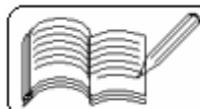


Instructions :

1. There are 4 Sections and total 60 questions in this question paper.
2. Symbols used in this question paper have their usual meanings.
3. Log table or simple electronic calculator can be used.
4. Write new Section on a new page.

SECTION A

- Questions 1 to 16 are multi-choice questions. Choose the correct option.
Each question is of ONE mark. 16
1. The radius of a conducting spherical shell is 10 mm and a 100 μC charge is spread on it. The force acting on a 10 μC charge placed at its centre is ... (Take $k = 9 \times 10^9 \text{ MKS}$).
(a) 10^3 N (b) 10^2 N (c) zero (d) 10^5 N
 2. The potential energy of the system in which one electron is brought closer to another electron will
(a) increase (b) not change (c) decrease (d) become zero
 3. The maximum amount of current which can be drawn from the battery, whose emf is equal to 12 V and internal resistance 0.4Ω , will be equal to ...
(a) 24 A (b) 30 A (c) 4.8 A (d) 48 A
 4. Select the correct statement from the following :
(a) Peltier effect is the combined effect of Seebeck and Thomson effects.
(b) Thomson effect is the combined effect of Peltier and Seebeck effects.
(c) Seebeck effect is the combined effect of Peltier and Thomson effects.
(d) None of the above.
 5. A charged particle is moving through a uniform magnetic field, then its
(a) momentum changes but kinetic energy does not change.
(b) both momentum and kinetic energy change.
(c) momentum and kinetic energy do not change.
(d) kinetic energy changes but momentum does not change.
 6. At a place, horizontal component of earth's magnetic field is $\sqrt{3}$ times its vertical component. The angle of dip at the place is
(a) 0 (c) $\frac{\pi}{3} \text{ rad}$ (c) $\frac{\pi}{6} \text{ rad}$ (d) $\frac{\pi}{2} \text{ rad}$
 7. If a stationary charged particle does not experience any net electromagnetic force, then ...
(a) magnetic field may be zero or nonzero (b) magnetic field must be zero
(c) electric field may be zero or nonzero (d) electric field must be zero

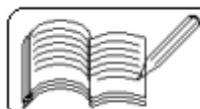


8. The real power in an A. C. circuit containing only inductor is equal to W.
(a) $\frac{1}{2} LI^2$ (b) $\frac{1}{2} LI$ (c) $2 LI^2$ (d) zero
9. According to Maxwell, a changing electric field produces
(a) emf (b) electric current (c) magnetic field (d) radiation pressure
10. Focal length of the lens of the eye is changed by
(a) retina (b) cornea (c) ciliary muscles (d) crystalline lens
11. In Young's experiment, the distance between the two slits is halved and the distance between the screen and the slit is doubled. The width of the fringe
(a) remains the same (b) becomes half (c) becomes double (d) becomes 4 times
12. If photo - electric effect is not seen with the ultra - violet radiations in a given metal, photo - electrons may be emitted with the
(a) infrared waves (b) radio waves (c) X - rays (d) visible light
13. In a hydrogen atom, when an electron experiences transition from fourth to second state, line is emitted.
(a) second of Paschen series (b) second of Balmer series
(c) first of Pfund series (d) second of Lyman series
14. The energy band diagram of Si semiconductor crystal at absolute zero temperature,
(a) has completely empty valence band and completely filled conduction band
(b) has completely empty conduction band and completely filled valence band
(c) has completely empty valence and conduction bands and completely filled forbidden gap
(d) the conduction band is partially filled
15. The bandwidth of an optical fibre communication system is approximately
(a) 10^6 Hz to 10^9 Hz (b) 10^9 Hz to 10^{11} Hz
(c) 10^{13} Hz to 10^{14} Hz (d) 10^3 Hz to 10^6 Hz
16. What is the minimum number of geostationary satellites needed to establish communication over the entire surface of the earth ?
(a) 2 (b) 3 (c) 4 (d) 6

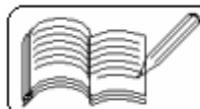
SECTION B

- Questions 17 to 32 are very short answer type questions, each carrying ONE mark. 16

17. State Gauss's Theorem (or Law).



18. Which of the fact is most generalized in case of a metallic conductor kept in an electric field ?
19. Define : ' Electric Current Density'.
20. What is known as the 'drift velocity' ?
21. Write a formula for magnitude of thermo - electric power for a thermocouple having thermoelectric constants α and β .
22. What is the change in the radius of the path and frequency of a charged particle moving in magnetic field when its momentum is increased ?
23. With reference to the earth, at which place is the angle of dip equal to $\frac{\pi}{2}$ radian ?
24. What is the power factor in L - C - R circuit when $\omega^2 LC = 1$? OR
What is known as 'Eddy current' ?
25. What are called the inductive components of electro - magnetic waves ? OR
The electro - magnetic waves having wavelengths less than A° are absorbed in ozone layer.
26. Which type of scattering is known as Rayleigh's scattering ? OR
Write the condition for total internal reflection.
27. State Brewster's law.
28. How can we find out whether the given light incident on tourmaline plate is polarized or unpolarized ?
29. Write de Broglie's hypothesis.
30. Which of the fact indicates that the nucleus has no definite surface ? OR
Which of the series is in the visible region of hydrogen spectrum ?
31. Draw a circuit symbol representing PN junction.
32. Of which category is the communication via modem ? OR
What is the function of transducer ?



SECTION C

- Questions 33 to 48 are short answer type questions, each carrying TWO marks. 32

33. A dipole coincides with Z - axis and origin is at the mid - point of dipole. Obtain an equation for electric field intensity of such electric dipole at a point having any position vector.

OR

Write any four characteristics of electric field lines.

34. In a parallel connection of two cells having different emf and different internal resistance, obtain an equation for current passing through each cell.
35. Electric current divides among two resistors connected in parallel in such a way that the joule - heat developed becomes minimum. Using this fact, obtain the equation of division of current.
36. Discuss variations in the Earth's magnetic field with respect to time.
37. Compare electric dipole and magnetic dipole. (Any two points of comparison for each).
38. Find the value of self - inductance of a very long solenoid of length l having total number of turns equal to N and cross - sectional area A .
39. Obtain rms value of Alternating voltage $V = V_m \cos \omega t$.

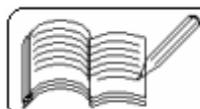
OR

In L - C - R, A. C. circuit voltage $V = V_m \cos \omega t$ is applied. Obtain differential equation for electric charge Q for this circuit.

40. Considering energy density of electromagnetic wave in any region as

$$\rho = \frac{\epsilon_0 \cdot E^2}{2} + \frac{B^2}{2\mu_0}, \text{ obtain an equation for energy density } \rho = \epsilon_0 \cdot E_{\text{rms}}^2.$$

41. For a thin lens, prove that when the heights of the object and the image are equal, object distance and image distance are equal to $2f$.
42. Write a detailed note on Nicol Prism.



43. Compare interference and diffraction with respect to their fringes.
44. State any four characteristics of photon.

OR

Write Einstein's explanation for photoelectric effect.

45. Write any four properties of LASER beam.
46. When one proton is converted into one neutron and also when one neutron is converted into one proton, then give the names of two particles emitted during each corresponding conversion. Give essential nuclear equations for each conversion.

OR

What is a nuclear chain reaction? Discuss any two precautions needed for it to be successful.

47. Write a note on P - type semiconductor.
48. Explain propagation of ground - waves.

SECTION D

- Answer the questions 49 to 60 as directed, each carrying THREE marks.

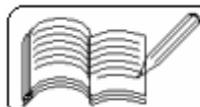
36

49. A circle having radius a has line charge distribution over its circumference having linear charge density $\lambda = \lambda_0 \cos^2 \theta$. Calculate the total electric charge residing on the circumference of the circle.

$$\left[\text{Hint: } \int_0^{2\pi} \cos^2 \theta \, d\theta = \pi \right]$$

50. Electric field present in certain region is given by $\vec{E} = \frac{A}{x^2} \hat{i}$. Prove that this field is a conservative field.
51. An emf of $412.5 \mu\text{V}$ is developed in a Fe - Cd (Cd = Cadmium) thermocouple when its cold junction is at 0°C and hot junction at 30°C . When hot junction is kept at 100°C , $1200 \mu\text{V}$ emf is produced, then find constants α and β of the thermocouple.

OR



The internal resistance of a 12 V battery is changing with current which is given by the equation $r = \alpha + \beta \cdot I$, where $\alpha = 0.15 \Omega$ and $\beta = 0.018 \Omega / A$. If the current flowing from the battery is given by $I_1 = 1 A$ and $I_2 = 10 A$, calculate terminal voltage of the battery.

52. An electron in an atom is revolving round the nucleus in a circular orbit with a speed of 10^7 m/s. If the radius of the orbit is 10^{-10} m, find the resulting magnetic field at the centre. ($e = 1.6 \times 10^{-19}$ C, $\mu_0 = 4 \pi \times 10^{-7}$ Tm/s)

OR

A steamer is to sail in the direction making an angle of 10° west with the south. The magnetic declination at the place is 17° west from the north. In which direction should the steamer sail ?

53. A U - shaped conducting frame is placed in a uniform magnetic field B in such a way that the plane of the frame is perpendicular to the field lines. A conducting rod is supported on the parallel arms of the frame, perpendicular to them and is given a velocity V_0 at time $t = 0$. Prove that the velocity of the rod at time t is given by

$$V_t = V_0 \cdot e^{\left(\frac{-B^2 l^2}{mR} \cdot t \right)}$$

Where R = resistance of the circuit,
m = mass of the rod and
l = distance between two arms.

54. Prove that the average value of an A. C. voltage source given by $V = V_m \sin \omega t$ is equal to $\frac{2V_m}{\pi}$ for half period of its cycle.

55. An object is moving towards the concave mirror along its principal axis with uniform velocity V_0 . Prove that when the object is at a distance u from the concave mirror, velocity of the image is

$$V_i = - \left[\frac{R}{2u - R} \right]^2 \cdot V_0 \quad R = \text{radius of curvature of the mirror.}$$

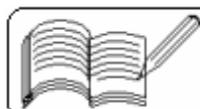
OR

The plane polarized light is normally incident on a Polaroid. The Polaroid is rotated with the angular speed 10 rad/s about this ray of light. If the incident light energy in one second is 4.0 mJ, what will be the light energy emerging out of the Polaroid during one rotation ?

$$\left[\text{Hint: } \int_0^T \cos^2 \omega t \, dt = \frac{\pi}{\omega} \right]$$

56. Radius of a beam of radiation of wave - length 5000 \AA is 10^{-3} m. Power of the beam is 10^{-3} W. What will be the charge emitted by the metal per unit area in unit time ? Assume that each incident photon emits one electron, $h = 6.6 \times 10^{-34}$ Js.

OR



11×10^{11} photons are incident on a surface in 10 s. These photons correspond to a wave - length of 10 \AA . If the surface area of the given surface is 0.01 m^2 , find the intensity of given radiations. Velocity of light = $3 \times 10^8 \text{ m/s}$, $h = 6.6 \times 10^{-34} \text{ Js}$.

57. In a X - ray tube, the p. d. between anode and cathode is 12.4 kV and current flowing is 2 mA. Find : (a) the number of electrons striking the anode in 1 s., (b) the speed of electrons while striking the anode and (c) minimum wave - length (λ_{\min}) emitted.
58. What fraction of a radioactive substance will be decayed in time $\frac{1}{\lambda}$?
 λ = radioactive constant.
59. The current gain of a common base (CB) circuit is equal to α and the current gain of a common emitter (CE) circuit is equal to β . Find the relationship between α and β .
60. Electron - hole pairs are formed when 6000 \AA wave - length light is incident on the semiconductor. What will be the band gap energy of the semiconductor ?
 $h = 6.62 \times 10^{-34} \text{ Js}$.

