

## (English Version)

**Instructions :**

1. *All parts are compulsory.*
2. *For PART – A questions, only the first written answers will be considered for evaluation.*
3. *Answers without relevant diagram / figure / circuit wherever necessary will not carry any marks.*
4. *Direct answers to numerical problems without detailed solutions will not carry any marks.*

**PART – A**

- I. Pick the correct option among the four given options for all of the following questions:

(15 × 1 = 15)

- 1) The electric dipole placed in uniform electric field experiences
  - a) Only force
  - b) Only torque
  - c) Force and torque
  - d) Neither force nor torque
- 2) A sphere has charge  $Q$ . Relative to  $V = 0$  at infinity, the electrostatic potential  $V$  and electric field  $E$  inside the sphere are
 

a) $V = 0$ and $E = 0$	b) $V \neq 0$ and $E = 0$
c) $V \neq 0$ and $E \neq 0$	d) $V = 0$ and $E \neq 0$
- 3) The ratio of magnitude of drift velocity and electric field is
 

a) Acceleration	b) Resistivity
c) Conductivity	d) Mobility

4) The relation between permittivity of free space ( $\epsilon_0$ ), permeability of free space ( $\mu_0$ ) and speed of light in vacuum(C) is given by

a)  $\epsilon_0 \mu_0 = C$       b)  $\epsilon_0 \mu_0 = C^2$   
 c)  $\epsilon_0 \mu_0 = \frac{1}{C^2}$       d)  $\epsilon_0 \mu_0 = \frac{1}{C}$

5) Below are two statements related to diamagnetism:

I. Diamagnetic material do not have permanent magnetic moment.  
 II. The resultant magnetic moment of individual electrons neutralizes each other.

a) Both statements I and II are correct and II statement is not the correct explanation for I  
 b) Both statements I and II are correct and II statement is the correct explanation for I  
 c) Statement I is wrong and statement II is correct  
 d) Statement I is correct and statement II is wrong

6) Lenz's law is the law of conservation of

a) Momentum      b) Charge  
 c) Resistance      d) Energy

7) Self inductance of a coil measures its

a) Magnetic flux  
 b) Electrical inertia  
 c) Motional emf  
 d) Mutual inductance

8) The opposition for current in series LCR circuit is called

- a) Resistance
- b) Capacitive reactance
- c) Inductive reactance
- d) Impedance

9) The concept of displacement current was introduced by

- a) Gauss
- b) Ampere
- c) Maxwell
- d) Faraday

10) The resolving power of a telescope can be increased by

- a) Using objective of larger diameter
- b) Using eye piece of smaller diameter
- c) Using objective of smaller diameter
- d) Using eye piece of larger diameter

11) Polaroids are used to

- a) Produce coherent waves
- b) Control the intensity of light
- c) Produce diffraction pattern
- d) Produce interference pattern

12) The statements given below are related to the properties of photons:

- I. photons are electrically neutral.
- II. photons are undeflected by electric and magnetic fields.
- III. photons are light waves.
- IV. In photon particle collision, total energy and momentum are not conserved.

- a) Only statements I and III are correct
- b) Only statements II and IV are correct
- c) Only statements I and II are correct
- d) Only statements I and IV are correct

13) The result of Geiger-Marsden experiment leads to the discovery of

- a) Atom
- b) Nucleus
- c) Radioactivity
- d) Line spectra of hydrogen atom

14) Stellar energy is due to

- a) Nuclear fission
- b)  $\beta$  – decay
- c)  $\alpha$  – decay
- d) Thermonuclear fussion

15) In intrinsic semiconductors

- a) Only free electrons are present
- b) Only holes are present
- c) Number of free electrons are equal to the number of holes
- d) Number of free electrons are not equal to the number of holes

II. Fill in the blanks by choosing appropriate answer given in the bracket for all the following questions:  $(5 \times 1 = 5)$

[Diffraction, Circular, Silicon, Independent, Interference, AC generator]

- 16) The charged particle moving perpendicular to the direction of uniform magnetic field traverse a \_\_\_\_\_ path.
- 17) The device working on the principle of electromagnetic induction is \_\_\_\_\_.
- 18) Encroachment of light in the region of geometrical shadow is called \_\_\_\_\_.
- 19) The nuclear density is \_\_\_\_\_ of its mass number.
- 20) \_\_\_\_\_ is an example for elemental semiconductor.

#### PART – B

III. Answer any five of the following questions:  $(5 \times 2 = 10)$

- 21) State and explain Gauss's law in electrostatics.
- 22) The potential at a point is given by  $V = ax - bx^2$  where a and b are constants.  
Find the value of electric field at that point.
- 23) Write the expression for Lorentz's force and explain the terms used.
- 24) Define magnetisation and write its SI unit.
- 25) When the magnetic flux through a given surface is
  - a) Maximum?
  - b) Minimum?

26) Give the value of power factor of

- Pure resistive circuit
- Pure inductive circuit.

27) Mention any two applications of microwaves.

28) Two thin convex lenses of focal length  $f_1$  and  $f_2$  are kept in contact. Write the expression for effective focal length and effective power of the combination.

29) Distinguish between conductors and insulators on the basis of band theory.

### PART – C

IV. Answer any five of the following questions:  $(5 \times 3 = 15)$

- Mention any three basic properties of electric charge.
- Obtain an expression for potential energy of system of two charges in the absence of electric field.
- Mention any three factors on which resistance of a conductor depends.
- Explain the conversion of given galvanometer into an ammeter.
- Write any three properties of magnetic field lines.
- Describe the coil and magnet experiment of electromagnetic induction.
- Write two conditions for total internal reflection of light and hence define critical angle.
- Give any three limitations of Bohr's atom model of hydrogen.
- Determine the radius of nucleus of mass number 125. [Given  $R_0 = 1.2 \times 10^{-15}$  m]

## PART – D

V. Answer any three of the following questions:  $(3 \times 5 = 15)$

39) a) Derive an expression for equivalent capacitance of two capacitors connected in series.  $(3)$

b) Write any two properties of the equipotential surface.  $(2)$

40) Deduce the condition for balance of a Wheatstone's bridge using Kirchhoff's laws.

41) Using Biot-Savart law, arrive at the expression for magnetic field at a point on the axis of circular current loop.

42) a) Prove the law of reflection of a plane wave using Huygen's principle.  $(3)$

b) Draw a schematic diagram of refraction of a plane wave by a thin prism.  $(2)$

43) What is photoelectric effect? Write experimental observations of photoelectric effect.

44) What is rectification? Using p-n junction diode explain the working of half wave rectifier with circuit diagram and write the input and output waveform.

VI. Answer any two of the following questions:  $(2 \times 5 = 10)$

45) The electrostatic force on a metal sphere of charge  $0.6 \mu\text{C}$  due to another identical metal sphere of charge  $-1.2 \mu\text{C}$  is  $45 \times 10^{-3} \text{ N}$ . Find the distance between two spheres. Also find the force between the same two spheres when they are brought into contact and then placed at their initial position.

46) The number density of free electrons in copper is estimated to be  $8.5 \times 10^{28} \text{ m}^{-3}$ . A copper wire of length  $5.0\text{m}$  and area of cross-section  $1.5\text{mm}^2$  is carrying a current of  $3.0 \text{ A}$ . Calculate the drift velocity of electrons. How long does an electron take to drift from one end of the wire to its other end?

47) A Sinusoidal voltage of 220V and 50 Hz is applied to a series LCR circuit, in which

$$R = 10\Omega, L = 25.48 \text{ mH and } C = 796 \mu\text{F}.$$

Find a) The frequency at which resonance occurs

b) The value of current at resonance.

48) An equilateral prism of refractive index 1.532 is placed in air. If a parallel beam of light is incident on one face of the prism at the minimum deviation position, find the angle of deviation.

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