Second Semester B.Sc. Degree Examination, April/May 2019

(Revised CBCS – 2018 Onwards)

Physics

Paper II — ELECTROSTATICS, ELECTROMAGNETISM AND CURRENT ELECTRICITY

Time : 3 Hours] *[Max. Marks : 90*

Instructions to Candidates : Answers should be written completely in English.

### PART – A

I. Answer any **FIVE** of the following. Each question carries **8** marks.   **(5 × 8 = 40)**

1. Derive expressions for the electric potential (a) inside and (b) outside of a uniformly charged solid sphere.   **(8)**

2. (a) Derive an expression for the energy stored by a charged capacitor.

   (b) Explain polarization of dielectrics.   **(6 + 2)**

3. (a) State and explain Biot-Savart's law.

   (b) Derive an expression for magnetic field due to current in a straight conductor of infinite length using Biot-Savart's law.   **(2 + 6)**

4. (a) Derive an expression for energy stored in the inductance coil.

   (b) What are eddy currents? Explain its applications.   **(4 + 4)**

5. (a) Define magnetic permeability and magnetic susceptibility.

   (b) What are dia, para and ferromagnetic materials? Mention their properties.   **(2 + 6)**

6. Deduce Maxwell's equations.

   (a) $\vec{\nabla} \cdot \vec{D} = \delta$

   (b) $\vec{\nabla} \cdot \vec{B} = 0$.   **(8)**

7. Obtain an expression for the growth of charge in a CR-circuit, with a steady e.m.f. applied to it. Define time constant of the CR circuit and represent the growth of charge graphically.   **(8)**

8. State and prove superposition theorem.   **(8)**

PART – B

II. Answer any **SIX** of the following. Each question carries **5** marks. **(6 × 5 = 30)**

9. If $\vec{A} = 2\hat{i} - 3\hat{j} - \hat{k}$ and $\vec{B} = \hat{i} + 4\hat{j} - 2\hat{k}$, find (a) $\vec{A} \times \vec{B}$ and (b) $\vec{B} \times \vec{A}$.

10. An insulating sphere with a radius of 20 cm carries a uniform volume charge density of 1.5 $\mu c/m^3$. Find the magnitude of electric field at a point inside the sphere that lies 8 cm from the centre. Given $E_0 = 8.85 \times 10^{-12}$ F/m.

11. A straight solenoid of length 2.4 m is wound on a non magnetic tube of radius 0.02 m. If there are 100 turns, calculate the magnetic field at the centre and at the end of the solenoid when current of 1.2 A flows through it. Given $\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}.

12. A condenser of capacity $1\mu F$ is discharged through a high resistance. Half the charge on the condenser leaks in 20 S, calculate the value of the high resistance.

13. A magnetic material has a magnetization of 2500 Am^{-1} and flux density 0.004 T. Calculate the magnetic field intensity and relative permeability of the material. Given $\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}.

14. Calculate the magnitude of the pointing vector on the surface of the hemisphere of radius 10 km with the broadcasting station at its centre, if the average power radiated by the station is 10 km. Also calculate the maximum value of electric field intensity on the surface of the hemisphere. Given $\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}.

15. A series circuit consists of 250Ω resistor, 3H inductor and 8.5μF capacitor. If the voltage is 240 V at 50 Hz. Calculate (a) impedance (b) the circuit current.

16. Using Norton's theorem calculate current flowing through 12Ω resistor.
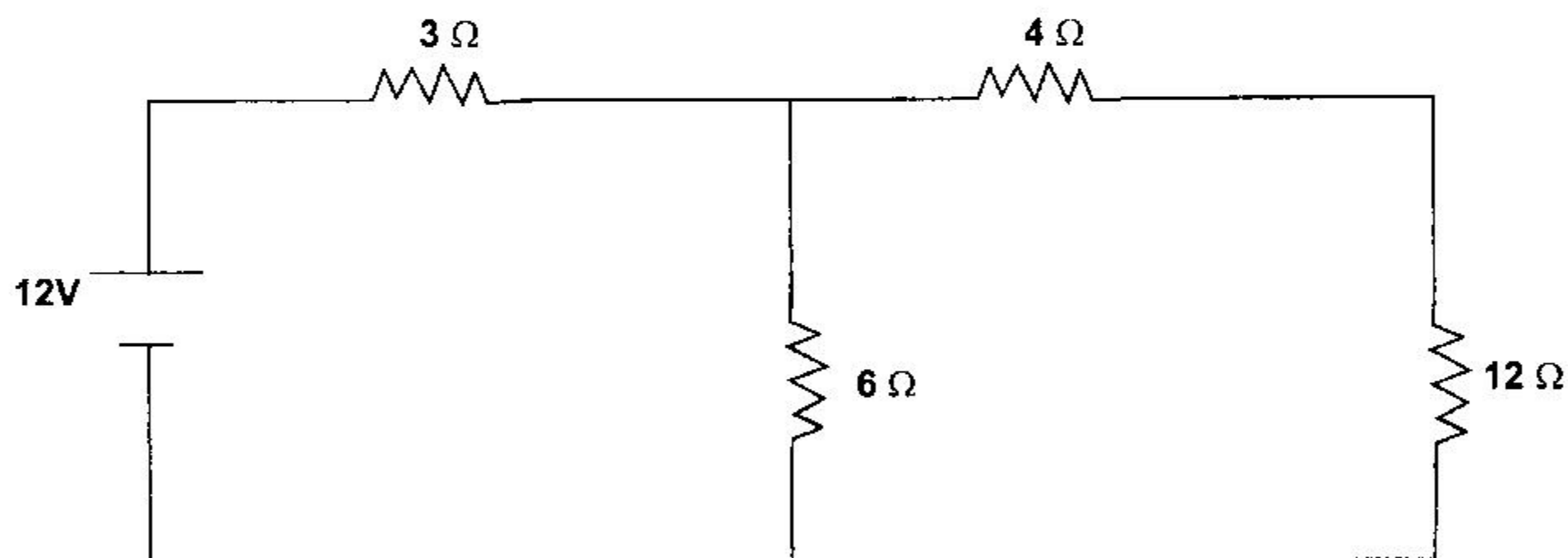
PART – C

III. Answer any **TEN** of the following. Each question carries **2** marks. **(10 × 2 = 20)**

17. (a) When does the dot product of two vectors becomes maximum? Explain.

   (b) Describe the physical significance of divergence.

   (c) What happens to the capacitance of a capacitor if the dielectric is introduced between the plates of a capacitor? Explain.

   (d) Is any work done by a magnetic field on a moving charge? Explain.

   (e) How do you increase the charge sensitivity of a ballistic galvanometer?

   (f) The induced e.m.f. is greater during break of the circuit than during make of the circuit. Why?

   (g) Why is hammering demagnetize a magnet?

   (h) Velocity of electromagnetic waves in a dielectric medium is less than that in free space. Explain.

   (i) Displacement current is as real as the conduction current. Explain.

   (j) How did resistance in series LR circuit influences the growth and decay of current?

   (k) A parallel resonance circuit is called as a rejector circuit. Why?

   (l) What is the condition on the value of load resistance to draw maximum power from the source?