write its S.I. unit.
3. Find out the ratio of nuclear densities of O_8^{16} to Fe_{26}^{56}
4. Write any two charteristics properties of nuclear force.

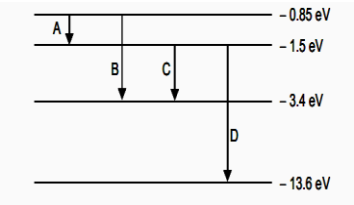
5. How is the mean life of a radioactive sample related to its half life ?
6. What is the significance of negative energy of electron in an orbit ?
7. Write the expression for Bohr's radius in hydrogen atom .
8. Draw a plot of potential energy of a pair of nucleons as a function of their separation. Write two important conclusions. Which you can draw regarding the nature of nuclear forces?
9. With the help of an example explain how the neutron to proton ratio changes during alpha decay of a nucleus .
10. If the nucleons bound in a nucleus are separated apart from each other , the sum of their masses is greater than the mass of the nucleus. Where does this difference come from ? Explain briefly .

SECTION-B (TWO MARKS)

1. The energy of the electron in the ground state of hydrogen atom is – 13. 6 eV .How much energy is required to take an electron in this atom from the ground state to the first excited state?
2. Define 1a.m.u? What is its relation with kilogram?
3. Differentiate between isotones and isobars?
4. Define mass defect and binding energy of nucleus? With binding energy curve in mind, show that why is uranium so unstable.
5. The activity of a radioactive material drops to 1/14 th of its value in 24 hours. Calculate the half-life and the decay constant?
6. Is the mass of electrons obtained by all sources equal?
7. The mass of β-particle is higher than the mass of electrons obtained by other sources, where as β-particles are also electrons.
8. What do you mean by the half life of a radioactive element? Explain half life time and decay constant by drawing a curve between undisintegrated atoms of the element and time?
9. After a certain lapse of time, the fraction of radioactive polonium undecayed is found to be 4.625% of its initial quantity. What is the duration of this time lapse if the half life of polonium is 138 days?
10. How can you show that the nuclear force is very much stronger than Coulomb force?
11. What is activity of a radioactive sample? How can you account for the exponential decay of a radioactive species?
12 Differentiate between the units Becquerel and curie?
13. Explain how radioactive elements can emit β-particles even though atomic nuclei do not contain these particles. Hence explain why the mass number of a radioactive nuclide does not change during β-decay.
14. Why is the mass of nucleus always less than the sum of the masses of its constituents, neutrons and protons?
15. Draw a graph showing the variation of potential energy of a pair of nucleons as a function of their separation. Indicate the regions in which the nuclear force is attractive and repulsive.
16. Prove that the instantaneous rate of change of the activity of a radioactive substance is inversely proportional to the square of its half life?
17. If the total number of protons and neutrons in a nuclear reaction is conserved, how then is the energy absorbed or evolved in the reaction? Explain.
18. The half life of a given radioactive nuclide is 1338.6 days. What is the mean life of this nuclide? After how much time will a given sample of this radioactive nuclide get reduced to only 12.5% of its initial value?

SECTION-C (3-MARKS)

1. The energy level diagram of an element is given below. Identify, by doing necessary calculations, which transition corresponds to the emission of a spectral line of wavelength 102.7 nm.



2. A radioactive nucleus 'A' undergoes a series of decays according to the following scheme :

$$A \xrightarrow{\alpha} A_1 \xrightarrow{\beta} A_2 \xrightarrow{\alpha} A_3 \xrightarrow{\gamma} A_4$$

The mass number and atomic number of A are 180 and 72 respectively. What are these numbers for A_4 ?

3. In an experiment on alpha particle scattering by a thin foil of gold, draw a plot showing the number of particles scattered versus the scattering angle Φ. Why is it that a very small fraction of the particles are scattered at Φ> 90^0?
Write two important conclusions that can be drawn regarding the structure of the atom from the study of this experiment.
4. Derive the expression for the law of radioactive decay of a given sample having initially N_0 nuclei decaying to the number N present at any subsequent time t. Plot a graph showing the variation of the number of nuclei versus the time t lapsed.
Mark a point on the plot in terms of $T_{1/2}$ value when the number present N = N_0 /16
5 .A nucleus $^{23}_{10}\mathrm{Ne}$ undergoes β^- decay and becomes $^{23}_{11}\mathrm{Na}$.
Calculate the maximum kinetic energy of electrons emitted assuming that the daughter nucleus and anti-neutrino carry negligible kinetic energy

$$\left\{\begin{array}{l}\text{mass of } {}^{23}_{10}\mathrm{Ne} = 22.994466\ \text{u} \\ \text{mass of } {}^{23}_{11}\mathrm{Na} = 22.989770\ \text{u} \\ 1\ \text{u} = 931.5\ \text{MeV}/c^2\end{array}\right\}$$

6. The half life of $_6{}^{12}C$ is 5700 years. What does it mean? Two radioactive nuclei P and Q initially contain an equal number of atoms. Their half life is 1 hour and 2 hours respectively. Calculate the ratio of their rates of disintegration after two hours.
7. Using the curve for the binding energy per nucleon as a function of mass number A, state clearly how the release in energy in the processes of nuclear fission and nuclear fusion can be explained.
8. Derive an expression for radius and Total Energy of electron in the nth orbit of Hydrogen atom in Bohr atomic model.
9 .Draw the plot of binding energy per nucleon (BE/A) as a function of mass number A. Write two important conclusions that can be drawn regarding the nature of nuclear force?
Use this graph to explain the release of energy in both the processes of nuclear fission and fusion?
10. Calculate the energy released in Mev in the following nuclear reaction
$_{92}U^{238} \rightarrow {}_{90}Th^{234} + {}_2He^4 + Q$ Mass of $_{92}U^{238}$ =238.05079 u, $_{90}Th^{234}$ =234.043630 u, $_2He^4$ =4.002600u 1u=931.5 Mev
11. Draw a Schematic arrangement of the Geiger-Marsden experiment. How did the scattering of alpha particles by a thin foil of gold provide an important way to determine an upper limit on the size of the nucleus ?
12. Using Bohr's postulates for hydrogen atom, show that the total energy (E) of the electron in the stationary states can be expressed as the sum of kinetic energy (K) and potential energy(U) , where U= -2K.
13. Define the term decay constant and half-life of a radioactive sample. Derive the relation connecting the two. How many disintegrations per second will occur in one gram of $_{92}U^{238}$, if its half-life against alpha decay is 1.42x10 17^s ?
14.A star converts all its hydrogen to helium achieving 100% helium composition. It then converts helium to carbon via the reaction:
$3_2{}^4He \rightarrow {}_2{}^{12}C + 7.27$ MeV
The mass of the star is 5.0 x 10^{30} kg and it generates energy at the rate of 5 x 10^{30} watt. How long will it take to convert all its helium to carbon?

SECTION-D -VALUE BASED QUESTIONS(4 MARKS)

1. For the past some time, Aarti had been observing some erratic body movement, unsteadiness and lack of coordination in the activities of her sister Radha, who also used to complain of severe headache occasionally. Aarti suggested to her parents to get a medical check-up of Radha. The doctor thoroughly examined Radha and diagnosed that she has a brain tumour.
(a) What, according to you, are the values displayed by Aarti?
(b) How can radioisotopes help a doctor to diagnose brain tumour?
2. Muthuswami a resident of Kundakulam was all set to leave everything and shift to another place in view of the decision of Govt. to start nuclear thermal power plant at Kundakulam. His granddaughter Prachi, a science student, was really upset on the ignorant decision of her grandfather. She could finally convince him not to shift, since adequate safety measures to avoid any nuclear mishap have already been taken by the Govt. before starting nuclear thermal plants.
    - What is the value displayed by Prachi in convincing her grandfather ?
    - What is the principle behind working of nuclear reactor ?
    - What are the main components of nuclear reactor ?
    - Why is heavy water used as moderator?

SECTION-E [5 MARKS]

1.Using Bohr's postulates, derive the expression for the frequency of radiation emitted when electron in hydrogen atom undergoestransition from higher energy state (quantum number n_i) to the lower state, (n_f).When electron in hydrogen atom jumps from energystate $n_i = 4$ to $n_f = 3, 2, 1$, identify the spectral series to which the emission lines belong.
2.(a) Use binding energy per nucleon (BE/A) graph to explain the release of energy in both the processes of nuclear fusion and fission.(b) Write the basic nuclear process of neutron undergoing β-decay.
Why is the detection of neutrinos found very difficult?
3 State Bohr's postulates of atomic model. Using this derive the expression for radius, velocity and energy of electron revolving in n^{th} orbit

UNIT-IX:SOLID AND SEMICONDUCTOR DEVICES

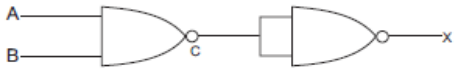
SECTION-A [1 MARK]

1. What happens to the width of depletion player of a p-n junction when it is (i) forward biased, (ii) reverse biased?
2. What is LDR? How it is used for measurement of Intensity of light.
3. Draw a voltage –current characteristic of a zener diode .
4. Why should a photo diode be operated at a reverse bias ?
5. Name one impurity each , which when added to pure Si, produces (i) n-type and (ii) p-type semiconductor.
6. Give the logic symbol of AND gate.

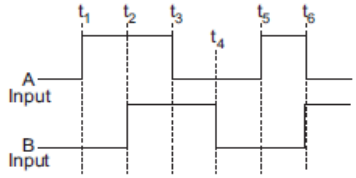
SECTION-B [TWO MARKS]

1. Name the semiconductor device that can be used to regulate an unregulated dc power supply. With the help of I-V characteristics of this device, explain its working principle.

2. Draw the circuit diagram of an illuminated photodiode In reverse bias. How is photodiode used to measure light intensity?
3. A logic gate is obtained by applying output of AND gate to a NOT gate. Name the gate so formed. Write the symbol and truth table of this gate.



4 .Draw a circuit diagram showing the biasing of an LED.
State the factor which controls
(i) Wavelength of light
(ii) Intensity of light emitted by the diode.



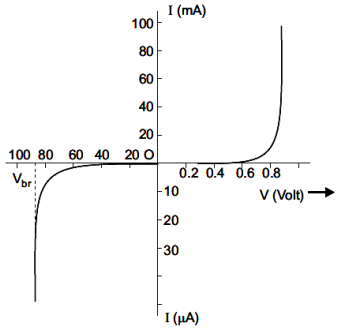
5. C, Si and Ge have the same lattice structure.
Why is C insulator while Si and Ge intrinsic semiconductor
6. Draw the output wave form at X, using the given inputs A, B for the logic circuit shown below.Also identify the gate.
7. Distinguish between an intrinsic semiconductor and P-type semiconductor. Give reason, why a P-type semiconductor crystal is electrically neutral, although $n_h >> ne$?
8. Write any two distinguishing features between conductors, semiconductors and insulators on the basis of energy band diagrams.

SECTION-C [3 MARKS]

1. Draw a labeled diagram of a full wave rectifier circuit. State its working principle. Show the input- output waveforms.
2. Name the important processes that occur during the formation of a p-n junction. Explain briefly, with the help of a suitable diagram , how a p-n junction is formed. Define the term 'barrier potential'.
3. With a circuit diagram ,briefly explain how a zener diode can be used as a voltage regulator.
4. For a CE- transistor amplifier, the audio signal voltage across the collector resistance of 2 kΩ is 2V. Suppose the current amplification factor of the transistor is 100, find the input signal voltage and base current , if the base resistance is 1 kΩ.
5. What is LED ?Mention two important advantages of LEDs over conventional lamps.
6. What are extrinsic semiconductors? Mention its types and explain the mechanism of conduction in each.
7 . Explain the conduction in N Type and P Type semiconductor on the basis of band theory.
8. Explain how the fundamental logic gates can be realised using NAND gates alone.
9. Explain the formation of depletion layer and potential barrier in a PN junction diode
10. With the help of a labeled circuit diagram explain the working of half wave rectifier and draw the input and output waveforms.
11 .Explain the action of a PNP transistor and an NPN transistor.(Explain how conduction takes place in NPN and PNP transistor.)
12. Draw the circuit diagram for determining transistor characteristics and describe the input and output characteristics of transistor in CE configuration with relevant graphs.
13. Draw the symbol, truth table and Boolean expression for OR, AND and NOT gate.
14. Draw the symbol and truth table of NOR gate and NAND gate.
15. Explain, how the fundamental logic gates can be realised using NOR gates alone.

SECTION-D [5MARKS]

1. (a)Differentiate between three segments of a transistor on the basis of their size and level of doping.
(b) How is a transistor biased to be in active state? (c) With the help of necessary circuit diagram, describe briefly how n-p-n transistor in CE configuration amplifies a small sinusoidal input voltage. Write the expression for the ac voltage gain.



2.(a) Draw the circuit diagram of a p-n junction diode in (i) forward bias , (ii) reverse bias.
How are these circuits used to study the characteristics of a silicon diode ?
Draw a typical V-I characteristics .
3 .The figure adjoining shows the V-I characteristics of a semiconductor diode
(i) Identify the semiconductor diode used (ii) Draw the circuit diagram to obtain the given characteristic of this device. (iii) Briefly explain how this diode can be used as a voltage regulator.

UNIT-X:COMMUNICATION SYSTEM

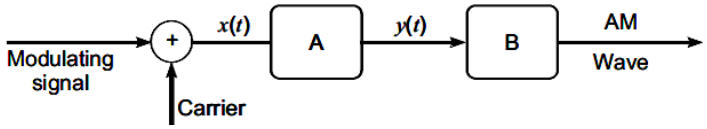
SECTION-A[1 MARK]

1. What is meant by transducer? Give one example of a transducer.
2. What is the function of a 'Repeater' in a communication system?
3 .Why should transmitters broadcasting programmes use different carrier frequencies?
4. Give expression for bandwidth in FM modulation.
5. Define modulation index.
6. Why is the amplitude of modulating signal kept less than the amplitude of the carrier wave ?
7. What is space wave communication? Write the range of frequencies suitable for space wave communication.

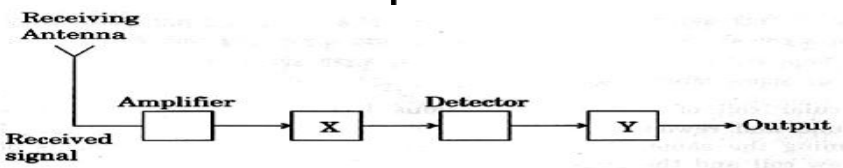
8. What is the range of frequencies used in satellite communication? What is common between these waves and light waves?
9. What is communication system ? Describe briefly the major constituents of a communication system.
10. What is the role of band pass filter in amplitude modulation?

SECTION-B [2 MARKS]

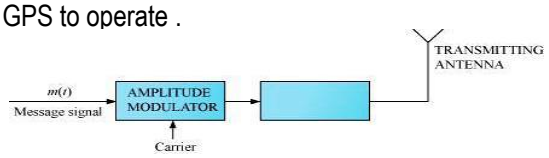
1. Write the functions of the following in communication systems:
   (i) Transmitter (ii) Modulator
2. In the block diagram of a simple modulator for obtaining an AM signal, shown in the figure, identifythe boxes A and B. Write their functions.



3. In the given block diagram of receiver, identify the boxes labelled as X and Y and write their functions.

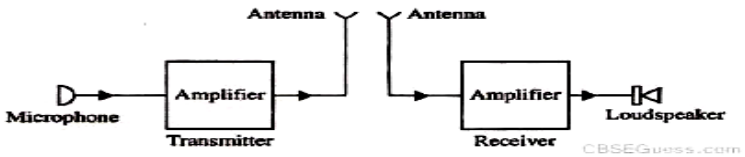


4 .Why ground wave transmission signal is is restricted to only 1500 KHz.
5. What is GPS ? How it is useful? How many minimum satellites are required for GPS to operate .
6. A T.V tower has a height of 500 m at a given place. Calculate its coverage range if the radius of the earth is 6400 Km.
7. Label the unlabeled box in the given figure. Write its function.



SECTION-C [3 MARKS]

1. A transmitting antenna at the top of a tower has a height of 36 m and the height of the receiving antenna is 49 m. What is the maximum distance between them, for satisfactory communication in the LOS mode ? (Radius of earth = 6400 km).
2. What does the term 'LOS communication' mean? Name the types of waves that are used for this communication. Give typical examples, with the help of a suitable figure, of communication systems that use space wave mode propagation..
3. Ground receiver station is receiving a signal at (i) 5 MHz and (ii)100 MHz transmitted from a ground transmitter at a height of 300 m, located at a distance of 100 km from the receiver station. Identify whether the signal is coming via space wave or sky wave propagation or satellite transponder. Radius of earth = 6.4 x 10^6 m. N_{max} of the Ionosphere = 10^{12}/ m^3.
4. A schematic arrangement for transmitting a message signal (20 Hz to 20 KHz) is given below: Give two drawbacks from which this arrangement suffers. Describe briefly with the help of a block diagram the alternative arrangement for the transmission and reception of the message signal.



5. Name three modes of propagation of electromagnetic waves. Explain using a proper diagram the mode of propagation used in the frequency range above 40 MHz.
6. Draw a plot of the variation of amplitude versus ω for an amplitude modulated wave. Define modulation index. State its importance for effective amplitude modulation .
7. Derive an expression for the range of transmission via space wave from a transmitting antenna of height h.
8. Describe radio wave propagation via (a) Ground Wave (b) Space Wave and (c) Sky Wave.
9. What is the need for satellite communication? Elaborate.
10. Explain the need for modulation for long distance transmission.
11. Define amplitude modulation and illustrate it using diagrams (graphs) How it is carried out?
12. What are the advantages and disadvantages of FM over AM?
13. Describe the mechanism of demodulation (detection) of AM Wave using block diagram, circuit diagram and graphical Representation. Why a capacitor is used at the output?
14. Draw a block diagram showing the basic elements in a communication system . Explain the function of each.