(English Version)

General Instructions :

1. *All parts are* **compulsory.**
2. *For* **Part – A** *questions, only the first written answer will be considered for awarding marks.*
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** the following questions: **(15 × 1 = 15)**

1) How many electrons must be removed from a body to get charge on the body +1 C?

(a) 6.25×10^{12} (b) 6.25×10^{18}

(c) 1.6×10^{18} (d) 1.6×10^{12}

2) Water molecule is a polar molecule because

(a) the centres of positive and negative charges coincide

(b) the centres of positive and negative charges do not coincide

(c) it does not have permanent dipole moment

(d) In an external electric field it does not induce charges

3) The resistance R of a metallic conductor is inversely proportional to _____

(a) Length of the conductor

(b) area of cross section of the conductor

(c) both length and area of cross section of the conductor

(d) temperature of the conductor

4) SI unit of magnetic field is

(a) gauss

(b) newton metre ampere

(c) tesla

(d) newton metre

5) The net magnetic moment per unit volume of a substance is

(a) magnetisation

(b) magnetic permeability

(c) magnetic susceptibility

(d) magnetic flux

6) The magnitude of the induced emf in a circuit is equal to the time rate of change of magnetic flux through the circuit is the statement of:

(a) Gauss's law in magnetism

(b) Faraday's law

(c) Ampere's circuital law

(d) Biot-Savart's law

7) Statement I : Inductance is a scalar quantity

Statement II : The dimensional formula of inductance is $[ML^2T^{-2}A^{-2}]$

(a) Statement I is correct and statement II is wrong

(b) Both the statements I and II are correct

(c) Both the statements I and II are wrong

(d) Statement I is wrong and statement II is correct

8) Mutual induction is the working principle of _____

(a) ammeter

(b) electric motor

(c) transformer

(d) voltmeter

9) Which one of the following electromagnetic waves has highest frequency?

(a) X-rays (b) Radiowaves

(c) Infrared rays (d) Gamma rays

10) The ratio of speed of light in vacuum to the speed of light in a medium gives:

(a) absolute refractive index of the medium

(b) relative refractive index

(c) relative mass density

(d) mass density of the medium

11) Statement I : Light is a transverse electromagnetic wave

Statement II : Polarisation of light confirms transverse nature of light

(a) Statement I is correct but statement II is wrong

(b) Statement I is wrong but Statement II is correct

(c) Both the statements are correct and statement II is correct confirmation of Statement I

(d) Both the statements are wrong

12) Following particles are moving with same speed, which one of them has longest de Broglie wavelength?

(a) proton (b) neutron

(c) alpha particle (d) electron

13) The plum pudding model of atom was given by

(a) J.J. Thomson (b) Rutherford

(c) Niels Bohr (d) Einstein

14) Which one of the following is not a characteristic of Nuclear forces?

(a) strongest forces

(b) saturated forces

(c) charge independent forces

(d) charge dependent forces

15) An intrinsic semiconductor is

(a) a substance having equal number of free electrons and holes at room temperature

(b) a substance having unequal number of free electrons and holes at room temperature

(c) a conductor at temperature T = 0 K

(d) an insulator at room temperature

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

(Heavy nucleus, diffraction, attract, decreases, Lenz's law, repel)

16) Two parallel long straight conductors carrying currents in the same direction _____ each other.

17) _____ gives polarity of induced emf.

18) The phenomenon in which formation of alternate dark and bright regions in geometrical shadow of a opaque object is called _____

19) The breaking of _____ into two nuclei of intermediate masses and release of energy is called nuclear fission.

20) When a p-n junction is in forward-biased as biased potential increases, the width of depletion region _____ .

Part - B

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

21) State and explain Gauss's law in electrostatics.

22) Two capacitors 3μF and 6μF are connected in series. Find the equivalent capacitance of the combination.

23) When does a charged particle moving in a uniform magnetic field experience?

(i) Maximum force

(ii) Minimum force.

24) Give any two properties of magnetic field lines.

25) Write an expression for induced emf in a straight conductor moving perpendicular to uniform magnetic field and explain the terms.

26) Write an expression for instantaneous current in an ac circuit containing pure capacitor and explain the terms.

27) Give two applications of UV rays.

28) Define critical angle of a medium. Mention the relation between refractive index and critical angle of a medium.

29) Write any two differences between p-type and n-type semi conductors.

Part - C

IV. Answer any five of the following questions: **(5 × 3 = 15)**

30) Mention three basic properties of electric charges.

31) Derive the relation between electric field and electric potential in a uniform electric field.

32) State and explain Kirchhoff's rules of electrical network.

33) With a circuit diagram explain conversion of galvanometer to voltmeter.

34) Write any three differences between diamagnetic and ferromagnetic substances.

35) Obtain an expression for instantaneous induced emf produced in an ac generator.

36) Draw a ray diagram of refraction of monochromatic light through a prism. Mention the expression for deviation in a thin prism.

37) Deduce an expression for energy of electron in hydrogen atom in terms of radius of the orbit.

38) Calculate binding energy of oxygen nucleus $\left({}^{16}_{8}O\right)$ in MeV using the following data:

Mass of oxygen nucleus = 15.99053 u

Mass of a proton = 1.00727 u

Mass of a neutron = 1.00866 u

Part - D

V. Answer any **three** of the following questions: (3 × 5 = 15)

39) Obtain an expression for electrostatic potential at a point due to an isolated point charge.

40) Deduce expressions for equivalent emf and equivalent internal resistance, when two different cells are connected in parallel.

41) Derive an expression for magnetic field at a point on axis of circular current loop.

42) (a) What are coherent sources? (1)

(b) Mention the conditions for constructive and destructive interference of light in terms of path difference. (2)

(c) Write any two uses of Polaroids. (2)

43) (a) What is meant by photoelectric effect? (1)

(b) Mention any two experimental observations of photoelectric effect. (2)

(c) Write Einstein's photoelectric equation and explain the terms. (2)

44) With a neat circuit diagram explain the working of p-n junction diodes as full wave rectifier, also draw input and output waveforms.

VI. Answer any **two** of the following questions: (2 × 5 = 10)

45) The electrostatic force on a small sphere of charge 0.4 μC due to another small sphere of charge – 0.8 μC in air separated by a distance (d) is 0.2 N.

(a) Find the distance between the two spheres.

(b) What is the magnitude and nature of force on the second sphere due to the first?

46) The number density of free electrons in a metallic wire is $8.0 \times 10^{28}\ m^{-3}$. The area of cross section of the wire is $1.5 \times 10^{-6}\ m^2$ and carries a current 2.0 A. Find the drift velocity of free electrons and current density.

47) A sinusoidal voltage of rms value 10 volts and frequency 50Hz is applied to a series LR circuit in which R = 3Ω, and L = 12.75 mH

Find

a) Impedance of the circuit

b) rms current

c) phase difference between current and voltage.

48) Double-Convex lenses are to be manufactured from a glass of refractive index 1.52, with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 25 cm? What will be the new focal length, when the lens is immersed in water of refractive index 1.33?
