B.Sc. DEGREE END SEMESTER EXAMINATION - OCTOBER 2025
SEMESTER 5 : PHYSICS
COURSE : **19U5CRPHY05 : ELECTRICITY AND ELECTRODYNAMICS**

(For Regular 2023 Admission and Supplementary 2022/ 2021/ 2020/ 2019 Admissions)

Time : Three Hours   Max. Marks: 60

PART A
Answer any 8 (2 marks each)

1. State, what are monochromatic plane waves.

2. Illustrate skin effect, graphically.

3. State, an application for the law of intermediate temperatures, in the context of thermoelectricity.

4. Recall the wave equation, relating to electric field.

5. Give the work done to move a point charge from one point to another on an equipotential surface?

6. Illustrate voltage and current waveforms in a resistive circuit.

7. State, what are plane waves.

8. Recall the expression for current and voltage in a capacitive circuit.

9. Comment on the net force and torque on a dipole placed in a uniform electric field.

10. An electric field of 10^5N/C points towards east at a certain point. What is the direction of the magnetic field also calculate the magnitude of the force on a charge -3μC placed at that point.

(2 x 8 = 16)

PART B
Answer any 6 (4 marks each)

11. Explain how Maxwell corrected Ampere's Law.

12. A coil has an inductance of 0.2 H and a resistance of 15 ohms. It is connected to 220 V, 60 Hz mains. Determine (i) the reactance of the coil, (ii) impedance of the coil.

13. A capacitor is charged by DC supply through a resistance of 2 mega ohms. If it takes 500 ms for the charge to reach 3/4 of its final value, what is the capacitance of the capacitor?

14. A resistance R and a 2 micro farad capacitor in series are connected to a 200 V DC supply. Across the capacitor is a neon lamp that strikes at 120 V. Calculate the value of R to make the lamp strike at 5 s after the switch has been closed.

15. An alternating potential of 120 V at 60 Hz is applied across a series circuit having an inductance of 5 Henry, a resistance of 100 ohm and a variable capacitance. At what value of the capacitance will the current in the circuit be in phase with the applied voltage? Calculate the current in this condition. What will be potential drops across the circuit elements?

16. A horizontal rod $0.2m$ long is mounted on a balance and carries a current. At the location of the rod a uniform horizontal magnetic field has magnitude of $0.067\,T$ and direction perpendicular to the rod. The magnetic force on the rod is found to be $0.13\,N$. What is the current in the rod?

17. Derive the wave equations of electric and magnetic fields.

18. A wire of length l carries a current I along the x-axis. A magnetic field of $B=B_0(\hat{y}+\hat{z})$ exists in the space. Find the magnitude of the magnetic force acting on the wire.

(4 x 6 = 24)

PART C
Answer any 2 (10 marks each)

19. Setup the differential equation governing the alternating current flow in a series LCR circuit and obtain the oscillatory solution.

20. State Maxwell's equations. Discuss the boundary conditions of fields.

21. Discuss the oscillatory growth of electric current in a LCR circuit.

22. (a) Write down the electrostatic properties of an ideal conductor. (b) Two spherical cavities , of radii a and b, are hollowed out from the interior of a conducting sphere of radius R. At the centre of each cavity a point charge is placed - call these charges q_a and q_b. (c) (i) Find the surface charge densities σ_a, σ_b and σ_R . (ii) What is the field outside the conductor. (iii) What is the field within each cavity. (iv) What is the force on q_a and q_b?

(10 x 2 = 20)