Session 2019-2020

CLASS -12

SUBJECT-PHYSICS (042)

ELECTROSTATICS

(Weightage-8 Marks)

Short Answer Type Questions-(2 Marks Each)

1. positive point charge +q is kept in the vicinity of an uncharged conducting plate. Sketch electric field lines originating from the point on the surface of the plate.
2. An electric dipole is held in a uniform electric field.
   (i) Show that the net force acting on it is zero.
   (ii) The dipole is aligned parallel to the field. Find the work done in rotating it through the angle of 180^o.
3. A metallic spherical shell has an inner radius R_1 and outer radius R_2.A charge $Q$is placed at the centre of the spherical cavity. What will be surface charge density on (*i*) the inner surface, and (*ii*) the outer surface?
4. Two isolated metal spheres *A* and *B* have radii *R* and 2*R* respectively,and same charge *q*. Find which of the spheres have greater energy density just outside the surface of the spheres.
5. Two infinitely large plane thin parallel sheets having surface charge densities σ_1 and $\sigma_2(\sigma_1 > \sigma_2)$ are shown in the figure. Write the magnitudes and directions of the net fields in the regions marked ll and lll.
6. Find an expression for the electric field strength at a distant point situated (*i*) on the axis and (*ii*) along the equatorial line of an electric dipole.
7. Two charges *q* and -3*q* are placed fixed on x-axis separated by distance '*d*'. Where should a third charge 2*q* be placed such that it will not experience any force?

A charge is distributed uniformly over a ring of radius '*a'*. Obtain an expression for the electric intensity E at a point on the axis of the ring. Hence show that for points at large distances from the ring, it behaves like a point charge.

8. Two point charges, $q_1 = 10\times10^{-8}$C and $q_2 = -2\times10^{-8}$C are separated by a distance of 60 cm in air.
   a. Find at what distance from the q_1, would the electric potential be zero.
   b. Also calculate the electrostatic potential energy of the system.
9. Two capacitors of capacitance 6µF and 12µF are connected in series with a battery. The voltage across the 6µF capacitor is 2V. Compute the total battery voltage.
10. An electric dipole is free to move in a uniform electric field. Explain its motion when it is placed (i) parallel to the field, (ii) perpendicular to the field

11. An electric dipole of length 10 cm having charges $\pm 6\times10^{-3}$ C, placed at 30^0 with respect to a uniform electric field experiences a torque of $6\sqrt{3}$ N-m. Calculate

    (i) Magnitude of electric field (ii) the potential energy of the dipole.

12. Electric charge is distributed uniformly on the surface of a spherical rubber balloon. Show how the value of electric intensity and potential vary

    (i) on the surface (ii) inside and (iii) outside?

13. State and prove Gauss's theorem in electrostatics.

14. Explain the underlying principle of working of a parallel plate capacitor. If two similar plates, each of area A having surface charge densities $+\sigma$ and $-\sigma$ are separated by a distance'd' in air, write the expressions for (i) The electric field at points between the two plates.

(ii) The potential difference between the plates.

(iii) The capacitance of the capacitor so formed.

8. A 20 μF capacitor is charged by a 30 V d.c. supply and then connected across an uncharged 50 μF capacitor. Calculate

(i) the final potential difference across the combination.

(ii) Initial and final energies. How will you account for the difference in energies?

9. The battery remains connected to a parallel plate capacitor and a dielectric slab is inserted between the plates. What will be the effect on its

(i) capacity (ii) charge (iii) potential difference (iv) electric field (v) energy stored?

10. Define the term electric potential due to a point charge. Calculate the electric potential at the centre of a square of side $\sqrt{2}$ m, having charges 100 μC, -50μC, and 20μC and-60μC at the four corners of a square.

11. Three identical charges each +q are placed at the corners of an equilateral triangle of side d cm. Calculate the force on +2q placed at the centroid of the triangle.

12 . Is the capacitance of a capacitor proportional to the charge Q ? Sketch a graph to show how the capacitance C of a capacitor varies with the charge Q given to it.

13. The plates of a parallel plate system are charged up to 100V. A 4mm thickness dielectric slab is inserted between the plates. Then to maintain the same potential difference, the distance between the systems plates are increased by 2mm. find the dielectric constant.

14. A point charge placed at any point on the axis of an electric dipole at some large distance experiences a force F. Find the force acting on the point charge when its distance from the dipole is quadrupled.

15. In the electric field of a point charge ‘q’, the four points A,B,C and D are equidistant from q, however AB>AC>AD. Calculate the work done in taking a unit charge along AB, AC and AD.

Short Answer Type Questions-(3 Marks Each)

1(i). N identical spherical drops charged to the same potential ‘V’ is combined to form a big drop. Find the potential of the new big drop formed.

(ii) An inflated balloon is charged by rubbing with fur. Will it stick readily to a conducting wall or to an insulating wall? Give reason.

2. An electron is projected with an initial speed of 25×10 m/s directly towards a proton which is at rest. Initially the electron is supposed to be at a fairly large distance from the

proton. Find the distance of the electron from the proton when its instantaneous speed becomes twice the initial speed.

3. Two conducting spheres one of radius 6cm and the other of radius 12cm each carrying 3×10^{-6} C are placed very far apart. If these spheres are connected by a conducting wire, find the direction of motion and the magnitude of charge transferred.

4. A solid metal disc of radius 'R' rotates with constant angular velocity about its axis. Calculate the electric field 'E' at a distance 'x' from the axis and the potential difference 'V' between the centre and the edge of the disc.

5. Three charges of +0.1C each is placed at the corners of an equilateral triangle, of 1m side. If energy is supplied at the rate of 1kW, how many days would be required to move one of the charges to the midpoint of the line joining the other two?

6. A parallel plate capacitor is made by stacking 'n' equally spaced plates connected alternatively. If the capacitance between any two plates is 'C', determine the resultant capacitance of the combination.

7. Can you create an electric field in which all the lines of force are parallel but their density increases continuously in a direction perpendicular to the lines of force? Give reason.

8. Can you suggest an arrangement of three point charges separated by some finite distance that has zero electric potential energy?

9. Eight dipoles of charges of equal magnitude are placed inside a cube. Calculate the total electric flux coming out of the cube.

15. Two deuterons are separated by a distance 'r' meter and have coulomb force equal toF. If two alpha particles are separated by a distance of 2r meter, find the force between the alpha particles. Using Gauss's law obtain the expression for the electric field due to a uniformly charged thin spherical shell of radius *R* at a point outside the shell. Draw a graph showing the variation of electric field with r > *R* and r <*R*.
16. (a) Define electric flux. Write its Sl unit.
    (b) Using Gauss's law, prove that the electric field at a point due to a uniformly charged infinite plane sheet is independent of the distance from it.
    (c) How is the field directed if (i) the sheet is positively charged, (ii) negatively charged?
17. Show that the electric field at the surface of a charged conductor is $E = \sigma / \varepsilon_0 n$ where σ is surface charge density and n is a unit vector normal to the surface in the outward direction.
18. A small sphere of radius r_1 and charge q_1 is enclosed by a spherical shell of radius r_2 and charge q_2. Show that if q_1 is positive, charge will necessarily flow from the sphere to the shell (when the two are connected by a wire), no matter, what the charge q_2 on the shell is.
19. Two charged conducting spheres of radii a and b are connected to each other by a wire. What is the ratio of electric fields at the surfaces of the two spheres? Use the result obtained to

explain why charge density on the sharp and pointed ends of a conductor is higher than on its flatter portions.

20. Obtain the equivalent capacitance of the network. For a 300 V supply,determine the charge and voltage across each capacitor.
21. Depict the equipotential surfaces for a system of two identical positive point charges placed a distance '*d*' apart.
22. Draw an equipotential surface for a system consisting of two charges Q,-Q separated by a distance *r* in air. Locate the points where the potential due to the dipole is zero.
23. Plot a graph comparing the variation of potential 'V' and electric field 'E' due to a point charge 'Q' as a function of distance 'R' from the point charge.
24. Derive an expression for the electric potential at a point due to an electric dipole. Mention the contrasting features of electric potential of a dipole at a point as compared to that due to a single charge.
25. Derive an expression for the capacitance of a parallel plate capacitor when a dielectric slab of dielectric constant *K* and thickness t = d/2 but of same area as that of the plates is inserted between the capacitor plates.
26. Derive an expression for equivalent capacitance of three capacitors when connected (i) in series and (ii) in parallel.
27. Derive an expression for the energy stored in a parallel plate capacitor *C*, charged to a potential difference *V*. hence derive an expression for the energy density of a capacitor.

Long Answer Type Questions (5 Mark Each)-

1. Explain the principle on which Van-de-Graff generator operates. Draw a labeled

schematic sketch and write briefly its working. A Van-de- Graff type generator is capable of building up potential difference of 15×10^6 V. The dielectric strength of the gas surrounding the electrode is 5×10^7 Vm^{-1}. What is the minimum radius of the spherical shell required?

2. An electric dipole is held in a uniform electric field.

(i) Show that no translatory force acts on it.

(ii) Derive an expression for the torque acting on it.

(iii) The dipole is aligned parallel to the field. Calculate the work done in rotating it through 180^0.

3. If one of the electrons of H_2 molecule is removed we get a hydrogen molecules ion H_2^+.In the ground state of a H_2^+ the two protons are separated by roughly 1.5Å and the electron is roughly 1Å from each proton. Determine the potential energy of the system.

4. Three capacitors are connected in series. Obtain the expression for the equivalent capacitance.

When two capacitors are connected in series, the effective capacitance is 2.4μF and when connected in parallel, the effective capacitance is 10μF.Calculate the individual capacitances.

5. What is an electric dipole? Obtain the expression for the electric field at a point lying on the equatorial line of the dipole.

Two fixed charges -2Q and Q are located at the points with co-ordinates (-3a, 0) and (+3a, 0) respectively in the x-y plane. Show that all the points in the x-y plane where the electric potential due to the two charges is zero lie on a circle. Find its radius and location of its centre.

6. Two square metallic plates of side 1.5m are kept 0.015m apart like a parallel plate capacitor, in air in such a way that one of their edges is perpendicular to an oiled surface in a tank filled with insulating oil. The plates are connected to a battery of EMF 600V. The plates are then lowered vertically into the oil at a speed of 0.002m/s. Calculate the current drawn from the battery during the process

7. What is a dielectric? Why does the capacitance of a parallel plate capacitor increase on introduction of a dielectric slab between the plates?
For a parallel plate capacitor, prove that the total energy stored in the capacitor is $1/2CV^2$ and hence derive expression for the energy density of the capacitor.

8. State Gauss theorem. Obtain the expression for the electric field at a point due to a line charge.
A spherical Gaussian surface encloses a charge of 8.85×10^{-8}C.

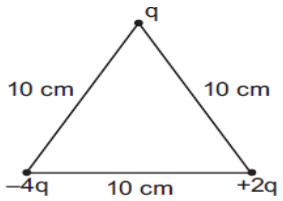
(i) Calculate the electric flux passing through the surface.
(ii) If the radius of the Gaussian surface is doubled, how would the flux change?

9. Apply this theorem to derive an expression for electric field intensity at a point near an infinitely long straight charged wire.
An infinite line charge produces a field of 9×10^4 N/C at a distance of 2 cm. Calculate the linear charge density.

10. Define electric potential. Show that it can be expressed as the line integral of the electrostatic field.

Also derive an expression for the electric potential of a dipole at a point on its axis. Mention the contrasting features of electric potential of a dipole at a point as compared to that due to a single charge.

11. (a) Derive an expression for the torque experienced by an electric dipole kept in a uniformly electric field.
(b) Calculate the work done to dissociate the system of three charges placed on the vertices of a triangle as shown. Here q □ 1□ 6 □ 10□ □ 10

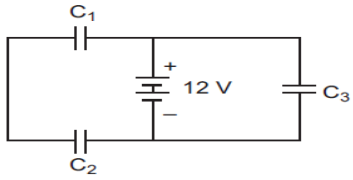


12. Using Gauss's law derive an expression for the electric field intensity at any point near a uniformly charged thin wire of charge/length □ □ C/m.

13 (a) Using Gauss law, derive an expression for the electric field intensity at any point outside a uniformly charged thin spherical shell of radius R and charge density □ □ C/m 2 . Draw the field lines when the charge density of the sphere is (i) positive, (ii) negative.
(b) A uniformly charged conducting sphere of 2□ 5 m in diameter has a surface charge density of 100 □ C/m 2 . Calculatethe
(i) charge on the sphere (ii) total electric flux passing through the sphere.

14 A thin conducting spherical shell of radius R has charge Q spread uniformly over its surface.Using Gauss's law, derive an expression for an electric field at a point outside the shell.Draw a graph of electric field $E(r)$ with distance r from the centre of the shell or $0< R < \alpha$

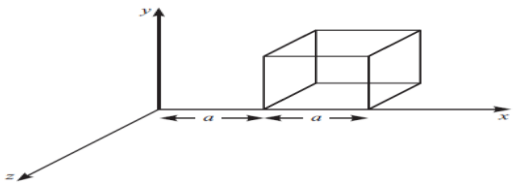
15 Three identical capacitors C_1 , C_2 and C_3 of capacitance 6 mF each are connected to a 12 V battery as shown.
Find:
(i) charge on each capacitor
(ii) equivalent capacitance of the network
(iii) energy stored in the network of capacitors



16 (a) A charge +Q is placed on a large spherical conducting shell of radius R. Another small conducting sphere of radius r carrying charge 'q' is introduced inside the large shell and is placed at its centre. Find the potential difference between two points, one lying on the sphere and the other on the shell.
(b) How would the charge between the two flow if they are connected by a conducting wire? Name the device which works on this fact.

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

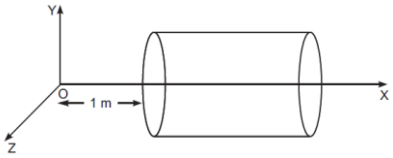
18 State Gauss's law in electrostatic. A cube with each side 'a' is kept in an electric field given by E_X C i(as is shown in the figure) where C is a positive dimensional constant. Find out
(i) the electric flux through the cube, and
(ii) the net charge inside the cube



OR

19 A hollow cylindrical box of length 1 m and area of cross-section 25 cm2 is placed in a three dimensional coordinate system as shown in the figure. The electric field in the region is given by $E\,xi$ □ 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.



20 A capacitor of 200pF is charged by a 300*V* 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 combined system and the initial energy stored in the single capacitor.

OR

21 A capacitor of 150 pF is charged by a 220 V battery. The battery is then disconnected and the charged capacitor is connected to another uncharged capacitor of 50 pF. Calculate the difference between the final energy stored in the combined system and the initial energy stored in the single capacitor.

OR

22 A capacitor of 400pF is charged by a 100*V* 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 combined system and the initial energy stored in the single capacitor.

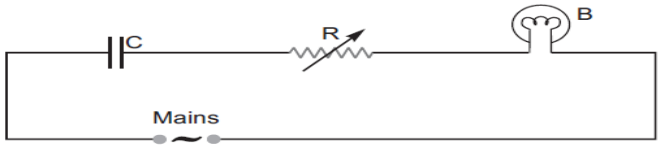
23 A parallel plate capacitor, each of plate area A and separation ‘d’ between the two plates, is charged with charges + Q and – Q on the two plates. Deduce the expression for the energy stored in the capacitor.

24 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/2, 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.

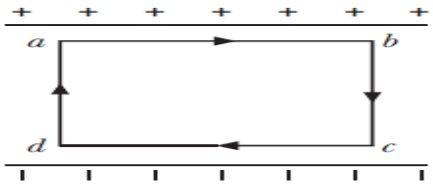
25 A capacitor, made of two parallel plates each of plate area A and separation d, is being charged by an external ac source. Show that the displacement current inside the capacitor is the same as the current charging the capacitor

26 A capacitor of unknown capacitance is connected across a battery of V volts. The charge stored in it is 360 □ C. When potential across the capacitor is reduced by 120 V, the charge stored in it becomes 120 □ C.
Calculate:
(*i*) The potential V and the unknown capacitance C.
(*ii*) What will be the charge stored in the capacitor, if the voltage applied had increased by120V

27 A capacitor ‘C’, a variable resistor ‘R’ and a bulb ‘B’ are connected in series to the ac mains in circuits as shown. The bulb glows with some brightness. How will the glow of the bulb change if (*i*) a dielectric slab is introduced between the plates of the capacitor, keeping resistance R to be the same;(*ii*) the resistor R is increased keeping the same capacitance?



28 (*a*) Obtain the expression for the energy stored per unit volume in a charged parallel plate capacitor.
(*b*) The electric field inside a parallel plate capacitor is *E*. Find the amount of work done in moving a charge *q* over a closed rectangular loop *abcda*.



29 Derive the expression for the electric potential at any point along the axial line of an electric dipole ?

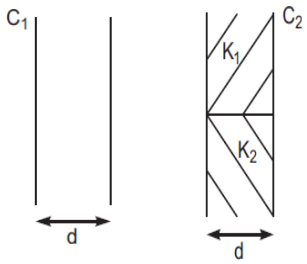
30 (a) Using Gauss law, derive an expression for the electric field intensity at any point outside a uniformly charged thin spherical shell of radius *R* and charge density □ □ C/m 2 . Draw the field lines when the charge density of the sphere is (i) positive, (ii) negative.
(b) A uniformly charged conducting sphere of 2□ 5 m in diameter has a surface charge density of
100 □ C/m 2 . Calculate the (i) charge on the sphere (ii) total electric flux passing through the sphere.

32 Derive an expression for the potential energy of an electric dipole of dipole moment **p** in an electric field **E**

33 Derive an expression for the torque acting on an electric dipole, which is held in a uniform electric field, when the axis of the dipole makes an angle θ with the electric field.

34 Define the term 'electric dipole moment.' Is it scalar or vector?
Deduce an expression for the electric field at a point on the equatorial plane of an electric dipole of length 2*a*.

35 You are given an air filled parallel plate capacitor *C*1. The space between its plates is now filled with slabs of dielectric constants *K*1 and *K*2 as shown in *C*2 . Find the capacitances of the capacitor *C*2 if area of the plates is A and distance between the plates is *d.*



36 An electric dipole is held in a uniform electric field.
(*i*) Show that the net force acting on it is zero.
(*ii*) The dipole is aligned parallel to the field. Find the work done in rotating it through the angle of 180°

UNIT -2

CURRENT ELECTRICITY

Very Short Answer Type Questions(1 mark each)

1. If a wire is stretched to double of its length. What will be its new resistivity?

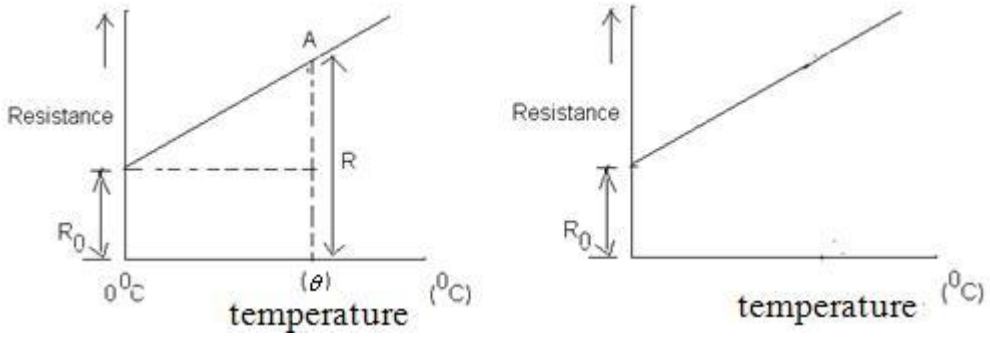
2. Name any one material having a small value of temperature coefficient of resistance. Write one use of this material?

3. Figure shows a piece of pure semiconductor S in series with a variable resistor Rand a source of constant voltage V. Would you increase and decrease the value of R to keep the reading of ammeter (A) constant, when semiconductor S is heated ? Give reasons.

4. The variation of resistance of a metallic conductor with temperature is given in figure.

(a) Calculate the temperature coefficient of resistance from the graph.

(b) State why the resistance of the conductor increases with the rise in temperature.



5. Sketch a graph showing the variation of resistivity of carbon with temperature.

6. If a wire is replaced with another half of its length. What will be its new resistivity?

7. If the potential difference applied across a conductor is doubled, how will the drift velocity of the electrons change?

8. A carbon resistor is marked in red, yellow and orange bands. what is the resistance of the resistor?

9. State the condition in which the terminal voltage across a secondary cell is equal to its emf.

10. Of metals and alloys, which have greater value of temperature coefficient of resistance?

11. Two wires of equal cross sectional area, one of copper other of manganin have the same resistance. Which one will be longer?

12. Two electric bulbs A and B are marked 220 V,60 W and 22-V,100W respectively. Which has greater resistance?

13. What are superconductors?

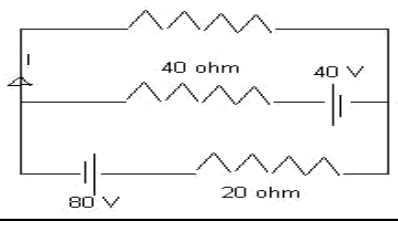
14. What is the effect of heating a conductor on the applied voltage?

15. A student obtains resistances 3,4,12 and 16 ohms using only two metallic resistors either separately or joined together. What is the value of resistance of each of the resistors?

Short Answer Type Questions-(2 Marks Each)

1. A battery of e.m.f E and internal resistance r sends a current I1 and I2, when connected to an external resistance of R1 and R2 respectively .Find the e.m.f. and internal resistance of the battery?

2. Calculate the current I in the given electrical network.



3. Obtain ohm's law from the expression for electrical conductivity.

4 A cylindrical wire is stretched to increase its length by 10% calculate the percentage increase in resistance?

5. Name any one material having a small value of temperature coefficient of resistance. Write one use of this material?

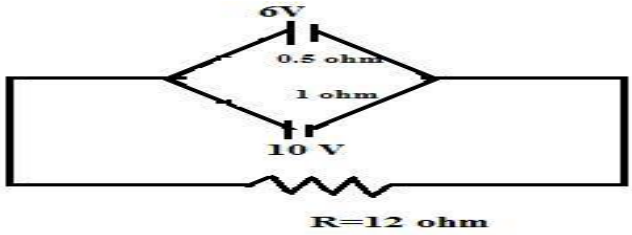
6Explain the principle on which the working of a potentiometer is based.

7. State Kirchhoff's laws for electrical circuits.

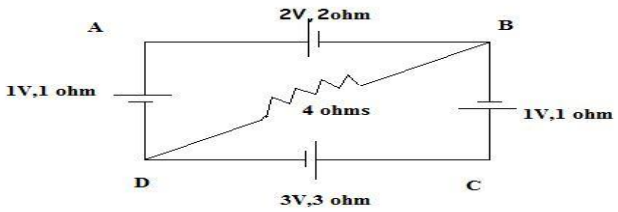
8. Derive the balance condition for a Wheatstone bridge using Kirchhoff's laws.

9. Why is the use of a potentiometer preferred over that of a voltmeter for the measurement of emf of a cell.

10. Determine the current in each branch of the given network. 3



11. For the given circuit, calculate the potential difference between B and D.



12. Explain the term potential gradient.

13. Explain how electron mobility changes for a conductor when the temperature of the conductor is decreased at constant potential difference.

14. How does the electron mobility of a conductor change when applied potential difference is doubled at constant temperature?

15. What is meant by drift velocity? Write its expression.

Short Answer Type Questions-(3 Marks Each)

1.With the help of a circuit diagram explain how the emf of two cells can be compared using a potentiometer

2.A potentiometer wire of length 1m is connected to a driver cell of emf 3V. When a cell of emf 1.5V is used in the secondary circuit the balance point is found to be at 60cm. On replacing this cell by a cell of unknown emf, the balance point shifts to 80cm.(i)calculate the unknown emf of the cell.(ii)explain with reason whether the circuit works if the driver cell is replaced with a cell of 1V.

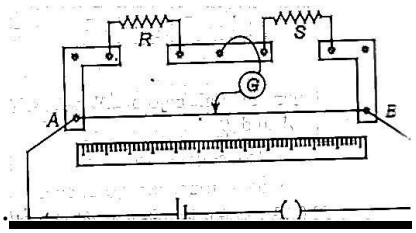
3. A piece of copper and other of germanium from room temperature to 100 K. What will happen to their conductivities?

4. Prove that the current density of a metallic conductor is directly proportional to the drift speed of electrons.

5. With the help of a circuit diagram explain how the internal resistance of a cell can be measured using a potentiometer.

6. In a meter bridge, the null point is found at a distance of 60cm from A .If now a resistance of 5 ohm is connected in series with S, the null point occurs at 50cm

.Determine the value of R and S.



7. Define the term current density of a metallic conductor. Deduce its relation with the conductivity of a conductor, when an electric field E is applied to it.

8. What is electrical conductivity? Calculate it for a conductor of length 3m,area of cross section $0.02m^2$ having a resistance of 2 ohms.

9. In a meter bridge the null point is found at a distance of 33.7 cm from A. If now a resistance of 12 ohms is connected in parallel with S, the null point occurs at 51.9 cm. Determine the values of R and S.

10. A storage battery of 6 lead accumulators of emf 2 V and internal resistance 0.4 ohm is charged by a 100 V dc supply. What series resistance should be used in the charging circuit in order to limit the current to 8A? Also obtain the power dissipated as heat.

28. (i) Derive an expression for drift velocity of free electrons.
    (ii)How does drift velocity of electrons in a metallic conductor vary with increase in temperature? Explain.
23. (a) State Kirchhoff's rules and explain on what basis they are justified.
    (b) Two cells of emfs E_1 and E_2 and internal resistances r_1 and r_2 are connected in parallel. Derive the expression for the (i) emf and (ii) internal resistance of a single equivalent cell which can replace this combination.
24. Using the concept of free electrons in a conductor, derive the expression for the conductivity of a wire in terms ofnumber density and relaxation time. Hence obtain the relation between current density and the applied electric field *E*.
25. Deduce Ohm's law using the concept of drift velocity.
26. Draw the circuit diagram of a potentiometer which can be used to determine the internal resistance (*E*) of a given cell of emf. Describe a method to find the internal resistance of a primary cell.
27. (a) State the principle of working a potentiometer.
    (b) Draw a circuit diagram to compare the emf of two primary cells. Write the formula used. How can the sensitivity of a potentiometer be increased

Long Answer Type Questions (5 Mark Each)

1.Deduce the condition for balance in a Wheat stone bridge. Using the principle of Wheat stone bridge describe the method to determine the specific resistance of a wire .Write two precautions you observe while performing the experiment

2.A battery of emf E and internal resistance r gives a current0.5A with external resistor of 12ohm and current of 0 .25 A with an external resistor of 25 ohm. Calculate (i) internal resistance and(ii)emf of the cell.

3. Give the principle of a potentiometer. With the help of a circuit diagram explain how the emf of two cells can be compared using a potentiometer.

4. State the Joules heating law. A heater coil is rated 100W; 200V.It is cut into two identical parts. Both parts are connected in parallel to the same 200 V source. Calculate the energy liberated per second in the new combination.

5. Describe the construction of a potentiometer. How can you find the internal resistance of a cell, with its help?

6. Derive the formula for the equivalent emf and internal resistance for the parallel combination of two cells with emf e_1 and e_2 and internal resistances $r_1$and r_2 respectively. What is the corresponding formula for the series combination? Two cells of emf 1V and 2V and internal resistances 2 ohms and 1 ohms respectively are connected in series What should be the external resistance in the circuit so that the current through the resistance be the same

7. State Kirchhoff's laws for an electrical circuit.

12 cells each of emf 1.5 V and internal resistance 0.5 ohms, are arranged in m rows each containing n cells in series. Calculate the values of n and m for which this combination would send the maximum current through an external resistance of 1.5 ohms.

8.Deduce Ohm's law using the concept of drift velocity. Plot a graph showing the variation of resistivity with temperature for a metallic conductor.

9.What is meant by resistivity? State the factors on which it depends.

Two wires of same resistivity have the cross-sectional are in the ratio 2:3 and lengths in the ratio 1"2. They are first connected in series and then in parallel to a dc source. Find the ratio of the drift speeds of the electrons in the two wires for the two cases.

10.Obtain the expression for the net resistance when three resistors are connected in (i) series (ii)parallel

A 20 V battery of internal resistance 1 ohms is connected to three resistors of 12,6 and 4 ohms (in parallel) to a resistor of 5 ohms and a reverse battery (emf 8V,internal resistance2 ohms).Calculate (i)the current in the circuit (ii)potential difference across each battery.

UNIT-3

MAGNETISM AND MAGNETIC EFFECTS OF CURRENT

(Weightage-8 Marks)

Very Short Answer Type Questions(1 mark each)-

1.Under what condition is the force acting on a charge moving through a uniform magnetic field minimum?

2.What is the nature of the magnetic field in a moving coil galvanometer?

3.What is the value of angle of dip at a place where the ratio of the vertical component to the horizontal component of the earth's magnetic field is 3?

4.Why do magnetic lines of force prefer to pass through ferromagnetic substances than through air?

5.What is the value of the horizontal component of the earth's magnetic field at the poles

6.Steel is preferred for making permanent magnets whereas soft iron is preferred for making electromagnets. Why?

7.In which direction would a compass needle align if taken to geographical north?

8. A small magnetic needle pivoted at the center is free to rotate in a magnetic meridian. At what place will the needle be vertical?

9.Equal currents are flowing through two infinitely long parallel wires, What will be the magnetic field at a point midway when the currents are flowing in the same direction?

10. A current is passed through a loop of flexible wire. What shape will it take?

11.Name the physical quantity which has the unit J/T. Is it a scalar or a vector quantity?

12. How does the pole strength of each part of a bar magnet change if it is cut into two equal pieces along its length?

13.An electron beam projected along +X axis experiences a force due to the magnetic field along +Y axis. What is the direction of the magnetic field?

14.An electron and a proton having equal momenta, enter a uniform magnetic field at right angles to the field lines. What will be the ratio of the radii of curvature of their trajectories?
\
15. What is the force acting on electron moving parallel to a magnetic field?

Short Answer Type Questions-(2 Marks Each)

1.Define the terms magnetic meridian and geographic meridian

2.Explain the domain theory of magnetism

3.Discuss the equivalence of a current carrying solenoid and a bar magnet.

4.Discuss the action of a current carrying coil as an equivalent magnetic dipole.

5.How are magnetic lines of force different from electric lines of force?

6.Define magnetic susceptibility

7.Compare the properties of an electromagnet and a permanent magnet

8.How a galvanometer is converted into a voltmeter?

9. How a galvanometer is converted into an ammeter?

10.State and prove Amperes circuital law.

11.Which one of the two has a higher resistance-an ammeter or a milli ammater?

12.Show mathematically that the cyclotron frequency does not depend on speed of the particle.

13. Compare Biot Savart law and Ampere's circuital law.

14.Write the expression for the magnetic dipole moment for a closed current loop. Give its S.I unit

15.Sketch the lines of force of the magnetic field around a bar magnet, placed along the magnetic meridian, with its north pole pointing towards the geographical north. Indicate the position of the neutral points.

16. A metallic rod of length *l* is rotated at a constant angular speed □ , normal to a uniform magnetic field *B.* Derive an expression for the current induced in the rod, if the resistance of the rod is *R.*

17.Define magnetic susceptibility of a material. Name two elements, one having positive susceptibility and the other having negative susceptibility. What does negative susceptibility signify ?

When an electron revolves around a nucleus, obtain the expression for the magnetic moment associated with it.

29. Use it to derive an expression for the magnetic field produced at a point near along current carrying wire.
30. Sketch the magnetic field for a circular current loop, clearly indicating the direction of the field.
31. Derive an expression for the magnetic field at a point on the axis of a current carrying circular loop.
32. Using Ampere's circuital law find an expression for the magnetic field at a point on the axis of a long solenoid with closely wound turns.
33. Using Ampere's circuital law, derive an expression for the magnetic field along the axis of a toroidal solenoid.
34. Explain with the help of a labelled diagram construction, principle and working of a cyclotron stating clearly the functions of electric and magnetic fields on a charged -particle. Derive an expression for time period of revolution and cyclotron frequency. Show that it is independent of the speed of the charged particles and radius of the circular path.
35. Derive an expression for the force per unit length between two long straight parallel current carrying conductors. Hence define SI unit is current (ampere).
36. Derive an expression for torque acting on a rectangular current carrying loop kept in a uniform magnetic field B. Indicate the direction of torque acting on the loop.

37. Deduce an expression for magnetic dipole moment of an electron revolving around a nucleus in a circular orbit. Indicate the direction of magnetic dipole moment? Use the expression to derive the relation between the magnetic moment of an electron moving in a circle and its related angular momentum?
38. Draw the labelled diagram of a moving coil galvanometer. Prove that in a radial magnetic field, the deflection of the coil is directly proportional to the current flowing in the coil.
39. Explain, using a labelled diagram, the principle and working of a moving coil galvanometer. What is the function of (i) uniform radial magnetic field, (ii) soft iron core?
40. With the help of a circuit, show how a moving coil galvanometer can be converted into an ammeter of a given range. Write the necessary mathematical formula.

41. Describe the principle construction and working of a cyclotron.

2.Explain the elements of earth's magnetism.

3.Define the terms magnetization and magnetic intensity.

4.Compare the properties of dia , para and ferromagnetic substances.

5.Describe the principle, construction and working of a moving coil galvanometer.

6.Describe the conversion of a galvanometer in to (a)Voltmeter (b) Ammeter

7.Derive an expression for cyclotron frequency

8.What is hysteresis? Draw the hysteresis curve for a magnetic substance and explain the terms retentivity and coercivity. How do these factors help in selecting suitable materials for (a) Permanent magnet (b) Electromagnet

9.Derive an expression for the intensity of magnetic field (a)on the axial position (b) equatorial position.

10.Derive an expression for the torque on a current carrying coil placed in a uniform magnetic field

Long Answer Type Questions (5 Mark Each)-

1.Derive an expression for the potential energy of a magnetic dipole in a uniform magnetic field. What is Bohr magneton? Derive an expression for it and calculate its value.

2.What is a radial magnetic field? Draw diagram to illustrate how is it realized in a moving coil galvanometer. What is the advantage of a radial magnetic field in MCG?

3.Derive an expression for the force between two straight parallel current carrying conductors of infinite length and hence define one ampere.

4.Derive an expression for the force on a current carrying conductor in a uniform magnetic field.

5.Describe the motion of a charged particle that enters into a magnetic field at right angle. Obtain expression for (i) time period (ii) frequency and (iii) angular frequency

6. Find an expression for the force on a moving charge in a magnetic field. State Fleming's left hand rule. Find the force on a moving charge when (i) moving parallel or anti parallel to the field (ii) moving at right angle to the field and (iii) at rest. Also give the definition of unit magnetic field.

7. What is Lorentz force? Give some important characteristics of this force. How can it be used to differentiate the motion of a charged particle in a magnetic field and electric field?

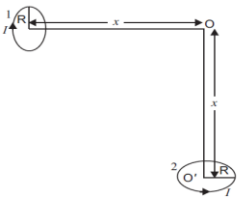
8. Show that the kinetic energy of a charged particle moving in a uniform magnetic field remains constant.

9. Derive an expression for the maximum kinetic energy acquired by a charged particle accelerated in a cyclotron. Why electrons and neutrons cannot be accelerated in a cyclotron?

10. State Ampere's Circuital law and apply it to find the magnetic field at a point due to

(a) A straight conductor carrying current (b) A current carrying solenoid (c) A current carrying toroid

11. (a) Using Biot-Savart's law, derive an expression for the magnetic field at the centre of a circular coil of radius *R*, number of turns *N*, carrying current *I*.
(b) 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*.



OR

12. State Biot-Savart law, giving the mathematical expression for it.
Use this law to derive the expression for the magnetic field due to a circular coil carrying current at a point along its axis.How does a circular loop carrying current behave as a magnet?

13. Draw a schematic diagram of a cyclotron. Explain its underlying principle and working, starting clearly the function of the electric and magnetic fields applied on a charged particle. Deduce an expression for the period of revolution and show that it does not depend on the speed of the charged particle.

OR

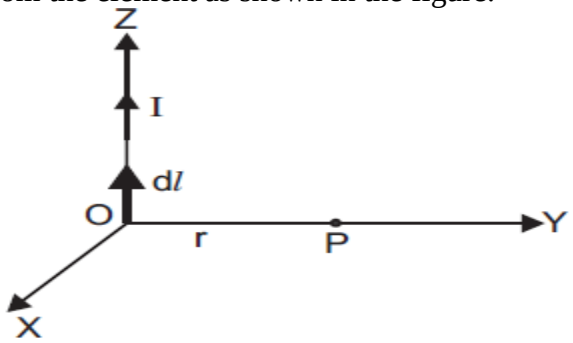
16. With the help of a labelled diagram, state the underlying principle of a cyclotron. Explain clearly how it works to accelerate the charged particles.
Show that cyclotron frequency is independent of energy of the particle. Is there an upper limit on
the energy acquired by the particle? Give reason.

17. 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. 3

18. Using Ampere's circuital law, derive an expression for the magnetic field along the axis of a
toroidal solenoid. 2

19. Distinguish between paramagnetic and diamagnetic substances. A magnetizing field of 1500 A/m produces a flux of 2.4x 10^5 weber in a bar of iron of cross-sectional area 0.5 cm2 . Calculate the permeability and susceptibility of the iron-bar used. 2

20. State Biot-Savart law. 3
A current *I* flows in a conductor placed perpendicular to the plane of the paper. Indicate the direction of the magnetic field due to a small element *d l* at point *P* situated at a distance *r*
from the element as shown in the figure.



21. A long straight wire of a circular cross-section of radius '*a*' carries a steady current '*I*'. The
current is uniformly distributed across the cross-section. Apply Ampere's circuital law to calculate
the magnetic field at a point '*r*' in the region for (*i*) *r* □ □*a* and (*ii*) *r* □ □*a*.

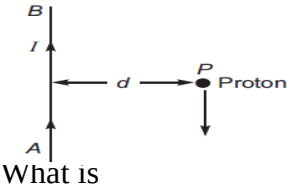
22. State the underlying principle of working of a moving coil galvanometer. Write two reasons why a
galvanometer can not be used as such to measure current in a given circuit. Name any two factors
on which the current sensitivity of a galvanometer depends.

OR

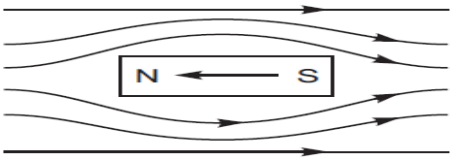
23. (*a*) With the help of a diagram, explain the principle and working of a moving coil galvanometer.
(*b*) What is the importance of a radial magnetic field and how is it produced

(*c*) Why is it that while using a moving coil galvanometer as a voltmeter a high resistance in
series is required whereas in an ammeter a shunt is used?

24. (*a*) Derive an expression for the force between two long parallel current carrying conductors.
(*b*) Use this expression to define S. I. unit of current.
(*c*) A long straight wire *AB* carries a current *I.* A proton
with a speed *v*, parallel to the wire, at a distance *d* from
direction opposite to the current as shown in the figure. What is
the force experienced by the proton and what is its direction?

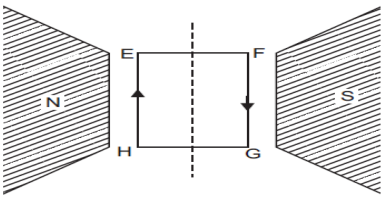


25. (*i*) Magnetic lines of force form continuous closed loops because a magnet is always a dipole 3
and as a result, the net magnetic flux of a magnet is always zero.
(*ii*) When a diamagnetic substance is placed in an external magnetic field, a feeble magnetism is
induced in opposite direction. So, magnetic lines of force are repelled.



26. (*i*) Elements of earth's magnetic field: 3
(*a*) Angle of declination (□) (*b*) Angle of dip (□)
(*c*) Horizontal component of earth's magnetic field (*BH*)
(*ii*) At equator.

27. (a) Two straight long parallel conductors carry currents *I* 1 and *I* 2 in the same direction. 3
Deduce the expression for the force per unit length between them.
Depict the pattern of magnetic field lines around them
(b) A rectangular current carrying loop *EFGH* is kept a uniform magnetic field as shown in the fig.
(i) What is the direction of the magnetic moment of the current loop?
(ii) When its the torque acting on the loop (a) maximum, (b) zero?



28. (a) A galvanometer coil of 50 □ □ resistance shows full scale deflection for a corrent of 5 mA. How
will you convert this galvanometer into a voltmeter of range 0 to 15 V?
(*b*) "Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage
sensitivity." Justify this statement.
(*c*) Outline the necessary steps to convert a galvanometer of resistance *RG* into an ammeter of a
given range.

29. (*a*) Using Ampere's circuital law, obtain the expression for the magnetic field due to

a long
solenoid at a point inside the solenoid on its axis.
(*b*) In what respect is a toroid different from a solenoid? Draw and compare the pattern of the
magnetic field lines in the two cases.
(*c*) How is the magnetic field inside a given solenoid made strong?

30. (*a*) Write the expression for the force, *F*, acting on a charged particle of charge '*q*', moving with a velocity *v* in the presence of both electric field *E* and magnetic field *B*. Obtain the condition under which the particle moves undeflected through the fields.
(*b*) A rectangular loop of size $l \times b$ carrying a steady current I is placed in a uniform magnetic
field B. Prove that the torque τ acting on the loop is given by $\tau = m \times B$
, where m is the magnetic moment of the loop.

UNIT-4

ELECTROMAGNETIC INDUCTION AND AC CURRENT

(Weightage-8 Marks)

Very Short Answer Type Questions(1 mark each)-

1.Why is spark produced in the switch of a fan, when it is switched off

2. Coils in the resistance boxes are made from doubled up-insulated wire. Why?

3. A galvanometer connected in an A.C. circuit does not show any deflection. Why?

4. A capacitor blocks D.C. but allows A.C to pass through it. Explain. Why?

5. Can we use transformer to step up D.C. voltage? If not, why?

6. Calculate the r.m.s value of alternating current shown in the figure.

7. The instantaneous emf of an ac source is given by E= 300 sin 314t.What is the rms value of emf?

8. What is the power factor of an LCR circuit?

9. Why is the core of a transformer laminated?

9. A vertical metallic pole falls down through the plane of magnetic meridian. Will any emf be induced between the ends?

11. The power factor of an ac circuit is 0.5, what will be the phase difference between voltage and current in this circuit?

12. Can a choke be replaced by a capacitor of suitable capacitance?

13. What is the inductance of an inductor that would have a reactance of 50 ohm when used with an ac source of frequency $25/\pi$ kHz.

14. A magnet is moved towards a coil and an electric charge is induced in it. If the resistance of the coil is increased/how will the induced charge change?

15. In India, domestic power supply is at 220 V,50 Hz, while in USA it is at 110 V,50 Hz.

Give its one advantage and one disadvantage.

Short Answer Type Questions-(2 Marks Each)-

1. Write the principle of an a.c. generator.

2. An a.c. generator consists of a coil of 50 turns and area 2.5m2 rotating at an angular speed of 60 rads-1 in a uniform magnetic field B = 0.30 T between two fixed pole pieces. The resistance of the circuit including that of coil is 500 .(i) Find the maximum current drawn from the generator(ii) What will be the orientation of the coil with respect to the magnetic field to have (a) maximum, (b) zero magnetic flux?

3. Would the generator work if the coil was stationary and instead the pole pieces rotated together with same speed as above?

4.How does the self inductance of an air core coil change, when (i) the number of turns in the coil is decreased, (ii) an iron rod is introduced in the coil?

4. A copper coil L wound on a soft iron core and a lamp B are connected to a battery E through a tapping key K. When the key is suddenly opened, the lamp flashes for an instant to much greater brightness. Explain.

5. How is the mutual inductance of a pair of coils affected when:
Separation between the coils is increased?
The number of turns of each coil is increased?

A thin iron sheet is placed between the two coils, other factors remaining the same? Explain your answer in each case.

7. A conducting rod 1 m in length is rotating with a frequency of 50 rev/s about an axis passing through the center of the coil perpendicular to the plane of the coil. A constant magnetic field parallel to the axis is present everywhere. What is the emf between the center and the metallic ring? Given that B = 1T.

8. Two circular coils, one of small radius r1 and the other of very large radius r2 are placed co-axially with centers coinciding. Obtain an expression for the mutual inductance of the arrangement.

9. Evaluate the induced emf in the loop if the wire carries a current of 50 A and the loop has an instantaneous velocity v = 10m/s at the location x = 0.2 m as shown. Take a = 0.1 m and assume that the loop has a large resistance.

10. Two long coaxial solenoids, each of length 'L'. The outer solenoid has an area of cross-section A and number of turns/length n1. The corresponding values for the inner solenoid are A2 and n2.. Write the expression for self inductance L1, L2 of the two coils and their mutual inductance M. Hence show that $M < \sqrt{L1\ L2}$.

11. A rectangular wire frame, shown below, is placed in a uniform magnetic field directed upward and normal to the plane of the paper. The part AB is connected to a spring. The spring is stretched and released when the wire AB has come to the position A'B' (t = 0). How would the induced emf vary with time? Neglect damping.

12 .An armature coil consists of 20 turns of wire, each of area A = 0.09 m^2 and total resistance 15.0 . It rotates in a magnetic field of 0.5T at a constant frequency of $150/\pi$ Hz. Calculate value of (i) maximum (ii) average induced emf produced in coil.

13. Why does metallic piece become every hot when it is surrounded by coil carrying high frequency alternating current?

14. Three students X, Y, and Z performed an experiment for studying the variation of alternating current with angular frequency in a series LCR circuit and obtained the graphs shown below. They all used a.c. sources of the same r.m.s. value and inductances of the same value. What can we (qualitatively) conclude about the (i) capacitance value (ii) resistance values used by them? In which case will the quality factor be maximum? What can we conclude about nature of the impedance of the set up at frequency wo?

15. In the series LCR circuit, R represents an electric bulb. If the frequency of the supply is doubled, how should the values of C and L is changed so that glow in the bulb remains unchanged?

Short Answer Type Questions-(3 Marks Each)

1. An air cored coil L and a bulb B are connected in series to the mains:The bulb glows with some brightness. How would the glow of the bulb change if an iron rod were inserted in the coil? Give reasons in support of your answer.

2. When a circuit element 'X' is connected across an a.c. source, a current of $\sqrt{2}$A flows through it and this current is in phase with the applied voltage. When another element 'Y' is connected across the same a.c. source, the same current flows in the circuit but it leads the voltage by $\pi/2$ radians.(i) Name the circuit elements X and Y. (ii) Find the current that flows in the circuit when the series combination of X and Y is connected across the same a.c. voltage. (iii) Plot a graph showing variation of the net impedance of

3. A light bulb (B) and iron cored inductor connected to a DC battery through a switch

(S). (i) what will one observe when switch (S) is closed? (ii) How will the glow of the bulb change when the battery is replaced by an ac source of rms voltage equal to the voltage of DC battery? Justify your answer in each case.

4. A circuit containing a 80 mH inductor and a 60 μF capacitor in series is connected to a

230 V, 50 Hz supply. The resistance of the circuit is negligible. (a) Obtain the current amplitude and rms values. (b) Obtain the rms values of potential drops across each element. (c) What is the average power transferred to the inductor? (d) What is the average power transferred to the capacitor? (e) What is the total average power absorbed by the circuit? Ans (a) 8.24A, 11.7A (b)V_L=207V,V_C=437V (c)zero (d)zero (e)zero.

5. A series LCR-circuit with L = 0.12 H, C = 480 nF, R = 23 is connected to a 230 V variable frequency supply. (a) What is the source frequency for which current amplitude is maximum? Obtain this maximum value. (b) What is the source frequency for which average power absorbed by the circuit is maximum? Obtain the value of this maximum power. (c) For which frequencies of the source is the power transferred to the circuit half the power at resonant frequency? What is the current amplitude at these frequencies? (d) What is the Q-factor of the given circuit?

Ans (a) 4167 rad s^{-1} , 1.41A (b) 2300 W (c) 648Hz, 678Hz, I_0=10A(d) 21.7

6. An LC-circuit contains a 20 mH inductor and a 50 μF capacitor with an initial charge of 10 mC. The resistance of the circuit is negligible. Let the instant the circuit is closed be t = 0(a) what is the total energy stored initially. Is it conserved during the LC-oscillations? (b) What is the natural frequency of the circuit? (c) At what times is the energy stored? (i) Completely electrical (i.e., stored in the capacitor)? (d) At what times is the total energy shared equally between the inductor and the capacitor? (e) If a resistor is inserted in the circuit, how much energy is eventually dissipated as heat?

7. How does the self inductance of a coil change, when Number of turns in the coil is decreased. An iron rod is introduced into it. Justify your answer in each case.

8. When a series combination of a coil of inductance L and a resistor of resistance R is connected across a 12 V-50 Hz supply, a current of 0.5.A flows through the circuit. The

current differs in phase from applied voltage by $\pi/6$ radian. Calculate the value of L and R.

9. An A.C. generator is connected to a sealed box through a pair of terminals. The box may contain R L C or the series combination of any two of the three elements. Measurements made outside the box reveal that:

$E=75 \sin \omega t$ (in volt) and $I= 1.2 \sin (\omega t+ \pi/2)$(in ampere)
Name the circuit elements
What is the Power factor of the circuit?
What is the rate, at which energy is delivered by the generator to the circuit?

10 Two different coils have self inductance L_1=8 mH and L_2 = 2 mH.

At a certain instant, the current in the two coils is increasing at the same constant rate and the power supplied to the two coils is same. Find the ratio of (a) induced voltage (b) current and (c) energy stored in the two coils at that instant?

Long Answer Type Questions (5 Mark Each)-

1. Explain with the help of a diagram the principle, construction and working of a step up transformer.

2. Does the current in an A.C. circuit lag, lead or remain in phase with the voltage of frequency u applied to the circuit when
(i) $u = u_r$ (ii) $u < u_r$ (iii) $u > u_r$
Where u_r is the resonance frequency.
Obtain the expression for the power dissipation in an ac circuit and hence define the power factor.

3. With the help of a neat diagram explain the principle, construction and working of an ac generator.

4. State the Faradays laws of electromagnetic induction. Circular coil of radius r is placed coaxially with another coil of radius R with the centers of the coils coinciding. Obtain the expression for the mutual inductance of the two coils.

5. What is meant by impedance? Give its unit. Using the phasor diagrams derive the expression for the impedance of a series LCR ac circuit Find the expression for the resonance frequency.

6. Define he rms value of alternating current and derive the relation between rms and peak value of ac.

7. A small town with a demand of 800kWof electric power at 220 V situated at 15 km away from an electric plant generating power at 440V.The resistance of the two wire line carrying power is 0.5 ohms/km. The town gets power from the line through a 4000-220V step down transformer at a substation in the town (i)Estimate the line power loss in the form of heat.

(ii)How much power must the plant supply, assuming no power loss due to the leakage?
(iii)Characterize the step up transformer at the plant.

8. A series LCR circuit with L= 0.12 H, C= 480 nF, R=23 ohms is connected to a 230 V ac
(i) What is the source frequency for which current amplitude is maximum?
(ii) Obtain the current amplitude.
(iii)Find the maximum power.
(iv)What is the Q-factor of the given circuit?

9. Explain the possible causes of energy loss in a transformer? How are these minimized?

10. Deduce an expression for the self inductance of a long solenoid of N turns. How does the self inductance of a coil change, when Number of turns in the coil is decreased?

An iron rod is introduced into it.
Justify your answer in each case

UNIT -5

ELECTROMAGNETIC WAVES

(Weightage-3 Marks)

Very Short Answer Type Questions(1 mark each)-

1. What is displacement current?

2. Can displacement current or a changing electric flux induce a magnetic field? Explain

3. State the important consequences of displacement current.

4. State the important property of displacement current.

5. Write Maxwell's equations of electromagnetism and state the law underlying each equation.

6. Explain what led Maxwell to predict the existence of electromagnetic waves.

7. How are electromagnetic waves represented mathematically?

8. Write the properties of electromagnetic waves.

9. What is electromagnetic spectrum. The frequencies of radio waves in AM broadcast band range from 0.55×10^6 to 1.6×10^6Hz. What are the longest and shortest wavelengths in this band?

10. A plane electromagnetic wave of frequency 25 MHz travels in free space along X – direction. At a particular point in space and time, E = 6.3 j V/m. What is B at this point?

11. How are ÎR rays different from X rays?

12. Write the following radiations in ascending order in respect of their frequencies:

microwaves, X-rays, infra-red rays and radio waves.

13. What modification was made to Ampere's Circuital Law by Maxwell?

14. Which can be polarized –sound waves or electromagnetic waves?

15. What is the ratio of speed of gamma rays and radio waves in vaccum?

Short Answer Type Questions-(2 Marks Each)

1. Name the main parts of the electromagnetic spectrum and mention their frequency range and source of production. Also write their important properties and uses.

2. Discuss the inconsistency in Ampere's Circuital Law.

3. Conduction current and displacement current can be separately discontinuous. But their sum is continuous. Explain.

4. Discuss how an accelerating charge becomes a source of an electromagnetic wave?

5. Describe Hertz’s experiment for producing and detecting electromagnetic waves.

6. Explain how Hertz demonstrated the various properties of electromagnetic waves?

7. Prove the transverse nature of electromagnetic waves mathematically.

8. Why is it that induced electric fields due to changing magnetic flux are more readily observable than the induced magnetic fields due to changing electric fields?

9. A variable frequency AC source is connected to a capacitor. Will the displacement current increase or decrease with increase in frequency?

10. Why sound waves are not considered em waves?

11. What is the phase relationship between the oscillating electric and magnetic fields in an electromagnetic wave?

12. X- Rays and gamma rays have a region of overlapping frequencies and have similar characteristics. But why they are treated as different?

13. Why is the ozone layer of atmosphere crucial to the existence of life on earth?

Short Answer Type Questions-(3 Marks Each)

1.Why does "RADAR" use microwaves?

2.In a microwave oven, the food kept in a closed plastic container get s cooked without melting or burning the plastic container. Explain how?

3.Can an electromagnetic wave be deflected by an electric or magnetic field? Justify your answer.

5. Name the constituent radiation of electromagnetic spectrum which

(a) is used in satellite communication
(b)Is used for studying crystal
structure
(c)Is emitted during decay of radioactive nuclei

(d) is absorbed by ozone layer Write two more uses of each

6. What is the dimension of E/B? Show that the dimensions of are that of electric current

7. The sunlight reaching the earth has a maximum electric field of 810 V/m. What is the maximum magnetic field associated with it?

8. Calculate the relative permittivity of a medium of relative permeability 1.0 if the velocity of light through the medium is 2×10^8 m/s

8 A parallel plate capacitor has circular plates, each of radius 5.0 cm. It is being charged so that electric field in the gap between its plates rises steadily at the rate of 10^{12}V $m^{-1}s^{-1}$. What is the displacement current?

9 The voltage between the plates of a parallel plate capacitor of capacitance 1.0 Î¼F is changing at the rate of 5 Vs^{-1}. What is the displacement current in the capacitor?

10A parallel plate capacitor has two metal plates of size 30 cm X 15 cm and separated by 2.0 mm. The capacitor is being charged so that the charging current has a steady value of 100 mA. Calculate the rate of change of potential difference between the capacitor plates. What is the displacement current between the capacitor plates?

UNIT-6

OPTICS

(Weightage-14 Marks)

Very Short Answer Type Questions(1 mark each)-

1 A plane wavefront is incident normally on a convex lens. Sketch the refracted wavefront

2 What happens to frequency when light travels from one medium to another medium?

3 What happens to the wavelength when light travels from rarer medium to denser medium?

4 What is the phase difference between any two points on a wavefront?

5 The refractive index of a medium is 1.5. What is the angle of refraction, if the unpolarised light is incident on it at the polarizing angle of the medium?

6 What is the value of refractive indices of a medium polarizing along 60°?

7 Light from a point source in air falls on a spherical glass surface (n= 1.5 and radius of curvature = 10 cm). The distance of light source from the glass surface is 200 cm. At what position the image is formed?

8 Define the limit of resolution of a telescope?
9 Give two uses of polaroid.

9. What evidence is there to show that sound is not electromagnetic in nature?

10. To demonstrate the phenomenon of interference , we require two sources, which emits radiations

(a) of nearly same frequency
(b) of same frequency
(c) of different wavelengths
(d) of the same frequency and having a definite phase relationship

12 What happens to the fringe pattern when the Young's double slit experiment is performed in water instead of air?

14 In a two-slit experiment with white light, a white fringe is observed on a screen kept behind the slits. When the screen is moved by 0.05m, what happens to the white fringe?

15What is of the order of the frequency of e-m wave which is best suited to observe a particle of radii 3×10^{-4} cm

16. Name the physical principle on which the working of optical fibers is based

17. What is a dioptre?

18 How does the focal length of a convex lens change if monochromatic red light is used instead of monochromatic blue light?

19 When light undergoes refraction, what happens to its frequency?

20. What are the factors on which the values of refractive index depend?

21 A convex lens and a concave lens, each having focal length 50 cm, are placed in contact. What is the focal length and power of the combination?

22. Define resolving power of a telescope.

Short Answer Type Questions-(2 Marks Each)

1 What are coherent sources of light? Draw the variation of intensity with position in the Young's double slit experiment

2 In a single slit diffraction experiment, if the width of slit is doubled, how does the (i) intensity of light and (ii) width of the central maximum change? Give reason for your answer.

3. How can one distinguish between an unpolarized light beam and a linearly polarized beam using a polaroid?

4. Draw a diffraction pattern due to a single slit illuminated by a monochromatic source of light. Light of wavelength 500 nm falls, from a distance source, on a slit 0.50 mm wide. Find the distance between the two dark bands, on either side of the central bright band of the diffraction pattern observed, on a screen placed 2 m from the slit.

5. State the conditions for obtaining sustained interference of light from different sources. The ratio of intensities of maxima and minima in an interference pattern is found to be 25: 9. Calculate the ratio of light intensities of the sources producing this pattern

6. Define critical angle with reference to the total internal reflection. Calculate the critical angle for glass-air surface, if a ray of light which is incident on the glass surface is deviated through 15^0, when angle of incidence is 45^0.

7. In a single slit diffraction pattern, how does the angular width of central maximum change, when:-

(a) The slit width is decreased.
(b) Distance between the slit and screen is increased.

(c) Light of smaller visible wavelength is
used? Justify your answer in each case.

8. Draw figure shows an experimental set up similar to Young's double slit experiment to observe interference of light. Obtain the condition of (i) Constructive (ii) Destructive, interference at any point P is in terms of path difference.

Does the central fringe observed in the above set up lie above or below O? Give reason in support of your answer.

9. What is meant by interference of light? What are two types of interference?

10.In a double slit experiment with monochromatic light, fringes are observed on a screen placed at some distance from the slits. If the screen is moved by $5x10^{-2}$ m towards the slits, the change in fringe width is $3x10^{-5}$ m. If the distance between the slits is 10^{-3} m, calculate the wavelength of light use

11. What are optical fibers? Give their one use.

12. What is the total focal length of a convex lens of focal length 30 cm in contact with a concave lens of focal length 20 cm? Is the system a converging or a diverging lens? Ignore thickness of the lenses.

13. A small telescope has an objective lens of focal length 144 cm and an eye-piece of focal length 6.0 cm. What is the magnifying power of the telescope? What is the separation between the objective and the eye-piece?

14. Which rays are conveniently chosen to form image of an object by a lens?

15. A convex lens made of a material of refractive index n_1 is kept in a medium of refractive indexn_2 A parallel beam of light is incident on the lens. Complete the path of rays of light emerging from the convex lens if (i) $n_1 > n_2$, (ii) $n_1 = n_2$, (iii) $n_1 < n_2$

Short Answer Type Questions-(3 Marks Each)

1. Define critical angle with reference to total internal reflection. Calculate the critical angle for glass-air surface, if a ray of light which is incident in air on the glass surface is deviated through 15^o , when angle of incidence is (H) 45^o

2. A double concave lens of glass of refractive index 1.6 has radii of curvature of 40 cm and 60 cm. Calculate its focal length in air

3. Where an object should be placed from a converging lens of focal length 20 cm, so as to obtain a real image of magnification 2?

4. Draw a labeled diagram of a compound microscope.

5. .Draw a labeled diagram of an astronomical telescope.

5. What do you mean by resolving power of an optical instrument? Explain.

6. State the reason for the following observations from the surface of the moon-(i) Sky appears dark (ii) Sunrise and sunset are abrupt

7. What is meant by diffraction of light ?How is it different from the interference of light?

8. A thin converging lens has focal length f in air. If it is completely immersed in a liquid, briefly explain how the focal length of the lens varies?

9. The sun is seen a little before it rises and for a short while after it sets. Why?

10. What are the common defects of human eye? Explain any one of them

11. Derive a relation between the object distance, Image distance and the focal length for a concave mirror.

12. What do you mean by the polarization of light and hence discuss Malus law.

13. State Huygens's principle. With the help of a diagram prove Snell's law of refraction.

14. What is sustained interference? Why two independent sources of light can not act as coherent?

Long Answer Type Questions (5 Mark Each)-

1. Obtain the lens makers formula for a thin lens.

A double convex lens made of glass of refractive index 1.5 has both radii of curvature of magnitude 20 cm. An object 2 cm high is placed at 10 cm from the lens. Find the position, nature and size of the image.

2. Draw a ray diagram to show the formation of image of an object placed between the optical centre and focus of the convex lens. Write the characteristics of image formed. Using this diagram, derive the relation between object distance, image distance and focal length of the convex lens. Write the assumptions and convention of signs used.

3. With the help of a diagram obtain the expression for the magnifying power of a compound microscope. How can the magnifying power be increased?

4. With the help of a diagram obtain the expression for the magnifying power of a telescope. How can the magnifying power be increased?

5. Draw a graph showing the variation of the angle of deviation with the angle of incidence through a prism and hence obtain the prism formula.

6. Obtain the expression for the fringe width in Youngs double slit experiment with a well labeled diagram.

7. What is meant by diffractions of light? Find the expression for the fringe within a single slit diffraction phenomenon.

8. Discuss the various methods of polarization of light and hence state Brewster's law.

9. What are myopia and hypermetropia? Give their causes. How are they rectified?

10. Draw a labeled diagram of a Newtonian type reflecting telescope. Give its advantages over refracting type.

11. A converging lens of refractive index 1×5 is kept in a liquid medium having same refractive index.What would be the focal length of the lens in this medium? 1

12. Calculate the distance of an object of height *h* from a concave mirror of focal length 10 1

cm, so as to obtain a real image of magnification 2.

13. Conditions for total internal reflection are:
(*i*) Light must travel from denser to rarer medium.
(*ii*) Angle of incidence must be greater than critical angle (*C*).

14 (*a*) Draw a labelled ray diagram of an astronomical telescope to show the image formation of a distant object. Write the main considerations required in selecting the objective and eyepiece lenses in order to have large magnifying power and high resolution of the telescope.
(*b*) A compound microscope has an objective of focal length 1.25 cm and eyepiece of focal length 5cm. A small object is kept at 2.5 cm from the objective. If the final image formed is at infinity, find the distance between the objective and the eyepiece.
OR

15. Draw a labelled ray diagram of an astronomical telescope, in the normal adjustment position and write the expression for its magnifying power.
An astronomical telescope uses an objective lens of focal length 15 m and eye-lens of focal length 1 cm. What is the angular magnification of the telescope? If this telescope is used to view moon, what is the diameter of the image of moon formed by the objective lens?

16 Draw a plot showing the variation of power of a lens, with the wavelength of the incident light.A converging lens of refractive index 1.5 and of focal length 15 cm in air, has the same radii of curvature for both sides. If it is immersed in a liquid of refractive index 1.7, find the focal length of the lens in the liquid.

17 Draw a labelled ray diagram of a compound microscope and write an expression for its magnifying power.The focal length of the objective and eye-lens of a compound microscope are 2 cm, 6.25 cm respectively. The distance between the lenses is 15 cm. (i) How far from the objective lens, will the object the be kept, so as to obtain the final image at the near point of the eye? (ii) Also calculate its magnifying power.

OR

18 State Huygen's principle. Show, with the help of a suitable diagram, how this principle is used to obtain the diffraction pattern by a single slit.
Draw a plot of intensity distribution and explain clearly why the secondary maxima become weaker with increasing order (*n*) of the secondary maxima.

19 Draw the nature of the wave front after refraction or reflection through
   i. Cocave mirror and lens
   ii. Convex mirror and lens
   iii. Prism
When a plane wave front is incident on them

20 (a) Draw a ray diagram for formation of image of a point object by a thin double convex lens having radii of curvatures *R*1 and *R*2 and hence derive lens maker's formula.
(b) Define power of a lens and give its S.I. units. If a convex lens of focal length 50 cm is placed in contact coaxially with a concave lens of focal length 20 cm, what is the power of the combination?

21 (*a*) Write three characteristic features to distinguish between the interference fringes in Young's double slit experiment and the diffraction pattern obtained due to a narrow

single slit.
(*b*) A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is observed on a screen 1 m away. It is observed that the first minimum is a distance of 2.5 mm away from the centre. Find the width of the slit.

22 In Young's double slit experiment, the two slits 0×15 mm apart are illuminated by monochromatic light of wavelength 450 nm. The screen is 1.0 m away from the slits.
(*a*) Find the distance of the second (i) bright fringe, (ii) dark fringe from the central maximum.
(*b*) How will the fringe pattern change if the screen is moved away from the slits?

23 How does an unpolarised light get polarised when passed through polaroid?
Two polaroids are set in crossed positions. A third polaroid is placed between the two making an angle θ with the pass axis of the first polaroid. Write the expression of the intensity of light transmitted from the second polaroid. In what orientations will the transmitted intensity be (*i*) minimum and (*ii*) maximum?
OR

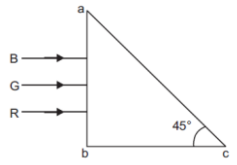
24 (*a*) Describe briefly, with the help of suitable diagram, how the transverse nature of light can be demonstrated by the phenomenon of polarization.
(*b*) When unpolarized light passes from air to a transparent medium, under what condition does the reflected light get polarized?
OR

25 (*a*) How does an unpolarised light incident on a polaroid get polarised?
Describe briefly, with the help of a necessary diagram, the polarisation of light by reflection from a transparent medium.
(*b*) Two polaroids '*A*' and '*B*' are kept in crossed position. How should a third polaroid '*C*' be placed between them so that the intensity of polarised light transmitted by polaroid B reduces to 1/8th of the intensity of unpolarised light incident on *A*?

26 When unpolarised light is incident on the boundary separating the two transparent media, explain, with the help of a suitable diagram, the conditions under which the reflected light gets polarised.Hence define Brewster's angle and write its relationship in terms of the relative refractive index of the two media.

27 How is a wavefront defined ? Using Huygen's construction draw a figure showing the propagation of a plane wave refracting at a plane surface separating two media. Hence verify Snell's law of refraction.

28 Three light rays red *(R)*, green (*G*) and blue (*B*) are incident on a right angled prism '*abc*' at face '*ab*'. The refractive indices of the material of the prism for red, green and blue wavelengths are 1 × 39, 1 × 44 and 1 × 47 respectively. Out of the three which colour ray will emerge out of face '*ac*'?
Justify your answer. Trace the path of these rays after passing through face '*ab*'.



29 (*a*) Draw a ray diagram to show refraction of a ray of monochromatic light passing through a glass prism.
Deduce the expression for the refractive index of glass in terms of angle of prism and angle of minimum deviation.
(*b*) Explain briefly how the phenomenon of total internal reflection is used in fibre optics.
OR

30 (*i*) A ray of monochromatic light is incident on one of the faces of an equilateral triangular prism of refracting angle A. Trace the path of ray passing through the prism. Hence, derive an expression for the refractive index of the material of the prism in terms of the angle minimum deviation and its refracting angle.

31 (*a*) Why are coherent sources necessary to produce a sustained interference pattern?
(*b*) In Young's double slit experiment using monochromatic light of wavelength l, the intensity of light at a point on the screen where path difference is l, is K units. Find out the intensity of light at a point where path difference is l/ 3.

32 (*a*) Use Huygens' geometrical construction to show the behaviour of a plane wavefront.
(*i*) passing through a biconvex lens;
(*ii*) reflecting by a concave mirror.
(*b*) When monochromatic light is incident on a surface separating two media, why does the refracted light have the same frequency as that of the incident light?

33 (*a*) What is the effect on the interference fringes in a Young's double slit experiment when
(*i*) the separation between the two slits in decreased?
(*ii*) the width of the source slit is increased?
(*iii*) the monochromatic source is replaced by a source of white light?
Justify your answer in each case.

34 (a) With the help of a suitable ray diagram, derive the mirror formula for a concave mirror.
(b) The near point of a hypermetropic person is 50 cm from the eye. What is the power of the lens required to enable the person to read clearly a book held at 25 cm from the eye?

UNIT-7

DUAL NATURE OF MATTER AND RADIATION

(Weightage-4 Marks)

Very Short Answer Type Questions(1 mark each)-

1. According to the quantum theory, what happens when the intensity of light increases?

2. If a LASER of power 3.98MW produces a monochromatic light of energy 2.48eV, how many photons per second, on an average, are emitted by the source?

3. Can all photons from a monochromatic light source emit photo-electrons of same kinetic energy?

4. What is maximum frequency of X-rays produced by 30KV electrons?

5. A nucleus of mass M, initially at rest splits into two fragments of masses M'/3 and 2M'/3(M>M'). Find the ratio of de-Broglie wavelengths of two fragments.

6. What does the slope of the Graph between frequency v/s stopping potential represent?

7. What is the nature of graphical relation between frequency of incident radiation and the stopping potential?

8. On which factor the magnitude of saturation photoelectric current depends upon?

9. The work function of aluminum is4.2eV. If two photons each of energy 3.5eV strike an electron of aluminium sheet then what will be the speed of electrons?

10. Write down the rest mass of photon?

11. Two metals A and B have a work function 4eV and 10 eV respectively. Which metal has a higher threshold wavelength?

12. Red light, however bright, cannot cause emission of electrons from a clean zinc surface. But even weak UV radiations can do so. Why?

13. Do x rays exhibit the phenomenon of photoelectric effect?

14. A photon and an electron have the same de-Broglie wavelength. Which is moving faster?

15. The de-Broglie wavelengths associated with a proton and a neutron, are found to be equal. Which of the two has a higher value for kinetic energy?

Short Answer Type Questions-(2 Marks Each)

1. Calculate the number of photons in 6.62J of radiation energy of frequency 10^{12} Hz. Given h=6.62*10^{-34} Js.

2. When photons of energy hν falls on an aluminium plate (of work function $E_{o)}$, photoelectrons of maximum kinetic energy K are ejected. If the frequency of radiation is doubled, find the maximum kinetic energy of the ejected photoelectrons.

3. If electron, proton and helium have same momentum, then write relation between de-Broglie's wavelengths of the above particles.

4. The energy of a photon is equal to the Kinetic energy of proton. Let λ_1 be the de-Broglie wavelength of the proton and λ_2 is the wavelength of the photon. Find the ratio λ_1/λ_2 in terms of energy 'E' of photon.

5. Draw the Graph which represents the variation of particle momentum and associated de-Broglie wave length?

6. Draw a graph showing the variation of stopping potential with frequency of radiations incident on a metal surface. How can the value of Planck's constant be determined from the graph?

7. Give the laws of photoelectric effect.

8. Calculate the maximum kinetic energy of electrons emitted from a surface of work function 3.2 eV, for the incident radiation of 300 nm.

9. Derive an expression for the de-Broglie wavelength of an electron moving under a potential difference of V volt.

10. If the frequency of incident radiation is doubled for the same intensity, what changes will you observe in (i) the kinetic energy of the electrons emitted (ii) photoelectric current

11. For a photosensitive surface, threshold wavelength is λ_1.Does photoemission occur if the wavelength of the incident radiation is (i)more than λ_1 (ii)less than λ_1

12. An electron and a proton have same kinetic energy. Which of the two has a greater de-Broglie wavelength Explain?
.

13. Electrons are emitted from a surface when it is illuminated by green light but does not take place by yellow light. Will the electrons be emitted with (i) red (ii) blue light? Justify your answer.

14.When the light of a certain frequency falls on a surface of work function 2.5 eV, the emitted electrons are completely stopped by applying a retarding potential of 4.1 V. Calculate the frequency of the incident radiation.

15. Show that the energy of photon is 2 λmc/h times the kinetic energy of electron.

Short Answer Type Questions-(3 Marks Each)

1. Alkali metals are most suitable for photoelectric effect. Explain why?

2. Show that the product of the slope of the stopping potential versus frequency graph and the electronic charge gives the value of Planck's constant.

3. When radiation of wavelength λ is incident on a metallic surface, the stopping potential is 4.8 volts. If the same surface is illuminated with a radiation of double the wavelength, then the stopping potential becomes 1.6 volts. What is the threshold wavelength for the surface?

4. A source of 25 watt emits monochromatic light of wavelength 6600Å. If efficiency for photoelectric emission is 3 %, then find the photoelectric current.

5. Explain the laws of photoelectric effect on the basis of Einstein's photoelectric equation.

6. What is the de-Broglie wavelength of a nitrogen molecule in air at 300K? Assume that the molecule is moving with the root mean square speed of molecules at this temperature. (Atomic mass of nitrogen is = 14.0076u).

7. Draw a diagram of Davison and Germer experiment and briefly explain how de-Broglie relation was verified in the case of electrons.

8. Explaining the functioning of a photocell. Give its two uses.

9. The work function of caesium cell is 2.14 eV.Find (i) the threshold frequency for caecium (ii) the wavelength of the incident radiation if the photoelectric current is brought to zero by a stopping potential of 0.60 V

10. The wavelength of light from the spectral emission line of sodium is 589nm.Find the kinetic energy at which (i) an electron, and (ii) a neutron, would have the same de-Broglie wavelength.

UNIT-8

ATOMS AND NUCLEI

(Weightage-6 Marks)

Very Short Answer Type Questions(1 mark each)-

1. Write the beta decay of $^{32}P_{15}$.

2. What do you mean by isotopes?

3. What are Isobars?

4. What do you mean by packing fraction?

5. What are Isotones?

6. The isotopes $_8O^{16}$ has 8 protons, 8 neutrons and 8 electrons, while $_4Be^8$ has 4 protons,

7. Neutrons and 4 electrons. Yet the ratio of their atomic masses is not exactly 2. Why?

8. Name the spectral series which lies in the visible region

9. The mass of the nucleus is less than the sum of the masses of the nucleons forming it, why?

10. Is the rest mass of a proton exactly equal to the rest mass of a neutron?

11. What is nuclear density?

12. Why are gamma rays emitted only in nuclear processes and not in orbital electron transitions

13. Two nuclei have mass numbers in the ratio 1:8.What is the ratio of their nuclear radii?

14. Two nuclei have mass numbers in the ratio 1:2.What is the ratio of their nuclear densities?

15. Can it be concluded from beta decay that electrons exist inside the nucleus?

16. Write the empirical relation between the mass number and the radius of a nucleus.

Short Answer Type Questions-(2 Marks Each)--

1. Define Bohr's radius?

2. The wavelengths of some of the spectral lines obtained in hydrogen spectrum are

9546A^o, 6463A^o and 1216A^o. Which one of these wavelengths belongs to Lyman series?

3. Write the empirical relation for Paschen series lines of hydrogen atom?

4. What is Bohr's quantization condition for the angular momentum of an electron in the second orbit?

5. State the limitations of Bohr's atomic model?

6. What are the three basic postulates of Bohr's model of hydrogen atom? Derive an expression for the total energy of electron in Bohr's stationary orbit.

7. Calculate the kinetic energy and potential energy of an electron in the first orbit of hydrogen atom. Given e = 1.6 x 10^{-19}C and r = 0.53 x 10^{-10}m.

8. The wavelength of the first member of Balmer series in the hydrogen spectrum is 6563A^o. Calculate the wavelength of the first member of Lyman series in the same spectrum.

9. Derive the expression for the radius of the n^{th} orbit of hydrogen atom using Bohr's postulates. Show graphically the (nature of) variation of the radius of orbit with the principal quantum number, n.

10. If the activity of a radioactive substance drops to 1/8 th of its initial value in 30 years, find its half life period?

11. What fraction of tritium will remain after 25 years? Given half life of tritium is 12.5 years.

12. Define half life of a radioactive element. Write its S.I. unit. Derive expression for half life?

13. A radioactive nuclide decays to form a stable nuclide its half life is 3 minutes. What fractions of its 1g will remain radioactive after 9 minutes?

14. The half life period of a radioactive substance is 30 days. What is the time for ¾ th of its original mass to disintegrate?

Short Answer Type Questions-(3 Marks Each)

1. Plot the distribution of kinetic energy of beta particles and state why the energy spectrum is continuous?

2. Define the terms half-life and decay constant of a radioactive sample and obtain the relation between them.

3. Give the characteristic features of nuclear force

4. Draw a graph showing the variations 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.

5. Explain with the help of a nuclear reaction, how the neutron to proton ratio changes during (i)alpha decay (ii)beta decay

6. Explain Rutherford experiment on the scattering of alpha particles and state the significant of the result.

7. Using the Bohr's model obtain the expression for size of the orbit and the speed of the electrons in n^{th} orbit

8. Using the Bohr's model explain the line spectrum of hydrogen atom.

9. Calculate the speed of the electron in hydrogen atom in n=1,2and 3 levels. Also calculate the orbital period in each of these levels.

10. A 12.5 eV beam is used to bombard gaseous hydrogen at room temperature. What series of wavelengths will be emitted?

11. Calculate the binding energy of $^{14}N_7$ given m ($^{14}N_7$)= 14.00307 u.

12. A radioactive isotope has a half life of T years. How long will it take the activity to reduce to (i)3.125% (ii)1% of the original value

13. Calculate the binding energy of $^{40}Ca_{20}$. Given m ($^{40}Ca_{20}$) =39.962589 u, m_n=1.008665 u and m_p=1.007825 u .

14. Draw a diagram to show the variation of binding energy per nucleon with the mass number for different nuclei. State the reason why light nuclei usually undergo nuclear fusion?

15. A hydrogen atom initially in the ground level absorbs a photon which excites it to n =

4 levels. Determine the wavelength and frequency of photon.

16 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.

17 Draw a plot of the binding energy per nucleon as a function of mass number for a large number of nuclei, 2 □ □*A* □ □ 240. How do you explain the constancy of binding energy per nucleon in the range 30 □ □*A* □ 170 using the property that nuclear force is short-ranged?

18 (*a*) Using de Broglie's hypothesis, explain with the help of a suitable diagram, Bohr's second postulate of quantization of energy levels in a hydrogen atom.
(*b*) The ground state energy of hydrogen atom is –13.6 eV. What are the kinetic and potential energies of the electron in this state?

19 Using the postulates of Bohr's model of hydrogen atom, obtain an expression for the frequency of radiation emitted when atom make a transition from the higher energy state with quantum number *ni* to the lower energy state with quantum number *nf* (*nf* □ □*ni*).

20 (a) 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.
(b) Use this graph to explain the release of energy in both the processes of nuclear fusion and fission.
(c) Write the basic nuclear process of neutron undergoing □–decay. Why is the detection of neutrinos found very difficult?

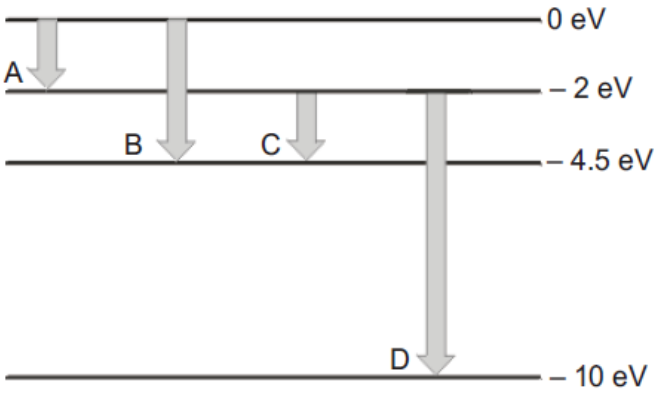
21 (*i*) Write symbolically the process expressing the □ □ □ decay of $_{11}Na^{22}$. Also write the basic nuclear process underlying this decay.
(*ii*) Is the nucleus formed in the decay of the nucleus $_{11}Na^{22}$ an isotope or isobar?

22 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 T1/ 2 value when the number present N = N_0 /16.

23 In both □ □ □ decay processes, the mass number of a nucleus remains same whereas the atomic number *Z* increases by one in □ □ □ decay and decreases by one in □ □ □ decay Explain, giving reason.

24 State the reason, why heavy water is generally used as a moderator in a nuclear reactor.

25 The energy levels of a hypothetical atom are shown below. Which of the shown transitions will result in the emission of a photon of wavelength 275 nm? Which of these transitions correspond to emission of radiation of (*i*) maximum and (*ii*) minimum wavelength?



UNIT-9

SEMICONDUCTOR DEVICES

(Weightage-7 Marks)

Very Short Answer Type Questions(1 mark each)-

1. How does the thickness of the depletion layer in a pn junction vary with the increase in reverse bias?

2. If the base region has the larger width in a transistor, how does the collector current change?

3. Name two factors on which electrical conductivity of a pure semiconductor at a given temperature depends.

4. What is the phase relationship between input and output voltages of a common emitter transistor amplifier?

5. An ac input signal of frequency 60 Hz, is rectified by a (i) half wave (ii) full wave rectifier. Write the output frequency in each case.

6. A common emitter transistor is preferred over common base amplifier. Why?

7. What is the order of energy gap in a transistor?

8. Give the ratio of the number of holes and electrons in an intrinsic semiconductor.

9. What type of biasing gives a diode low resistance?

10. Is a p-type semiconductor charged or electrically neutral?

11. What do you mean by encoding and decoding?

12..What is a truth table?

13 .What is an inverter?

14. Give two advantages of digital circuits over the analog circuits.

15.What are the limitations of digital circuits?

Short Answer Type Questions-(2 Marks Each)

1. A transistor amplifier circuit is operated with an emitter current of 2 mA. The collector current is 1.98 mA. What is the common emitter current gain (β_{dc}) of the transistor used in the circuit?
2. Explain how the input and output voltages are out of phase by 180^{o} for a common-emitter transistor amplifier.

3.For an n-p-n transistor in the common-emitter configuration, draw a labeled circuit diagram of an arrangement for measuring the collector current as a function of collector-emitter voltage for at least two different values of base current. Draw the shape of the curves obtained.

4. Illustrate the cut off, active, and saturation regions on a plot of V_0 and V_i for a transistor switch circuit.

5. Draw the logic symbol of an NAND gate and write the truth table.

6. The following truth table gives the output of a 2-input logic gate.

A	B	output
0	0	1
0	1	0
1	0	0
1	1	0

Identify the logic gate used and draw its logic symbol. If the output of this gate is fed as input to a NOT gate, name the new logic gate so formed?

7. How a depletion layer is formed in p-n junction?

8. What is the voltage gain of the amplifier in common emitter configuration?

9. What is the function of amplifier and how transistor will act as amplifier?

10. How do we bias the junctions of a transistor in common emitter configuration?

11. Which of the one between silicon and germanium preferred in the manufacturing of semiconductor devices? Why?

12. Why is a semiconductor virtually an insulator at room temperature? How its conductivity varies with temperature?

13. How does the addition of trivalent impurity to a pure semiconductor affect the electron hole pairs at room temperature?

14. For the same degree of doping, why is the conductivity of n-type semiconductor greater than that of p-type semiconductor? The base of a transistor is lightly doped. Explain why?

Short Answer Type Questions-(3 Marks Each)

1. Define the terms:

(i) output resistance and (ii) 'current amplification factor'..A transistor has a current gain of 30. If the collector resistance is 6kW, input resistance is 1kW, calculate its voltage gain?

2. Explain the use of a pn junction diode as a rectifier.

3. Draw the diagram to obtain (i) NOT (ii) OR (iii) AND, from NOR gate.

4. Draw the energy band diagram of a p type semiconductor. Deduce the expression for the conductivity of a semiconductor.

5. With the help of a circuit diagram, explain the use of a zener diode as a voltage stabilizer.

6. What is a solar cell? How does it work? Give its one use.

7. Explain the working of a transistor as a switch.

8. Explain How V-I characteristics of a pn junction diode are obtained in (i) forward (ii)reverse biasing.

9. Draw a circuit diagram to show how a photodiode is biased. Draw its characteristics curves for different illumination intensities.

10. A pn photodiode is fabricated from a semiconductor with band gap of 2.8 eV. Can it detect a wavelength of 6000nm?

Long Answer Type Questions (5 Mark Each)-

1. Draw the circuit diagram to study the characteristics curves of a transistor in common emitter mode. Draw the typical curves and explain how these graphs are used to calculate(i) output resistance (ii) input resistance and (iii) current amplification factor

2. Define current amplification factor in a common emitter mode of transistor?

Draw a labeled circuit diagram of a common emitter transistor amplifier. Draw the input and the output wave forms and also state the relation between input and output signal?

3. What is an oscillator? With the help of a circuit diagram explain the working of transistor as an oscillator.
Obtain the relation between α and β.

4. Explain the formation of depletion layer in a p-n junction. With the help of a diagram, explain how it works as a rectifier.

5. Draw a labeled circuit diagram of a common emitter transistor oscillator. Draw a circuit diagram showing how the feedback is accomplished by inductive coupling. Explain the oscillator action.

6. What is an intrinsic semiconductor? How can this be converted into p and n type semiconductor?

A Semiconductor has equal electron and hole concentration of $6x10^{12}/m^3$.On doping with certain impurity, electron concentration increases to$9x10^{12}/m^3$.

(i)Identify the new semiconductor obtained.
(ii) Calculate the new hole concentration.

7. Explain the working of a transistor as a switch. Draw the required graph and mark the regions (i) active (ii) cut off(iii) saturation state

8. Explain the action of a transistor with the help of a circuit diagram.

9. What are energy band diagram? How are they formed? Distinguish between conductors, insulators and semiconductors on the basis of energy band diagram.

10. In a transistor the base current is changed to 20μA.This results in a change of 0.02V in base to emitter voltage and a change of 2mAin the collector current.

(i)Find the input resistance and transconductance of the transistor.

(ii)This transistor is used as an amplifier in CE configuration with load resistance of 5k ohms. What is the voltage gain of the amplifier?

UNIT-10

COMMUNICATION SYSTEM

(Weightage-5 Marks)

Very Short Answer Type Questions(1 mark each)-

1. Why is the transmission of signals using ground waves restricted to frequencies less than 1500kHz?

2. Why TV signals are not transmitted using sky waves?

3. Name the type of radio wave propagation involved when TV signals broadcast by a tall antenna, is intercepted directly by the receiver antenna.

4. What is the band width offered by an optical fiber?

5. Who administers the present system of frequency allocations?
6. What is a band pass filter?

7. Define the term modulation index.

8. Why are sky waves not used for transmission of TV signals?

9. A message signal has a band width of 5 MHz Suggest a possible communication channel for its transmission.

10. What should be he length of dipole antenna for a carrier wave of frequency $6x10^8$Hz?

11. What is modulation?

12. Name the three basic units of communication system.

13. What is ionosphere? What is its use in radio broadcast?

14. Which device is used for transmitting TV signals over long distances?

15. Name the appropriate communication channel needed to send a signal of band width 100k Hz over a distance of 8 km.

Short Answer Type Questions-(2 Marks Each)

1. Draw a block diagram of a communication system.

2. Briefly describe the three basic parts of communication system.

3. What do you understand by line communication and space communication? Give example.

4. Why are sky waves reflected back from the ionosphere?

5. What do you mean by bandwidth of a signal? How much bandwidth is considered adequate for (i) speech signal (ii) music signal (iii) video and TV signals?

6. What do you mean by point to point communication and broadcast? Give examples

7. What do you mean by analog and digital communication system?

8. Briefly explain the ground wave propagation of radio waves.

9. Sky waves are not used in transmitting TV signals. Why? How can the range of TV signals be increased?

10. Write the expression of a TV station, area and the population covered by the transmission.

11. What is demodulation .Explain.

12. Give the essential steps of detecting an AM Wave with a circuit diagram.

13. Distinguish between FM and AM wave.

14. Why is an FM signal less susceptible to noise than an AM signal?

15. Define-(i) attenuation (ii) noise (iii) repeater (iv) transducer

Short Answer Type Questions-(3 Marks Each)

1. What is amplitude modulation? Represent the process graphically.

2. Explaining the need of modulation explain what is modulation.

3. Draw a block diagram of a simple amplitude modulation, Explain briefly how this is achieved.

4. Discuss briefly the principle of transmitting signals using a satellite. State its two main advantages.

5. Define the term critical frequency. On a particular day, the maximum frequency reflected from the ionosphere is 10MHz.On the other day, it was found to 8MHz.Calculate the ratio of the maximum electron densities of the ionosphere on the two days.

6. Draw a plot of variation of amplitude versus ω for an AM wave. Define modulation index. State its importance.

7. Derive an expression for the coverage range of TV transmitting tower.

8. What is meant by communication system?

For an AM wave, the maximum amplitude is found to be 2V.Determine the modulation index. What will be the value of the modulation index if the minimum amplitude is 0V?

9. A TV tower has a height of 100m.How much population is covered by the TV broadcast if the average population density around the tower is 1000 km^{-2}.

10. A modulating signal has zero dc component and peak voltage of 11V.It is used to amplitude modulate a carrier wave of peak voltage 10 V. Calculate the modulation index.

Long Answer Type Questions (5 Mark Each)-

1. Give two drawbacks of transmission without modulation. Describe with the help of a block diagram the arrangement for the transmission and reception of the message signal.

2. What does the term LOS communication mean? Name the two 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. Give two factors which determine the choice of a communication channel. Explain the use of coaxial cables as a communication channel the help of a diagram.

4. Distinguish between analog and digital communication. Write any two modulation techniques employed for the digital data. Explain.

5. What do you mean by communication channels?
Explain the communication through
(a)Ground waves
(b)Sky waves
(c)Space waves

6. .Derive an expression for the coverage range of TV transmitting tower.

By what percentage will the transmission range of a TV tower be affected when the height of the tower is increased by 21%?

7. What is modulation and explain the three types of modulation used in detail.

By what percentage will the transmission range of a TV tower be affected when the height of the tower is increased by 21 %.

8. What is space wave propagation? Which two communication methods make use of this mode of propagation? If the sum of the heights of transmitting and receiving antennas in

LOS communication is fixed at h, show that the range is maximum when the two antennas have a height of h/2 each.

9. Explain the various types of communication channels used in communication.

An intelligence signal with a band width of 100 kHz is to be communicated over a distance of 10 km. Suggest the form of a communication channel.

10. What is optical modulation and detection .Explain how this is done..Define the term critical frequency in relation to sky wave propagation of em waves. . On a particular day, the maximum frequency reflected from the ionosphere is 10MHz.On the other day, it was found to increase to11MHz.Calculate the ratio of the maximum electron densities of the ionosphere on the two days. Point out a plausible explanation for this.