

[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5401

J

Unique Paper Code : 2224001201

Name of the Paper : Electricity and Magnetism

Name of the Course : **B.Sc. Hons.-(Physics)_NEP: UGCF-2022**

Semester : II – (GE Paper)

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question 1 is compulsory.
3. Four questions to be attempted from Q. No. 2 to 6.

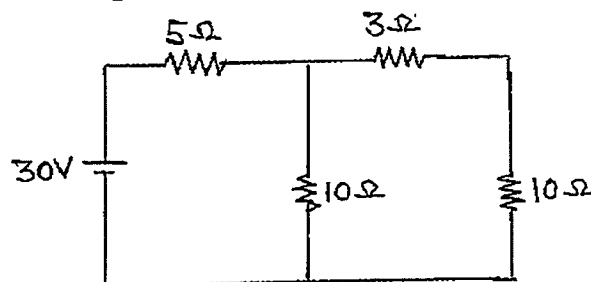
1. Attempt any **six** questions :

- (i) What do you understand by Line and Surface integral in electrostatics.
- (ii) What is Dielectric constant. Explain its significance in a Parallel plate capacitor.
- (iii) Explain the Divergence and Curl in magnetism.
- (iv) Define magnetic permeability, susceptibility and magnetization.
- (v) What is Lenz law. How it is related to the conservation of energy in electrostatics?
- (vi) Explain Kirchoff voltage law.
- (vii) State and explain Norton theorem. (6×3=18)

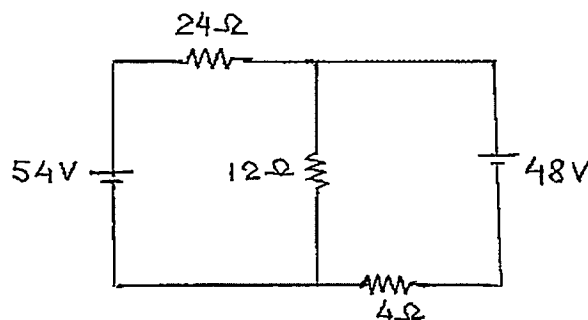
2.
 - (i) State and explain the Gauss law of Electrostatics. Use this law to derive the expression for electric field strength due to an uniformly charged thin spherical shell when the point under consideration is (a) inside the shell and (b) outside the shell
 - (ii) Define Electric field (E), Electric displacement vector (D) and Polarization (P). Derive the expression $P = \epsilon_0 E (K-1)$, where ϵ_0 is permittivity of free space and K is dielectric constant.
 - (iii) If two point conductors containing charges of 10 nC and 20 nC are placed 20 cm apart, find the electric field at the midpoint between the two charges. (8+7+3)

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3. (i) Explain Biot Savart law. Obtain expression for magnetic field due to current in a long straight wire.
- (ii) With the help of Ampere circuital law, derive an expression for the magnetic field due to a long solenoid.
- (iii) If area of each plate of a parallel plate capacitor is $8 \times 10^{-2} \text{ m}^2$ and are separated by a distance 2 mm apart, find the capacitance if the gap between the plate is filled with a medium of dielectric constant 5. (8+7+3)
4. (i) Define Self and Mutual induction. Find the equivalent inductance of two inductances L_1 and L_2 connected in series.
- (ii) Solve Maxwell equations to show that the electromagnetic waves are transverse in nature and travels with a speed of light in which electric and magnetic vectors are mutually perpendicular.
- (iii) A primary coil of 500 turns and a secondary coil of 40 turns are wound on an iron ring of mean radius of 10 cm and radius of the circular cross-sectional area of 2 cm. If the relative permeability of iron is 800, calculate the mutual inductance of the combined coils. (7+7+4)
5. (i) State and explain Thevenin theorem. Use this theorem to find the current flowing through $R_L = 10 \Omega$ in the network given below.



- (ii) State and prove Superposition theorem. Find the current flowing through 12Ω resistance using the Superposition theorem. (9+9)



6. Answer any **three** of the following questions :
- (a) Explain Ampere's circuital law with one application.
- (b) Differentiate between dia-, para- and ferro-magnetism.
- (c) Discuss Faraday's laws of electromagnetic induction.
- (d) State and prove Maximum power transfer theorem. (6+6+6)

(300)