61321

Third Semester B.Sc. Degree Examination, November/December 2019

(CBCS - Freshers Scheme)

Physics

Paper 301 – ELECTRICITY AND MAGNETISM

Time : 3 Hours] *[Max. Marks : 70*

*Instructions to Candidates : Answer any **FIVE** questions from each Part.*

PART – A

Answer any **FIVE** questions. Each question carries **8** marks : **(5 × 8 = 40)**

1. (a) What are ideal voltage and current sources?

   (b) State Thevenin's theorem. With a suitable network of resistances explain the determination of Thevenin's voltage and Thevenin's resistance. **(2 + 6)**

2. (a) Derive an expression for energy stored in an inductor.

   (b) Derive an expression for the decay of charge in a series CR circuit. **(3 + 5)**

3. Derive an expression for magnetic field at a point on the axis of a current carrying solenoid and hence show that field at one end of the solenoid of infinite length is half that at the centre. **(8)**

4. (a) Give the theory of moving coil ballistic galvanometer and hence obtain an expression for charge flowing through it.

   (b) Mention any three applications of ballistic galvanometer. **(5 + 3)**

5. (a) What is displacement current? Mention any two properties of displacement current.

   (b) Derive the Maxwell's equation $\nabla \cdot \vec{B} = 0$. What is its physical significance? **(3 + 5)**

6. (a) State and explain Poynting theorem.

   (b) Show that in an electromagnetic field energy is equally shared between electric and magnetic fields. **(6 + 2)**

7. (a) What is the condition for resonance of a series LCR circuit and hence obtain the expression for resonant frequency?

   (b) For a series resonant circuit, define (i) quality factor (ii) band width. Also write the expressions for them. **(4 + 4)**

8. (a) State the laws of thermoelectricity.

   (b) Applying the principle of thermodynamics arrive at the relation $\pi = T\left(\frac{dE}{dT}\right)$. **(4 + 4)**

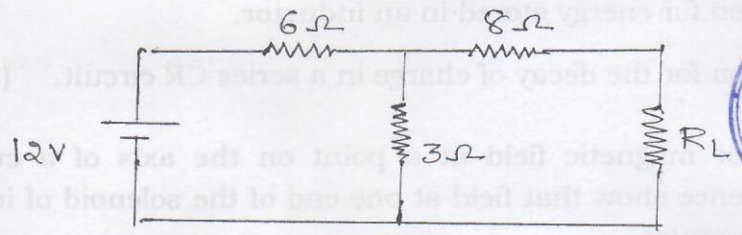
PART – B

Solve any **FIVE** questions. Each problem carries **4** marks : **(5 × 4 = 20)**

(permeability of free space = $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$)

(permittivity of free space = $t_0 = 8.85 \times 10^{-12} Fm^{-1}$)

9. Find the value of R_L in the given network to obtain maximum power in it. Also find the maximum power.



10. In an LR circuit the current attains $\frac{1}{3}$rd of its final steady value in 1s after the circuit is closed. What is the time constant of the circuit?

11. An electron experiences greatest force as it travels $3.9 \times 10^5 ms^{-1}$ in a magnetic field when it is moving westwards. The force is upward and is of magnitude $8.2 \times 10^{-13} N$. What is the magnitude and direction of the magnetic field? (Given electron charge = $1.6 \times 10^{-19} C$)

12. A Helmholtz galvanometer has coils of circumference 0.49 m each and number of turns 50. Calculate the current through the coils which produces a deflection of 45^0 (Given $B_H = 0.38 \times 10^{-4} T$)

13. A plane wave travelling in a loss less medium has a wavelength of 0.25 m and its velocity of propagation is $1.5\times10^{8}ms^{-1}$. Find the frequency and permittivity of the medium.

14. An electromagnetic wave of frequency $1.6\times10^{6}Hz$ propagating in a conducting medium has the conductivity of $38.2\times10^{6}Sm^{-1}$, calculate the skin depth Given $\mu_r = 1$.

15. A condenser of capacitance $2\mu F$ is connected in series with a resistor to a 220 V, 50 Hz ac supply. If the potential difference across the condenser and resistor are equal in magnitude, calculate the resistance and phase current in the circuit.

16. The temperature of cold junction of a thermocouple is $0^{0}C$ and the temperature of the hot junction is $\theta^{0}C$. The thermo emf is given by $E=16\theta-0.04\theta^{2}\mu v$. Find (a) neutral temperature (b) temperature of inversion.

PART – C

17. Answer any **FIVE** questions. Each question carries **2** marks : **(5 × 2 = 10)**

(a) Is there any loss of energy due to the production of back emf in a LR circuit? Explain.

(b) An α-particle and a β-particle are projected with the same velocity perpendicular to the magnetic field. Do they experience the same force? Explain.

(c) Is the field produced in a toroid uniform? Explain.

(d) In a ballistic galvanometer the leakage method is suitable to determine high resistance only. Why? Explain.

(e) What does the small value of quality factor indicate? Explain.

(f) Does the skin depth for a good conductor depend on the wave frequency? Explain.

(g) A series resonance circuit is called an acceptor circuit. Why? Explain.

(h) Does the thermo electric effect obey the law of conservation of energy? Explain.