

U.G. 2nd Semester Examination - 2022

PHYSICS

[HONOURS]

Course Code : PHY-H-CC-T-03

(Electricity and Magnetism)

Full Marks : 40

Time : $2\frac{1}{2}$ Hours

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP-A

1. Answer any **five** questions: 2×5=10
- What is critical damping resistance in a ballistic galvanometer? What are the uses of ballistic galvanometer?
 - State and explain maximum power transfer theorem.
 - Show that the power of an A.C. circuit is $P = E_{r.m.s} \times I_{r.m.s} \times \cos \theta$.
 - What is self inductance? Determine its S.I. unit.

[Turn Over]

- Calculate the torque on a current loop with area A and carrying current I in a uniform magnetic field B.
- A point charge Q is kept at the center of a cube. Calculate the electric flux through one face of the cube.
- State and explain Laplace equation. Find out the condition when potential is maximum or minimum.
- Define magnetic susceptibility and permeability. Find the relation between them.

GROUP-B

- Answer any **two** questions: 5×2=10
- Consider a rod of length 'l' with a charge Q distributed uniformly over it. A test charge q_0 is placed on the axis of the rod at a distance 'd' from its nearest end. Find the force on q_0 due to the rod.
 - The electric field at any inside point of a charged sphere of radius 'R' is $\vec{E} = Ar^3\hat{r}$ (where A is constant). Find the volume charge density and also the total charge within the sphere.

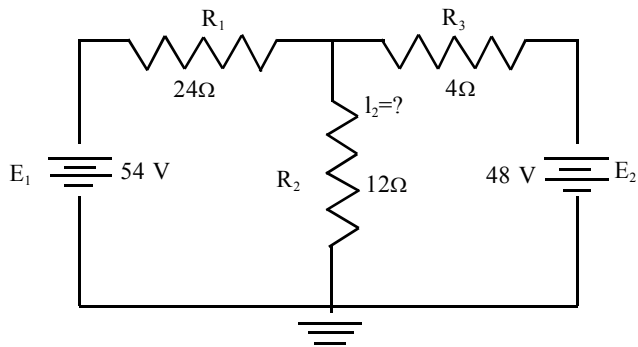
3+2

3. Deduce the boundary condition predominant at the interference of two dielectrics. 5
4. Calculate the magnetic field at the mid point of a Helmholtz coil with radius ' a ' and having ' N ' no of turns carrying current I . 5
5. An AC circuit is connected to a 220V, 50Hz supply contains a 40H coil of resistance 200Ω connected in series with a $1\mu\text{F}$ capacitor. Calculate the power factor of the circuit. 5

GROUP-C

Answer any **two** questions: 10×2=20

6. a) Using the superposition theorem, determine the current through the 12Ω resistor in the following figure



- b) Show that work done per unit volume per cycle of magnetization is equal to the area enclosed by the hysteresis loop. 7+3

7. a) What is magnetic vector potential? Determine the magnetic vector potential from the magnetic field due to volume current distribution.
- b) Find the magnetic field at the origin $(0, 0, 0)$ from a vector potential $\vec{A} = (y \cos ax)\hat{i} + (y + e^x)\hat{k}$.
- c) What are the damping factors in a moving coil Galvanometer. Construct an equation of motion for the damped harmonic motion of the moving coil Galvanometer. (1+3)+3+(1+2)

8. Consider a point charge $+q$ in front of a conducting sphere of radius ' a ' at a distance ' l ' from the center. Find (i) The location and the value of the image charge, (ii) potential and radial component of the electrical intensity at an external point due to the induced charge on the sphere. 5+5

9. a) Calculate self-inductance of a co axial cylinder with radii a_1 and a_2 .
- b) Consider two inductors with inductance L_1 and L_2 and M is the mutual inductance between them. They are in parallel combination. Calculate the equivalence inductance. 4+6