Q.P. Code : 11321

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

(CBCS – Freshers – Semester Scheme)

Physics

Paper III — ELECTRICITY AND MAGNETISM

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

Instructions to Candidates :

1) *Answer any Five questions from each Part.*

2) *Use of non-programmable Scientific calculator/Mathematical tables are allowed.*

PART – A

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

1. (a) How do you convert the current source into voltage source?

   (b) State and prove super position theorem. **(2 + 6)**

2. (a) Obtain an expression for the self inductance of a solenoid.

   (b) Derive an expression for the growth of charge in series CR circuit connected to a dc source. Represent it graphically. **(3 + 5)**

3. (a) Derive an expression for the force between two parallel current carrying conductors.

   (b) Obtain an expression for magnetic field at a point near a straight conductor carrying current using Biot-Savart's law. **(4 + 4)**

4. (a) Obtain an expression for the magnetic field on the axis of a solenoid carrying current.

   (b) Mention any two conditions for Ballistic Galvanometer to be dead beat. **(6 + 2)**

5. (a) Explain briefly surface integral of a function.

   (b) Derive Maxwell's equation $\nabla . B = 0$ and write its physical significance. **(2 + 6)**

6. (a) Derive the relation between refractive index and permittivity of a medium.

   (b) Show that the electromagnetic waves are transverse in nature. **(2 + 6)**

7. Derive expressions with diagrams for current, phase angle and impedance of series LCR ac circuit by J operator method. **(8)**

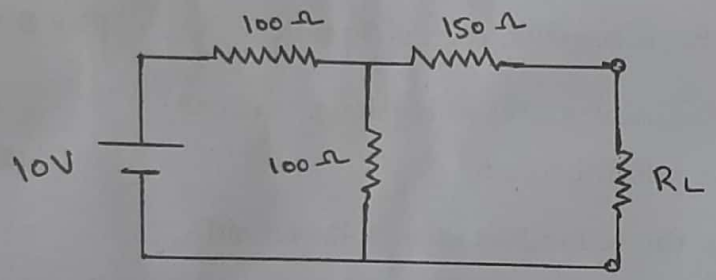
8. (a) Distinguish between Seebeck effect and Thomson effect.

   (b) Apply the principles of thermodynamics and arrive at the relation $\pi = T\left[\frac{dE}{dT}\right]$ where the symbols have their usual meaning. **(3 + 5)**

PART – B

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

9. For the circuit shown below, calculate the value of R_L to transfer maximum power and also the maximum power.



10. A coil having a resistance of 120 Ω and inductance of 24 H is connected across 24 V battery. Find the current after 0.2 seconds.

11. A capacitor of capacitance 1 μF is discharged through a high resistance of 10 MΩ. Find the time taken for half the charge on the capacitor to leak.

12. Each two coils of a Helmholtz Galvanometer contains 50 turns of wire of mean radius 0.2 m. When a current of 0.1 A is passed through the coil a deflection of 45° is obtained. Calculate the horizontal component of earth's magnetic field. Given $\mu_0 = 4\pi \times 10^{-7}\ \text{Hm}^{-1}$.

13. Find constants (a, b, c) so that the vector

$A = \hat{i}(x + 2y + az) + \hat{j}(6x - 3y - z) + \hat{k}(4x + cy + 2z)$ is irrotational.

14. Electromagnetic waves are propagating through a conductivity medium made up of aluminium with $\sigma = 38.2 \times 10^6\ Sm^{-1}$. Calculate the skin depth and frequency of wave having a velocity of 650 ms^{-1}. Given $\mu = \mu_0 = 4\pi \times 10^{-7}\ Hm^{-1}$.

15. A condenser of capacity $0.2\ \mu F$ is connected in series with a resistor to a 220 V, 50 Hz ac supply. If the potential drop across the condenser and resistor are equal in magnitude. Calculate the value of resistance and the potential drop across resistor.

16. The emf of a thermocouple of which one junction is at $0^\circ c$ and the other at $50^\circ C$ is 25 μV. The neutral temperature is $100^\circ C$. Find the emf when the junctions are at $0^\circ C$ and $200^\circ C$.

PART – C

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

(a) Can Thevenin's theorem be applied to nonlinear networks? Explain.

(b) What is the effect on frequency of oscillatory discharge in series LCR circuit if an inductor of more number of turns are used? Explain.

(c) Is it possible for a charge to pass through a magnetic field without getting deflected? Explain.

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

(e) Is the displacement current and conduction current being of same magnitude for a given system? Justify.

(f) Is it possible to have only electric wave or magnetic wave alone propagating through space? Explain.

(g) Does current lags the voltage in a pure inductive circuit? Explain.

(h) The thermo emf of a thermocouple is very small – Justify.
