This Question Paper contains 8 Printed Pages.

054(E)

(MARCH, 2007)

Time : 3.00 Hours] ***[Maximum Marks : 100***

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 from a new page.

SECTION - A

*Question Nos. **1** to **16** are multiple choice questions. Each carries **ONE** mark. Choose correct answer (A, B, C, D) from the given alternatives and write it.* **16**

1. The dimensions of Permitivity [ε_0] are .....

Take Q as dimension of charge

(A) $M^{-1}L^{3}T^{-2}Q^{-2}$ (B) $M^{-1}L^{-3}T^{2}Q^{2}$

(C) $M^{-1}L^{2}T^{-3}Q^{-1}$ (D) $M^{1}L^{-2}T^{-2}Q^{-2}$

2. One variable capacitor is connected to a 100 V battery. If the capacitance is increased from 2 μF to 10 μF, then the change in energy in the above system will be .....

(A) 2×10^{-2} J (B) 2.5×10^{-2} J

(C) 4×10^{-2} J (D) 6.5×10^{-2} J

3. Maximum power in a 0.5 Ω resistance connected with two batteries of 2V *emf* and 1Ω internal resistance in parallel is

(A) 2 W (B) 1.28 W

(C) $\frac{8}{9}$ W (D) 3.2 W

4. A wire of $2\,m$ is bent in the form of a circular loop. The magnetic moment of the loop when 1 A current flows through it is ..... Am^2.

(A) 2π (B) $\frac{1}{\pi}$

(C) $\frac{\pi}{2}$ (D) $\frac{\pi}{4}$

5. Magnetization intensity for Vacuum is

(A) Zero (B) Negative

(C) Positive (D) ∞

6. The relative permeability of a diamagnetic substance is

(A) negative (B) very large

(C) less than one (D) small but greater than 1.

7. An inductor stores energy in its .....

(A) electric field (B) conducting wire

(C) magnetic field (D) electric and magnetic field.

8. Which of the following option for L, C and R does not give us the dimension of frequency?

(A) $\frac{C}{L}$ (B) $\frac{1}{\sqrt{LC}}$

(C) $\frac{R}{L}$ (D) $\frac{1}{RC}$

9. The maximum value of $\vec{E}$ in an electromagnetic wave is equal to 18 Vm^{-1}, then the maximum value of $\vec{B}$ will be equal to

(A) 4×10^{-6} T (B) 6×10^{-8} T

(C) 9×10^{-9} T (D) 11×10^{-11} T

10. Focal length of the lens of the eye is changed by

(A) Cornea (B) Ciliary muscles

(C) Retina (D) Crystallic lens

11. Which of the following phenomenon is not possible for Sound?

(A) Polarization (B) Reflection

(C) Interference (D) Diffraction

12. A proton and an α-particle are passed through same potential difference. If their initial velocity is zero, the ratio of their de-Broglie's wave-length after getting accelerated is

(A) 1 : 1 (B) 1 : 2

(C) 2 : 1 (D) $2\sqrt{2} : 1$

13. The frequency of characteristic X-ray determines ..... property of the target.

(A) Atomic weight (B) Atomic number

(C) Melting point (D) Conductivity

14. Half life of a radio active element is 5 min. In 20 min. the .....% of the substance will remain undecayed.

(A) 6.25 (B) 25

(C) 75 (D) 93.75

15. Complete the following reaction :

$_{92}U^{235} + {}_0n^1 \rightarrow \ldots\ldots + {}_{38}Kr^{90} + \ldots\ldots\ldots$

(A) $_{54}Xe^{143}$, $3\,{}_0n^1$ (B) $_{54}Xe^{145}$

(C) $_{57}Xe^{142}$ (D) $_{54}Xe^{142}$, $_0n^1$

16. The value of the depletion capacitance ..... on increasing the reverse bias.

(A) increases (B) decreases

(C) becomes zero (D) does not change

SECTION - B

*Questions **17** to **32** are very short questions each carrying **ONE** mark.* **16**

17. Write Coulomb's Inverse Square law.

18. Define Static Electric Potential.

OR

Write dimensional formula of Capacitance.

19. How many electrons will pass in one second through a conducting wire carrying current equal to 0.64 A ? $e = 1.6 \times 10^{-19}$ C.

OR

What is Ohmic loss ?

20. What is called Toroid?

OR

What is called Gyro-magnetic ratio?

21. What is called Permanent magnets?

22. What is called Inductor? Draw its Circuit symbol?

23. Write principle of a Transformer.

24. How much current does leg or lead the voltage in A.C. circuit with only inductor?

25. What is Mie-Scattering?

26. Write Huygen's principle.

27. What is Polarised light?

28. Slope of a graph of $V_0 e \rightarrow f$ gives which physical quantity?

OR

Write De-Broglie hypothesis.

29. Name the series which falls in ultra violet region of Hydrogen spectra.

30. Fill in the blank :

$1\,n$ Ci = ... Bq

31. What is called Doping?

OR

Write boolean equation of 'NOT' gate.

32. In case of a transistor, write formula showing relation between I_E, I_C, and I_B.

SECTION - C

Question Nos. ***33*** *to* ***48*** *are short answer type questions.*

Each question carries ***TWO*** *marks.* **32**

33. Using Gaussian law, derive formula for electric field due to an infinitely long straight charged wire (line charge).

$$\vec{E} = \frac{\lambda}{2\pi\varepsilon_0} \cdot \frac{1}{r}\ \hat{r}\ .$$

OR

Obtain formula for capacitance of a parallel plate capacitor.

34. Write Kirchhoff's First Law and obtain equation using necessary figure.

35. Explain charging process in Lead storage cell (accumulator), using necessary circuit.

36. Obtain formula for force (Lorentz force) acting an a charge moving in a magnetic and electric field.

37. Write down points of comparison between an electric dipole and a magnetic dipole.

38. Write two definitions of Mutual Inductance and on which factors it depends?

39. Define real power for A.C. circuit and hence obtain formula for power.

$P = V_{rms}\ I_{rms} \cos\delta$ for A.C. series circuit.

40. Derive Gaussian formula for concave mirror using appropriate figure.

41. For a Prism, derive formula $i + e = A + \delta$.

42. Write down condition for constructive and destructive interference in terms of Path difference and Phase difference.

43. Write four characteristics of Photon.

OR

Write four uses of a Photocell.

44. Write limitations of Bohr model.

OR

Write four uses of LASER Light.

45. Define Radio activity and obtain Exponential law for radio-active decay.

46. Name the parameters of a Transistor and define them.

47. Draw logic circuit of AND gate and describe two cases of input and output of AND gate.

48. Explain Analog and Digital communication.

OR

Explain Simplex and Duplex communication.

SECTION - D

Question Nos. ***49*** *to* ***60*** *are short answer type questions.*
Each question carries ***THREE*** *marks.* ***36***

49. Q amount of charge is uniformly distributed over some body. How should the body be divided into two parts, so that the force acting between the two parts is maximum for a given separation between them?

50. A drop of water (spherically shaped) has 3×10^{-10} C amount of charge residing on it. 500 V electric potential exists on its surface. Calculate the radius of this drop. Two such drops (having identical charge and radius) combine to form a new drop. Calculate the electric potential on the surface of the new drop.

$K = 9 \times 10^9$ SI.

51. 29.1×10^{-2} A current is obtained when a 5Ω resistor is connected with a battery of unknown internal resistance r and unknown *emf*.

14.7×10^{-2} A current is obtained, if the above battery is connected to 10Ω resistor. Calculate the *emf* and internal resistance of the battery.

52. A battery having an *emf* ε and an internal resistance r is connected with a resistance R. Prove that the power in the external resistance is maximum when $R = r$.

53. An electron in an atom is revolving round the nucleus in a circular orbit with a speed of 10^7 ms^{-1}. If the radius of the orbit is 10^{-10} m, find the resulting magnetic field at the center. $e = 1.6 \times 10^{-19}$ C ; $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}

OR

A toroidal core with 3000 turns has inner and outer radii of 0.11 m and 0.12 m respectively. When a current of 700 mA is passed, then the magnetic field produced in the core is 2.5 T. Find the relative permeability of the core ($\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}).

54. Two long solenoids are of equal length l and the smaller solenoid having cross-sectional area a is placed within the larger solenoid in such a way that their axes coincide. Find the mutual inductance of the system.

OR

For an A.C. circuit comprising of L-C-R in series, L = 10 H, W=100 rad s^{-1}, R = 100 Ω and Power Factor is equal to 0.5. Calculate the capacitance of the circuit.

55. A 1000 W bulb is kept at the centre of a spherical surface and is at a distance of 10 m from the surface.

Find E_0, B_0 (the maximum electric and magnetic field strengths) and I (the intensity of the waves). Take the working efficiency of the bulb as 2.5% and consider it as a point source. $\varepsilon_0 = 8.85 \times 10^{-12}$ SI and $C = 3 \times 10^8$ ms^{-1}.

56. When a linear object is placed infront of a convex mirror, image of the ¼ th size of object is formed. Calculate the object distance and the image distance. This linear object is kept perpendicular to the axis.

OR

The ratio of intensities of light emerging from two sources is α. For the interference pattern produced by them, prove that

$$\frac{I_{max} + I_{min}}{I_{max} - I_{min}} = \frac{1+\alpha}{2\sqrt{\alpha}}$$

where I_{max} = Intensity of bright fringe, and

I_{min} = Intensity of dark (faint) fringe.

57. Wave length of Light incident on a photo-sensitive surface is reduced from 4000 Å to 360 nm. Find the change in stopping potential.
$h = 6.625 \times 10^{-34}$ Js.

58. Calculate the quantum number for which the radius of the orbit of electron in Be^{3+} would be equal to that for the ground state of electron in Hydrogen atom. Also compare the energy of the two states.

OR

Mass of a $_{17}Cl^{35}$ nucleus is 34.9800 u. If mass of a proton is 1.00783 u and neutron is 1.00866 u, find the binding energy of $_{17}Cl^{35}$ nucleus. Take 1 u = 931 M*e* V.

59. The base current changes by 200 μA when a 200 mV signal is applied at the input of a CE amplifier. If the output voltage is equal to 2 volt, what is the voltage gain?

60. Height of TV tower is 10^2 m. If the average population density is 1000 / km^2, how many people can observe the programmes of this station?
(Radius of the Earth = 6400 km)