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III Semester B.Sc. Degree Examination, March/April - 2022

PHYSICS

Electricity and Magnetism

(CBCS Semester Scheme Freshers 2021-22)

Paper : III

Maximum Marks : 70

Time : 3 Hours

Instructions to candidates :

- 1) All Multiple Choice questions in Part-A are to be compulsory answered in page-1
- 2) Non-programmable Scientific calculators are allowed.

PART - A

Answer All questions. Each question carries One Mark.

(10×1=10)

1. Kirchoff's voltage law is based on the
 - a) law of conservation of linear momentum
 - b) law of conservation of charge
 - c) law of conservation of energy
 - d) law of conservation of angular momentum.
2. A horizontal wire of length 0.1m and mass 0.5g carries a current of 5A. The magnitude of transverse magnetic field which can support the weight of the wire is ($g=10\text{ms}^{-2}$)
 - a) 10^{-3}T
 - b) 10^{-2}T
 - c) 10^{-4}T
 - d) 0.1 T
3. A proton being shot perpendicular to a uniform magnetic field
 - a) moves along a circle with its plane perpendicular to the field
 - b) moves along a circle with its plane along the field
 - c) moves straight
 - d) moves along an ellipse with its plane perpendicular to the field.
4. Two concentric coplanar loops of radii 7cm and 10cm carry currents such that the net magnetic field at their common centre is zero. If current in the outer loop is 7A clock wise, the current in the inner loop is
 - a) 4.9 A anti clock wise
 - b) 4.9 A clock wise
 - c) 14 A clock wise
 - d) 3.5 A clock wise

[P.T.O.]



5. Two identical loops one of copper and another of aluminium are rotated with same speed in a uniform magnetic field, then
- emf developed in copper loop is more than that in aluminium
 - emf developed in aluminium loop is more than that in copper
 - same emf is induced in both the loops
 - cannot be predicted as the induced emf is dependent on the direction of rotation.
6. Time constant of a C R circuit is the time for charging the capacitor
- completely
 - to about 63.2% of its maximum charge
 - to about 50% of its maximum charge
 - to about 36.8% of its maximum charge
7. Nature of a series LCR circuit fed by an ac source at resonance is
- capacitive
 - inductive
 - resistive
 - dependent on L and C value
8. The rate at which energy carried by an electromagnetic wave in free space per unit area is
- $\frac{1}{\mu_0}(\vec{E} \times \vec{B})$
 - $\frac{1}{\mu_0}(\vec{B} \times \vec{E})$
 - $\frac{1}{\mu_0}(\vec{E} \cdot \vec{B})$
 - $\frac{1}{\epsilon_0}(\vec{E} \times \vec{B})$
9. Which of the following is not an electromagnetic wave?
- Microwaves
 - γ -rays
 - Infrasonic waves
 - visible rays
10. The divergence of a vector is
- a scalar
 - a vector
 - either a scalar or a vector
 - always a null vector

PART - B

Answer any **Five** questions. Each question carries Two Marks.

(5×2=10)

11. State maximum power transfer theorem. What is the maximum possible power delivered to load resistance?
12. A current carrying conductor is placed in a uniform magnetic field. When does it experience
- maximum force
 - minimum force?



13. Using the expression for magnetic field at any point on the axis of a current carrying circular coil, arrive at the expression for the magnetic field at its centre.
14. What is self-induction? Define one Henry of self-inductance.
15. Mention the expression for the energy stored in an inductor and explain the symbols.
16. Write the expression for power dissipation in an alternating circuit. When does an ac circuit become wattless?
17. State Gauss' divergence theorem.
18. What is double refraction? Distinguish between positive and negative crystals.

PART - C

Answer any **Five** questions. Each question carries Six Marks. (5×6=30)

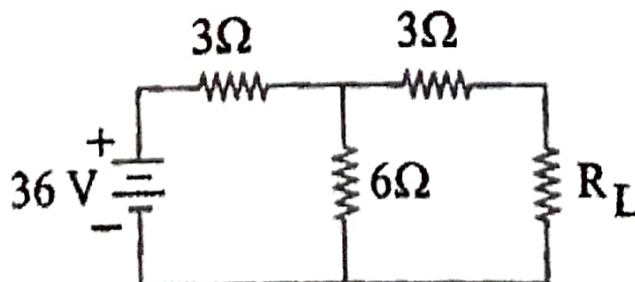
19. State and prove superposition theorem (6)
20. Arrive at the expression for the charge through a ballistic galvanometer. (6)
21. Discuss the theory of Helmholtz double coil tangent galvanometer. (6)
22. a) What is a transformer used for? Mention the principle on which a transformer works.
b) Mention the different power losses in transformers. (2+4)
23. Derive an expression for growth of current in a LR circuit. (6)
24. Obtain the expression for the impedance in a series LCR circuit by j operator method. (6)
25. Derive the Maxwell's equation $\nabla \cdot \vec{B} = 0$ (6)
26. a) What is a retarding plate? What is it used for?
b) Obtain the expression for the thickness of a quarter wave plate. (2+4)

PART - D

Answer **Four** questions. Each question carries Five Marks. (4×5=20)

27. Find the current through the load resistance R_L using Thevenin's theorem.

Given: $R_L = 2\Omega$





28. A capacitor of $2 \mu F$ being fully charged is discharged through a high resistance. If half the charge on the capacitor leaks in 20s, find the value of high resistance.
29. Two long and thin straight conducting wires A and B, carrying currents of 2 A and 1 A respectively are held parallel in free space at a separation of 2cm. Calculate the resultant magnetic field at the point midway between the wires if they carry currents in the
i) same direction and ii) opposite directions.
30. Magnetic flux linked with coil of resistance 10Ω varies with time according to the equation $\phi = 6t^2 - 5t + 4$. Calculate
i) induced emf and ii) induced current at $t=0.25s$.
31. A capacitor is being charged from a dc source through a resistance of $2M\Omega$. If it takes 0.5s for the charge to reach $\frac{3}{4}$ of its final value, find the capacitance of the capacitor.
32. A series combination of an inductor of self-inductance $\frac{1}{\pi} H$ and a resistor of resistance of 100Ω is connected to an ac source of 110V, $50H_z$. Find the current in the circuit.
33. Find the divergence of \vec{B} at a point (1,-1,1) given $\vec{B} = x^2y\hat{i} - 2y^3z^2\hat{j} + xy^2z\hat{k}$.
34. Calculate the thickness of a half wave plate for light of wavelength 5893\AA . Refractive indices of the crystal plate for ordinary and extraordinary rays are respectively 1.544 and 1.553.
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