CHAPTERWISE QUESTIONS FROM BOARD EXAM PAPERS
(March 2014 – June 2019)

CHAPTER – 1

Electric Charges and Fields

Charge:

Q. Name the SI unit of charge? **[March 2014]**

Properties of charges:

Q. Mention any three properties of charges. **[July 2014, March 2018, March 2019]**

Electrification:

Q. Mention one method of charging a body. **[March 2018]**

Coulomb's inverse square law:

Q. State and explain Coulomb's inverse square law. **[March 2014, June 2015, March 2017, March 2018, March 2019]**

Q. Write the expression for electrostatic force (Coulomb's law) in vector form and explain the terms. **[March 2015]**

Q. Define coulomb (or unit charge) or define SI unit of charge **[March 2015]**

Q. How does the electrostatic force between two point charges change when a dielectric is introduced in between them? **[June 2017]**

Electric field due to a point charge:

Q. Name the SI unit of electric field? **[July 2016]**

Electric dipole:

Q. What is an electric dipole? **[March 2016]**

Electric field due to an electric dipole:

Q. Derive the expression for electric field at a point on the axis of an electric dipole. **[March 2016, June 2017, March 2018]**

Q. Derive the expression for electric field at a point on the equatorial line (or perpendicular bisector) of an electric dipole. **[March 2015, June 2019]**

Electric field lines:

Q. Mention any three properties of electric field lines. **[June 2015, March 2016, March 2017, July 2018, June 2019]**

Q. Draw electric lines of force of point charge Q when (i) $Q > 0$ (ii) $Q < 0$ **[July 2016]**

Gauss' law:

Q. State and explain Gauss's Law. **[March 2014, June 2015, March 2017, June 2017, March 2019]**

Electric field due to charged thin wire:

Q. Derive the expression for electric field at a point due to an infinitely long straight uniformly charged thin wire using Gauss' theorem. **[June 2015, July 2016]**

Problems:

1. Two point charges $q_A = 3\ \mu C$ and $q_B = -3\ \mu C$ are located 20 cm apart in vacuum.
(a) What is the electric field at the midpoint O of the line AB joining the two charges?
(b) If a negative test charge of magnitude 1.5 nC is placed at this point, what is the force experienced by the test charge? **[March 2017]**

2. Two point charges 3nC and -3nC are placed at two corners A and B of an equilateral triangle of side 0.1m. Find the resultant electric field at C. **[March 2017]**

3. Three charges each equal to +4nC are placed at the three corners of a square of side 2cm. Find the electric field at the fourth corner. **[March 2018]**

Chapter – 2
Electrostatic Potential and Capacitance

Electric potential :

Q. Define electric potential at a point in an electric field. **[March 2017, M 2018]**

Q. Derive the relation between electric field and electric potential due to a point charge. **[July 2014, June 2015, March 2017, June 2017]**

Electric potential due to a point charge:

Q. Derive the expression for electric potential at a point due to a point charge. **[M18]**

Electric potential energy due to system of charges:

Q. Derive the expression for potential energy of system of two charges in the absence of external electric field. **[March 2014, July 2016]**

Electric potential energy due to dipole:

Q. Derive the expression for the electric potential energy of an electric dipole placed in a uniform electric field. **[March 2019]**

Equipotential surface:

Q. What is an equipotential surface? **[March 2018]**

Capacity of a capacitor:

Q. What is a capacitor? **[July 2014, March 2018]**

Capacity of parallel plate capacitor:

Q. Derive the expression for capacity of a parallel plate capacitor with air as medium. **[March 2015]**

Q. On what factor does the capacitance of parallel plate capacitors depends? **[March 2017, March 2018]**

Capacitors in series/parallel:

Q. Derive the expression for the equivalent capacitance of two capacitors connected in series.**[July 2018, June 2019]**

Q. Derive the expression for the equivalent capacitance of two capacitors connected in parallel. **[March 2017]**

Energy stored in a capacitor:

Q. Derive the expression for energy stored in a capacitor. **[March 2016, March 2017, March 2018]**

Q. A capacitor of capacitance 2nF is charged to a potential of 10V. Calculate the energy stored in it. **[March 2017**]

Problems:

1. Two charges 30nC and -20nC are located 15 cm apart. At what points on the line joining the two charges is the electric potential zero? Take the potential at infinity to be zero. **[July 2014, March 2017]**

2. Two point charges +1 nC and -4 nC are 1m apart in air. Find the positions along the line joining the two charges at which resultant potential is zero. **[March 2015]**
3. Charges 2μC, 4μC and 6μC are placed at the three corners A, B and C of a square ABCD of side x metre. Find what charge must be placed at the fourth corner so that net potential at the centre of the square becomes zero. **[July 2016]**
4. ABCD is a square of side 2m. Point charges of 5nC, 10nC and -5nC are placed at corners A, B, C respectively. Calculate the work done in transferring a charge of 5nC from D to the point of intersection of diagonals. **[June 2015]**
5. ABCD is a square of side 4cm. Point charges of +2nC, -2nC and +3nC are placed at corners A, B, C respectively. Calculate the work done in transferring a charge of +4nC from D to the centre of the square. **[M 2018]**
6. ABCD is a square of side 1m. Point charges of +3nC, -5nC and +3nC are placed at corners A, B, C respectively. Calculate the work done in transferring a charge of 12μC from D to the centre of the square. **[June 2019]**
7. In a parallel plate capacitor with air between the plates, each plate has an area of 6×10^{-3} m^2 and the distance between the plates is 3 mm. Calculate the capacitance of the capacitor. If this capacitor is connected to a 100 V supply, what is the charge on each plate of the capacitor? **[March 2014]**
8. In a parallel plate capacitor with air between the plates, each plate has an area of 8×10^{-3} m^2 and the distance between the plates is 2 mm. Calculate the capacitance of the capacitor. If this capacitor is connected to a 50 V supply, what is the charge on each plate of the capacitor? (Absolute permittivity of free space = 8.85×10^{-12} Fm^{-1}) **[June 2017]**
9. In a circular parallel plate capacitor, radius of each plate is 5 cm and they are separated by a distance of 2 mm. Calculate the capacitance and the energy stored, when it is charged by connecting the battery of 200 V. ($\epsilon_o = 8.854 \times 10^{-12}$ Fm^{-1}) **[March 2019]**
10. Energy stored in a system consisting of two capacitors in series and connected across 4kV line is 8J. When the same two capacitors are in parallel across the same line, energy stored is 36J. Find the capacitance of the capacitors. **[March 2016]**
11. The plates of a parallel plate capacitor have an area of 100 cm^2 each and are separated by 3 mm. The capacitor is charged by connecting it to a 400V supply. Calculate (a) the energy stored in the capacitor (b) if a dielectric constant 2.5 is introduced between the plates of the capacitor, then find the energy stored and also change in the energy stored. **[July 2018]**

CHAPTER – 3
Electric Current

Drift velocity

Q. What is drift velocity? **[July 2014, March 2018]**

Q. Derive the expression for drift velocity in terms of relaxation time. **[March 2016, July 2016]**

Q. Write the expression for drift velocity in terms of current and explain the terms. **[March 2019]**

Mobility and relaxation time:

Q. Define mobility. **[March 2014, March 2017, June 2017, March 2018]**

Q. Mention SI unit of mobility. **[June 2017]**

Q. Define relaxation time. **[March 2018]**

Current density:

Q. Name the SI unit of current density? **[March 2017]**

Ohm's law:

Q. State and explain Ohm's law **[March 2017, July 2018]**

Q. Mention the limitations of Ohm's law. **[July 2014, March 2015, June 2015, June 2019]**

Q. What is ohmic device? Give an example. **[June 2017]**

Variation of resistance with dimension:

Q. On What factors does the resistance of a conductor depend? **[March 2018]**

Q. How does the resistance of a conductor vary with its length? **[June 2019]**

Q. Define electrical resistivity of material of a conductor. **[March 2019]**

Q. Derive the expression for electrical conductivity of a material interms of relaxation time. **[June 2015, July 2018]**

Q. Derive the relation $J = \sigma E$ (Equivalent form of Ohm's law). **[June 2017]**

Carbon resistor:

Q. Write the colour code for a resistor of resistance 45Ω 10% **[March 2018]**

Variation of resistance with temperature:

Q. Represent graphically the variation of resistivity of i) copper ii) nichrome with absolute temperature. **[July 2018]**

Combination of cells:

Q. Derive the expression for equivalent emf and equivalent internal resistance when two cells are connected in series. **[March 2017]**

Q. Derive the expression for equivalent emf and equivalent internal resistance when two cells are connected in parallel. **[March 2018, March 2019]**

Kirchhoff's laws:

Q. State Kirchhoff's junction rule. **[June 2017, March 2018]**

Q. State Kirchhoff's II law or voltage law or loop rule. **[March 2018]**

Wheatstone's network:

Q. Obtain the expression for balanced condition of the Whetstone's network. **[July 2014, March 2016, July 2016, March 2017, March 2018, June 2019]**

Q. What is the condition for the balanced state of Wheatstone's network? **[June 2015]**

Q. Draw Wheatstone's bridge circuit and write the condition for its balance. **[March 2014, March 2017]**

Problems:

1. Calculate the current density and average drift speed of conduction electrons in a copper wire of cross sectional area 10^{-7} m^2 carrying a current of 1.5 A. Given free electron density of copper is 8×10^{28} electrons/m^3, $e = 1.6 \times 10^{-19}$ C. **[March 2017]**

2. 100 mg mass of nichrome metal is drawn into a wire of area of cross section 0.05 mm^2. Calculate the resistance of this wire. Given density of nichrome is 8.4×10^3 kgm^{-3} and resistivity of the material as 1.2μΩm. **[March 2018]**

3. (a) Three resistors 2Ω , 3Ω, and 4Ω are combined in series. What is the total resistance of the combination?
(b) If the combination is connected to a battery of emf 10 V and negligible internal resistance, obtain the potential drop across each resistor. **[March 2016]**

4. (a) Three resistors 4 Ω, 6 Ω and 8 Ω are combined in parallel. What is the total resistance of the combination? (b) If the combination is connected to a battery of emf 25 V and negligible internal resistance, determine the current through each resistor, and the total current drawn from the battery. **[June 2017]**

5. Two resistors of resistance 12 Ω and 6 Ω are connected in parallel to a battery of 12V. (a) Calculate the equivalent resistance of the network.
(b) Obtain the current in 12 Ω and 6 Ω resistors. **[July 2014]**

6. Two resistors of resistance 3 Ω and 6 Ω are connected in parallel to a cell of emf 1.5V and internal resistance 1 Ω. Calculate current through 3 Ω and 6 Ω and p.d across 3 Ω. **[March 2017]**

7. A battery of internal resistance 3 Ω is connected to 20 Ω resistor and potential difference across the resistor is 10V. If another resistor of 30 Ω is connected in series with the first resistor and battery is again connected to the combination, calculate the emf and terminal p.d across the combination. **[March 2014]**

8. When two resistances are connected in series with a cell of emf 2V and negligible internal resistance, a current of 2/5A flows in the circuit. When the resistances are connected in parallel, the main current is 5/3A. Calculate the resistances. **[March 2017]**

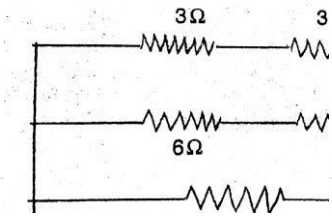
9. When two resistances are connected in series with a cell of emf 5V and negligible internal resistance, a current of 2A flows in the circuit. When the resistances are connected in parallel, the main current is 25/3A. Calculate theresistances. **[March 2019]**

10. A wire of length 2m, diameter 1mm and resistivity 1.963×10^{-8} Ω m is connected in series with a battery of emf 3V and internal resistance 1 Ω. Calculate the resistance of the wire and the current in the circuit. **[July 2016]**

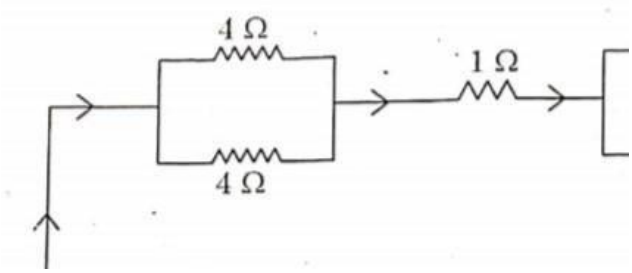
11. Two identical cells either in series or in parallel combination, gives the same current of 0.5A through external resistance of 4 Ω. Find the emf and internal resistance of each cell. **[June 2015]**

12. Two cells of emf 2V and 4V and internal resistance 1 Ω and 2 Ω respectively are connected in parallel so as to send the current in the same direction through an external resistance of 10Ω. Find the potential difference across 10 Ω resistor. **[March 2015]**

13. In the given circuit diagram
calculate (i) the main current through the circuit
(ii) also current through 9 Ω resistor. **[July 2018]**



14. A network of resistors is connected to a 16V battery with internal resistance 1Ω as shown in fig below.
Find (a) the equivalent resistance of the network b) total current in the circuit.
[June 2019]



Chapter 4
Moving Charges and Magnetism

Biot-Savart's law:

Q. State and explain Laplace's law (Biot- Savart's Law) and write its mathematical expression in vector form. **[March 2017]**

Magnetic field due to current loop:

Q. Using Biot-Savart's law, derive the expression for the magnetic field at a point along the axis of a current loop (circular coil). **[March 2014, March 2015, March 2017, March 2018, March 2019]**

Magnetic dipole:

Q. Derive the expression for magnetic dipole moment of a revolving electron in a hydrogen atom. **[March 2017]**

Force on a moving charge in a magnetic field:

Q. Mention the expression for force experienced by a charged particle moving in uniform magnetic field and explain the terms **[July 2014, March 2019]**

Q. When is the force experienced by a charged particle moving in a magnetic field (i) minimum
(ii) maximum? **[July 2014, July 2016, June 2019]**

Q. A charged particle enters a magnetic field in the direction of it. What is the nature of the path traced by it? **[June 2015]**

Lorent'z force:

Q. What is Lorent'z force? **[June 2017]**

Ampere circuital law:

Q. State and explain Ampere's circuital Law. **[July 2014, March 2015, June 2015, March 2018, June 2019]**

Q. Derive the expression for magnetic field at a point due to a long straight conductor using Ampere's circuital law. **[June 2015, March 2017, March 2018]**

Q. Mention the expression for the magnetic field at a point inside a solenoid carrying current and explain the terms. **[June 2019]**

Q. What is a toroid? Mention the expression for the magnetic field at a point inside a toroid and explain the terms. **[March 2016]** 66

Mechanical force on a conductor in a magnetic field:

Q. Write the expression for mechanical force acting on a current carrying straight conductor in a uniform magnetic field. **[July 2018]**

Force between two straight conductors:

Q. Derive the expression for force between two parallel current carrying conductors. Hence define ampere. **[June 2015, March 2016, July 2016, June 2017, July 2018]**

Q. Write the expression for force between two long parallel current carrying conductors. Hence define ampere. **[March 2019]**

Q. What is the nature of the force between two long straight parallel conductors when they carry currents in the (i) same direction? (ii) opposite direction? **[March 2014, July 2014, March 2018]**

Pointer galvanometer:

Q. Define current sensitivity of a galvanometer. **[July 2018]**

Conversion of galvanometer:

Q. Explain with a circuit diagram how a galvanometer can be converted into an ammeter.**[March 2015, March 2018, June 2019]**

Q. Explain with a circuit diagram how a galvanometer can be converted into a voltmeter. **[March 2017, June 2017]**

Problems:

1. A wire of length 0.26 m is bent to form a circular loop. If 2A of current is flowing through this loop, calculate the magnetic field due to this loop at a point P, which is at a distance of 0.15m from its centre on its axis. **[March 2018]**
2. A galvanometer having coil of resistance 12 Ω gives full scale deflection for a current of 4 mA. How can it be converted into a voltmeter of range 0-24V? **[July 2016]**

Chapter – 5

Magnetism and Matter

Magnetic field lines:

Q. Mention the properties of magnetic field lines. **[July 2014, M 2015, M 2017]**

Q. Draw the pattern of magnetic field lines for a bar magnet. **[March 2014]**

Magnetic dipole:

Q. State and explain Gauss law of magnetism. **[J 16, M 17, M 18, J 19]**

Q. Prove that a current carrying solenoid is equivalent to bar magnet. **[June 2017, March 2018]**

Q. Write the expression for magnetic potential energy of a dipole in a uniform magnetic field and explain the terms **[March 2018]**

Terrestrial magnetism:

Q. Define declination at a place. **[March 2014, March 2015, June 2015, March 2017, March 2018, March 2019, June 2019]**

Q. Define inclination at a place or magnetic dip. **[March 2014, June 2015, March 2017, March 2018, March 2019]**

Q. Define horizontal component of earth's magnetic field at a place. **[M 2014]**

Q. Where is magnetic dip zero on the earth's surface? **[July 2016, July 2018]**

Magnetisation:

Q. Define magnetisation. **[March 2016, March 2017]**

Q. Name the SI unit of magnetisation? **[June 2015, March 2017]**

Q. Define magnetic susceptibility. **[March 2014, March 2019]**

Magnetic materials:

Q. State and explain Curie law. **[June 2015, July 2016, July 2018]**

Hysteresis:

Q. What is Hysteresis? **[March 2018]**

Q. Draw hysteresis curve. Or Draw the variation of magnetic field with magnetic intensity when a ferromagnetic substance is subjected to cycle of magnetization. **[March 2016]**

Q. What is retentivity and coercivity? **[March 2018, July 2018, June 2019]**

Chapter – 6

Electromagnetic Induction

Electromagnetic induction:

Q. Explain briefly the coil-magnet experiment to demonstrate the phenomenon of electromagnetic induction. **[March 2016, July 2018]**

Q. State and explain the law of electromagnetic induction or Faraday's law of electromagnetic induction. **[July 2014, March 2016, March 2017, March 2018]**

Lenz' law:

Q. State and explain Lenz's law. **[March 2014, March 2017, July 2018]**

Q. What is the significance of Lenz's law? **[March 2015, July 2016, March 2017, March 2018]**

Motional emf:

Q. What is motional emf? **[June 2017]**

Q. Derive the expression for motional EMF induced in a conductor moving in a uniform magnetic field. **[July 2014, March 2015, July 2016, March 2017]**

Eddy current:

Q. What is eddy current and mention how to minimise eddy current? **[July 2014, June 2015, March 2017]**

Q. Mention any three applications or advantages of eddy currents. **[March 2014, July 2014, June 2015, March 2017, June 2017, June 2019]**

Self induction:

Q. What is self induction? **[June 2015]**

Q. Define self-inductance of a coil. **[July 2016]**

Q. Mention any two factors on which the self-inductance of a coil depends. **[July 2018]**

Q. How is the self inductance of a solenoid, depend on number of turns in the coil? **[March 2019]**

Q. Derive the expression for energy stored in the coil (or solenoid) carrying current **[June 2015]**

Q. Mention the expression for energy stored in the coil carrying current. **[March 2014, March 2017]**

Mutual induction:

Q. Define mutual inductance between pair of coils. **[July 2016]**

AC generator:

Q. Derive an expression for instantaneous induced emf in an AC generator. **[June 2019]**

Problems:

1. The magnetic flux linked with a coil varies as $\Phi = 3t^2 + 4t + 9$, what is the magnitude of induced emf at 0.25 s? **[June 2017]**
2. Current in a coil falls from 2.5A to 2.0A in 0.01 s, calculate the induced emf in a coil if its self inductance is 5mH. **[March 2016]**
3. A long solenoid with 20 turns per cm has a small loop of area 2.5 cm^2 placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from 0.2 A to 0.6 A in 0.1 s, calculate the induced emf in the loop while the current is changing **[March 2018]**
4. A circular coil of radius 10 cm and 25 turns is rotated about its vertical diameter with an angular speed of 40 $rads^{-1}$, in a uniform horizontal magnetic field of magnitude 50 mT. Calculate the peak value of emf induced in the coil. Also find the peak value of current in the coil if the resistance of the coil is 15 Ω. **[March 2018]**
5. A conductor of length 3m is moving in a uniform magnetic field of strength 100T. It covers a distance of 70 m in 5 s. Its plane of motion makes an angle of 30^o with the direction of magnetic field. Calculate the emf induced in it. **[March 2019]**

CHAPTER – 7
Alternating Current

Alternating current:

Q. Mention the expression for rms value of alternating voltage interms of peak value. **[March 2014, June 2017]**

Q. If the peak value of an ac is 4.24A, then find its rms value? **[March 2018]**

AC applied to pure resistor:

Q. Show that voltage and current are in phase with each other when AC is applied to a pure resistor. **[March 2018]**

AC applied to pure inductor:

Q. Obtain the expression for the current in an ac circuit containing a pure inductor.

Or

Show that voltage leads current by 90°, when A.C. voltage applied to pure inductance. [March 2015]

Q. What is the power loss in an ac circuit containing pure inductor? **[March 2017]**

AC applied to pure capacitor:

Q. What is the power factor of an AC circuit containing pure capacitor? **[June 2017]**

Series LCR circuit:

Q. Obtain the expression for impedance and current in a series LCR circuit using phasor diagram. **[March 2018, March 2019]**

Electrical resonance:

Q. Write the condition for electrical resonance in series LCR circuit. **[July 2018]**

Q. Derive the expression for resonant frequency or resonant angular frequency. **[July 2014]**

Q. What is wattless current? **[July 2018]**

LC oscillation:

Q. What is LC oscillation? **[March 2017]**

Q. Mention the expression for frequency of LC oscillations and explain the terms. **[March 2017]**

Transformer:

Q. What is transformer? Mention its principle of working. **[March 2014, June 2015, March 2016, March 2017]**

Q. Explain the construction and working of transformer. **[March 2014, July 2016, March 2018]**

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Q. What is a transformer? Mention the sources of energy losses in a transformer. **[June 2015, March 2016, March 2017, March 2018, March 2019, June 2019]**

Problems:

1. A pure inductor of 25.0 mH is connected to a source of 220 V. Find the inductive reactance and rms current in the circuit if the frequency of the source is 50 Hz. **[July 2014]**

2. An inductor and bulb are connected in series to an AC source of 220V, 50 Hz ac source. A current of 11A flows in the circuit and phase angle between voltage and current is $\pi/4$ radian. Calculate the impedance and inductance of the circuit. **[July 2016]**

3. A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which R = 3 Ω, L = 25.48 mH, and C = 796 μF. Find (a) the impedance of the circuit; (b) the phase difference between the voltage across the source and the current (c) the power factor (d) Average power dissipated in the circuit. **[March 2015, March 2017, June 2019]**

4. A sinusoidal voltage of peak value 285 V is applied to a series LCR circuit in which R = 5 Ω, L= 28.5 mH, and C = 800 μF. Find (a) resonant frequency (b) Calculate the impedance, current and power dissipated at resonance. **[June 2017]**

5. A 20 Ω resistor, 1.5 H inductor and 35μF capacitor are connected in series with a 220V, 50 Hz ac supply. Calculate the impedance of the circuit and also find the current through the circuit. **[July 2018]**

6. A resistor 100 Ω, a pure inductance coil of L = 0.5 H and capacitor are in series in a circuit containing an ac of 200V, 50 Hz. In the circuit current is ahead of the voltage by 30^o. Find the value of the capacitance. **[June 2015]**

7. An ac source of 110V, 50 Hz is connected in series with a 50 Ω resistor, 15μF capacitor and 2200μH inductor in series. Find impedance and current through the circuit. **[March 2017]**

8. Obtain the resonant frequency of a series LCR circuit with L = 4.0 H, C = 27 μF and R = 8.4 Ω. What is the Q-value of this circuit? Also find the band width. **[March 2014, March 2016]**

9.A source of alternating emf of 220V, 50 Hz is connected in series with a resistance of 200 Ω and inductance 0.1 H and capacitance of 30μF. Does the current lead or lag the voltage and by what angle? **[March 2017]**

Chapter – 8

Electromagnetic Waves

Conduction current and displacement current:

Q. What is conduction current? **[March 2017]**

Electromagnetic waves:

Q. What are electromagnetic waves? **[July 2016]**

Q. Who predicted the existence of electromagnetic waves? Give the wavelengths of electromagnetic spectrum. **[March 2014]**

Q. Write the expression for speed of electromagnetic wave in vacuum interms of permeability of free space and permittivity of free space. **[July 2016, June 2017, March 2019]**

Electromagnetic spectrum:

Q. Mention the wavelength range of X-rays? **[March 2016]**

Q. What are the uses of X-ray? **[March 2018]**

Q. What are the uses of UV rays? **[July 2018, June 2019]**

Q. What are the uses of IR rays? **[March 2015, March 2018]**

Q. What are the uses of microwaves? **[July 2014, March 2017]**

Chapter – 9

Ray Optics and Optical Instruments

Refraction through plane surface:

Q. State the laws of refraction **[July 2014]**

Q. A blue ray of light enters an optically denser medium from air. What happens to its frequency in denser medium? **[July 2018]**

Total internal reflection:

Q. Define critical angle. **[June 2017]**

Q. What is total internal reflection? **[July 2016, March 2017]**

Q. Mention the conditions for total internal reflection. **[June 2015, March 2017, June 2017]**

Q. Mention three applications of total internal reflection of light. **[March 2014]**

Q. Mention two applications of optical fibre. **[July 2016]**

Refraction through a prism:

Q. Derive the expression for the refractive index of the material of a prism in terms of the angle of the prism and angle of minimum deviation. **[March 2015, March 2017]**

Refraction through curved surface:

Q. Derive the relation between n_1, n_2, u, v and R for refractrion at a single spherical surface.**[March 2018]**

Refraction through a lens:

Q. How does the power of a lens vary with its focal length? **[March 2015, March 2016, March 2017]**

Q. Derive lens maker's formula. **[June 2015, July 2016, March 2017, June 2017, March 2019]**

Q. For which position of the object magnification of convex lens is -1? **[March 2019]**

Combination of lenses:

Q. Derive an expression for effective focal length of combination of two thin lenses in contact **[March 2016, July 2018]**

Q. Two lenses of power -0.5D and +1.5D are kept in contact. Find the effective power of the combination. **[March 2018]**

Simple microscope:

Q. Draw the ray diagram for formation of image in simple microscope. **[March 2019]**

Compound microscope:

Q. Draw the ray diagram of a Compound Microscope when the image is formed at near point or least distance of distinct vision. **[March 2015]**

Telescope:

Q. Draw the ray diagram for formation of image by a refracting telescope and write the expression for magnifying power of telescope. **[March 2017]**

Problems:

1. Two convex lenses of focal lengths 0.20 m and 0.30 m are kept in contact. Find the focal length of the combination. Calculate powers of two lenses and combination. **[March 2014]**
2. An equilateral prism produces a minimum deviation of 40^{o}. What is the R.I of the material of the prism? Calculate the angle of incidence. **[July 2014]**
3. An equilateral prism is made of glass. When a parallel beam of light is incident on a face of the prism the angle of minimum deviation is found to be 40^{o}. Calculate the R.I of the prism. If this prism is placed in water of R.I 1.33, find the new angle of minimum deviation for the parallel beam of light. **[March 2017, March 2018]**
4. The radii of curvature of two surfaces of a convex lens is 0.2 m and 0.22 m. Find the focal length of the lens if refractive index of the material of lens is 1.5. Also find the change in focal length, if it is immersed in water of R.I 1.33. **[July 2018]**
5. An object of height 3 cm is placed 14 cm in front of a concave lens of focal length 21 cm. Find the position, nature and size of the image formed. **[June 2019]**

CHAPTER – 10
Wave optics

Wavefront:

Q. What is a wavefront? **[March 2014]**

Q. Derive Snell's law using Huygens Principle. **[March 2017, March 2018]**

Q. Using Huygens Principle, show that the angle of incidence is equal to the angle of reflection during a plane wavefront reflected by a plane surface. **[June 2019]**

Interference of light:

Q. What is meant by interference of light? **[March 2015]**

Q. Give the condition for constructive and destructive interference in terms of path difference between the interfering waves. **[March 2015, July 2016]**

Q. Explain the theory of interference of two waves of the same amplitude and write the condition for constructive interference in terms of path difference and phase difference. **[March 2018]**

Young's double slit experiment:

Q. Describe Young's double slit experiment. **[June 2015]**

Q. Obtain the expression for the fringe width of interference fringes in Young's double slit experiment. **[March 2014, July 2014, March 2017, July 2018, June 2019]**

Diffraction of light:

Q. What is diffraction of light? **[March 2019]**

Q. Write differences between diffraction pattern and interference. **[June 2017]**

Resolving power:

Q. Mention the expressions for limit of resolution of (a) microscope and (b) telescope. **[July 2014]**

Q. Mention the methods of increasing resolving power of microscope. **[July 2014]**

Q. Mention the method of increasing resolving power of telescope. **[March 2016]**

Q. Mention the expressions for resolving power of microscope and explain the terms **[March 2017]**

Problems:

1. In young's double slit experiment while using a source of wavelength

4500Å, the fringe width obtained is 5mm. If the distance between the screen and plane of the slits is reduced to half, what should be the wavelength of the light required to get fringes of width 4mm? **[July 2016]**

2. In young's double slit experiment while using a source of wavelength 6000Å, the fringe width obtained is 6mm. If the distance between the screen and plane of the slits is reduced to half, what should be the wavelength of the light required to get fringes of width 4mm? **[March 2017]**
3. A beam of light consisting of two wavelengths 420 nm and 560 nm is used to obtain interference fringes in Young's double slit experiment. The distance between the slits is 0.3 mm and the distance between the slits and the screen is 1.5 m. Compute the least distance of the point from the central maximum, where the bright fringes due to both the wavelengths coincide. **[June 2015]**
4. In Young's double slit experiment, fringes of certain width are produced on the screen kept at a certain distance from the slits. When the screen is moved away from the slits by 0.1 m, fringe width increases by 60 □m. The separation between the slits is 1 mm. Calculate wavelength of light used. **[March 2016]**
5. In Young's double-slit experiment distance between the slits is 1 mm. The fringe width is found to be 0.6 mm. When the screen is moved through a distance of 0.25 m the fringe width becomes 0.75 mm. Find the wavelength of the light used. **[March 2015]**
6. In Young's double slit experiment distance between the slits is 0.5 mm. When the screen is kept at a distance of 100 cm from the slits the distance of 9^{th} bright fringe from the central fringe system is 8.835 mm. Find the wavelength of light used. **[June 2017]**
7. In Young's double slit experiment the distance of the screen from the double slit is 2m. When light of wavelength 550 nm is incident on the double slit, fringes of width 2mm are obtained. Determine the separation between the slits. Find the fringe width when light of wavelength 400 nm is used. **[March 2017]**
8. In Young's double slit experiment the slits are separated by 0.28 mm and the screen is placed at a distance of 1.4 m away from the slits. The distance between the central bright fringe and the fifth dark fringe is measured to be 1.35 cm. Calculate the wavelength of the light used. Also find the fringe width if the screen is moved 0.4 m towards the slits for the same experimental setup. **[March 2018]**
9. In Young's double slit experiment wavelength of light used is 500 nm and distance between the slits is 2mm, distance of the screen from the slits is 1m. Find the fringe width and also calculate the distance of 7^{th} dark fringe from central bright fringe. **[March 2019]**

CHAPTER – 11

Dual Nature of Radiation and Matter

Electron emission:

Q. Mention three types of electron emissions. **[March 2014, March 2019, June 2019]**

Q. Define electron volt. **[July 2016]**

Photoelectric effect:

Q. Mention Hallwachs' and Lenard's observations. **[June 2015]**

Q. Define work function. **[June 2015, July 2016, June 2017, March 2018]**

Q. Define threshold frequency. **[June 2015, June 2017, March 2018]**

Q. Mention five experimental observations of photoelectric effect (or laws of photoelectric emission) **[March 2016, March 2017, July 2018, March 2019]**

Q. Write Einstein's equation of photoelectric effect. Give Einstein's explanation of photoelectric effect. **[March 2015]**

Q. Define stopping potential. **[June 2015, June 2017]**

Photon:

Q. Mention three properties of photon. **[March 2014, March 2018]**

Q. What is the rest mass of a photon? **[June 2019]**

Matter waves:

Q. What are matter waves or de-Broglie waves? **[July 2016, June 2017]**

Q. What is de-Broglie wavelength? **[March 2017]**

Q. How does the de-Broglie wavelength vary with momentum of moving particle? **[June 2017]**

Q. Mention the de-Broglie relation and explain the terms. **[July 2016, March 2017]**

Q. Write the de-Broglie wavelength of electrons in terms of electric potential and explain the terms. **[March 2019]**

Q. Calculate de-Broglie wavelength associated with an electron moving with a speed of 2×10^5 ms^{-1}. Given $h = 6.625 \times 10^{-34}$ Js, $m_e = 9.11 \times 10^{-31}$ kg. **[July 2018]**

Problems:

1. The work function of caesium metal is 2.14 eV. When light of frequency 6×10^{14}Hz is incident on the metal surface, photoemission of electrons occurs. What is the (a) energy of the incident photons (b) maximum kinetic energy of the emitted electrons. (c) Stopping potential, and (d) maximum speed of the emitted photoelectrons? Given $h = 6.63 \times 10^{-34}$ Js, $e = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$kg **[July 2014]**

2. Light of frequency 8.41 x 10^{14} Hz is incident on a metal surface. Electrons with their maximum speed of 7.5 x 10^{5} ms^{-1} are ejected from the surface. Calculate the threshold frequency for photoemission of electrons. Also find the work function of the metal in eV. Given Planck's constant = 6.625 x 10^{-34} Js and mass of the electron = 9.1x 10^{-31} kg. **[March 2018]**

3. Light of frequency 7.21 x 10^{14} Hz is incident on a metal surface. Electrons with their maximum speed of 6.0 x 10^{5} ms^{-1} are ejected from the surface. Calculate the threshold frequency for photoemission of electrons. Given Planck's constant = 6.626 x 10^{-34} Js
[March 2017]

CHAPTER – 12

Atoms

Atomic models:

Q. Draw the schematic diagram of Geiger-Marsden (Rutherford's) experiment. **[March 2018]**

Q. What is impact parameter? When it is minimum? **[March 2017]**

Bohr's theory:

Q. State and explain Bohr's postulates of hydrogen atom. **[March 2014, June 2015, March 2017, March 2018, March 2019]**

Radius of orbit:

Q. Obtain the expression for radius of n^{th} orbit of H-atom. **[March 2015]**

Energy of electron:

Q. Obtain the expression for energy of the electron in the n^{th} orbit of H-atom. **[July 2014, July 2016, June 2017, July 2018, June 2019]**

Q. Write the expression for energy of the electron in the n^{th} orbit of H-atom. **[March 2019]**

Hydrogen series:

Q. Name the spectral series of hydrogen which lies in the ultraviolet region of electromagnetic spectrum. **[March 2015, March 2018]**

Q. Name the spectral series of hydrogen which lies in the visible region of electromagnetic spectrum. **[June 2015, June 2019]**

Q. Mention the limitations of Bohr model. **[March 2014, March 2018]**

de-Broglie's explanation:

Q. Give de Broglie's explanation of Bohr's second postulate of quantisation. **[March 2018]**

Problems:

1. Calculate the shortest and longest wavelength of Ballmer series of hydrogen atom. Given $R = 1.097 \times 10^7\ m^{-1}$. **[March 2016]**
2. The first member of the Balmer series of hydrogen atom has wavelength 6563Å. Calculate the wavelength and frequency of the second member of the same series.$c = 3 \times 10^8\ ms^{-1}$. **[March 2017]**
3. Calculate the wave number, wavelength and frequency of H_α line of hydrogen spectrum. $R = 1.097 \times 10^7\ m^{-1}$, $c = 3 \times 10^8\ ms^{-1}$. **[March 2017]**

Chapter – 13
Nuclei

Nuclei:

Q. What are isotopes? Give example. **[July 2014, March 2016, June 2019]**

Q. What are isobars? Give example. **[March 2016]**

Properties of nucleus:

Q. What is the ratio of nuclear densities of two nuclei having mass number in the ratio 1:3? **[July 2016]**

Mass defect and binding energy:

Q. Mention the element which has highest specific binding energy. **[March 2017]**

Nuclear force:

Q. What is a nuclear force? Mention its properties. **[July 2014, March 2016, March 2018]**

Nuclear fission and fusion:

Q. Fusion reaction requires very high temperature. Why? **[March 2017]**

Radioactivity:

Q. The decay of proton to neutron is possible only inside the nucleus. Why? **[March 2018]**

Activity:

Q. Name the SI unit of activity? **[June 2015, March 2017]**

Half and mean life:

Q. Define half life. **[July 2014, March 2017, June 2017, March 2018]**

Q. Derive the expression for half life of a radioactive element. **[July 2014, March 2017, March 2018]**

Q. Identify the particle X in the following reaction: $n \rightarrow p + e^{-1} + X$ **[March 2016]**

Problems:

1. Calculate the mass defect and specific binding energy of $_7N^{14}$, given that the rest mass of nitrogen nucleus is 14.00307 u, m_P = 1.00783 u and m_n = 1.00867 u. **[March 2014, March 2018]**

2. Determine the mass of Na^{22} which has an activity of 5 mCi. Half life of Na^{22} is 2.6 years. Avogadro number = 6.023×10^{23} **[March 2015]**
3. Calculate the half life and mean life of Radium 226 of activity 1Ci. Given mass of Radium 226 is 1g. 226 g of radium consists of 6.023×10^{23} atoms. **[June 2015]**
4. The half life of a radioactive sample $_{38}Sr^{90}$ is 28 years. Calculate the rate of disintegration of 15 mg of this isotope. Given Avogadro number = 6.023×10^{23} **[July 2018]**
5. Half life of U-238 undergoing α-decay is 4.5×10^9 years. What is the activity of one gram of U-238 sample? **[March 2019]**

CHAPTER – 14

Semiconductor Electronics

Band theory of solids:

Q. Explain conduction band, valence band and energy gap in semiconductor. **[March 2019]**

Q. Explain the formation of energy bands in solids. On the basis of energy bands distinguish between a metal, a semiconductor and an insulator. **[March 2014]**

Q. Classify metals, semiconductors and insulators based on the band theory of solids with diagram. **[March 2015, March 2018]**

Intrinsic and extrinsic semiconductor:

Q. What are intrinsic semiconductors? **[June 2015]**

p-type and n-type semiconductor:

Q. Name the element used as dopant to obtain p-type semiconductor. **[June 2015]**

Q. Distinguish between n-type and p-type semiconductor. **[July 2014, July 2016, March 2017, March 2018, March 2019]**

p-n junction diode:

Q. What is depletion region in a semiconductor diode? **[March 2018]**

Q. Describe the action of a p-n junction when it is (i) forward biased (ii) reverse biased with I-V characteristics **[July 2018]**

Rectifiers:

Q. What is rectification? **[June 2015, March 2016, March 2017, March 2018, June 2019]**

Q. What is a rectifier? **[March 2018]**

Q. Write the neat circuit diagram of a half wave rectifier and explain its working. Draw the input and output waveforms. **[March 2018, June 2019]**

Q. Write the neat circuit diagram of a full wave rectifier and explain its working. Draw the input and output waveforms. **[July 2014, June 2015, March 2016, March 2017]**

Optoelectronic junction devices:

Q. What is a photodiode? **[March 2015]**

Q. Mention the applications photodiode. **[March 2015]**

Q. Mention the applications LED. **[July 2014, March 2017]**

Q. Mention two advantages of LED over conventional incandescent low power lamps. **[June 2017, July 2018]**

Logic gates:

Q. Write the circuit symbol and truth table of OR gate. **[March 2014]**

Q. Write the circuit symbol and truth table of AND gate. **[July 2014, March 2017, June 2017, March 2018]**

Q. Draw the circuit symbol of NOR gate. **[March 2017]**

Q. What is NAND gate? **[March 2017, June 2019]**

Q. Write the circuit symbol and truth table of NAND gate. **[March 2016, July 2016, March 2017, June 2019]**

Q. Write the output of the NAND gate if A = 1 and B = 0. **[June 2015]**