Bhairab Ganguly College
2nd-SEM, Class Test-2020
Paper-CORET3, Physics Honours
Paper Name: Electricity & Magnetism
Class Teacher: Dr. D. Bhadra

Time: 1 hour Full Marks: 30

1. Answer any **five** from the following 2X5=10

   i) What is magnetomotive force? What is its unit?

   ii) Is the field $\vec{E} = 4y\hat{i} - 2x\hat{j} + \hat{k}electrostatic$? How?

   iii) State and establish Superposition theorem in electrical circuits.

   iv) Show that an electromagnetic ield we can write $\vec{E} = -\vec{\nabla}\phi - \frac{\partial A}{\partial t}$, where the symbols have usual meanings.

   v) A charged particle moves with uniform velocity $\vec{u} = 4\hat{i}\, m/s$ in a region where $\vec{E} = 20\hat{j}V/m$ and $\vec{B} = B_0\hat{k}$ Wb/m^2. Determine B_0 such that the velocity of the particle remains constant.

   vi) Find the electric field in a region is given by $\vec{E} = 8x\hat{i} - 4y\hat{j} - 4z\hat{k}$. Find the equation of lines of force in the plane (z=0).

   vii) Show that the force on a closed current loop placed in an uniform magnetic field is zero.

   viii) In a certain region of space electric field is given by $\vec{E} = \hat{j}E_0 Cos(\omega t - kx)$. Using differential form of Faraday's law find the corresponding magnetic field $\vec{B}$.

Answer any **two** from the following. 2X10=20

Q2. (a) Self inductances of two coils are L_1 and L_2 and their mutual inductance is M. Starting from their energy consideration show that $M^2 \le L_1 L_2$. What is coefficient of coupling? 2+3+1

(b) Verify the magnetic vector potential $\vec{A}$ due to uniform magnetic field $\vec{B}$ is given by $\vec{A} = -\frac{1}{2}(\vec{r} \times \vec{B})$. 2

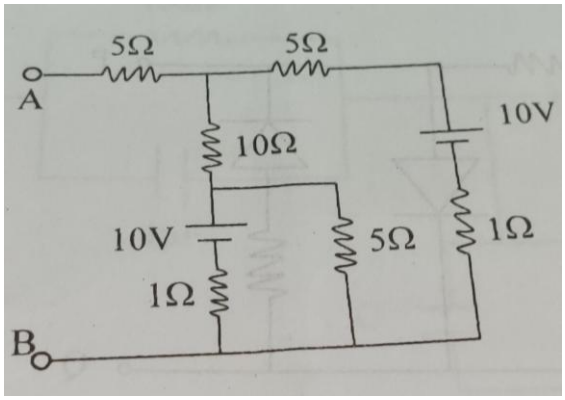
(c) Magnetic field arises due to charges in motion. Can a system have magnetic moment, even though its net charge is zero? Give example. 2

Q3. (a) The vector potential $\vec{A}$ and scalar potential φ in a certain region of space are given by $\vec{A}=\frac{3}{2}(x\hat{j}-y\hat{i});\varphi=\frac{3}{4}(x^2+y^2)$ Find the electric field corresponding to these potentials. 2

(b) The magnetic flux linked with a coil is $\varphi = 3t^2+4t+8 milliweber$. Calculate the magnitude of emf induced in the loop when time t=3 sec. 2

(c) Calculate the magnetic dipole moment due to the orbital motion of an electron. 2

(d) Thevenize the circuit given below. 4



Q4. (a) Show that equivalent inductance of two coils of self-inductance L_1, L_2 and mutual inductance M connected in parallel is given by $L_{eq}=\frac{L_1L_2-M^2}{L_1+L_2\mp 2M}$.

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(b) Examine the possibilities of magnetic field.

(i) $\vec{B}=5x\hat{i}+3y\hat{j}-6z\hat{k}$

(ii) $\vec{B}=2x\hat{i}-5y\hat{j}+3z\hat{k}$

Hence find the steady current density that can give rise to the magnetic field $\vec{B}$.

2+1

(c) Find the current flowing through 8-ohm resistor of the circuit given below using Superposition theorem. 4