B.Sc. 2nd Semester (Honours) Examination, 2019

PHYSICS

(Electricity and magnetism)

Paper : 201/C-3

Course ID : 22411

**Time: 1 Hour 15 Minutes**   **Full Marks: 25**

The figures in the right hand side margin indicate full marks.

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

Section-I

1. Answer *any five* questions: 1×5=5

   (a) What is the power factor of an alternating current circuit?

   (b) A sphere of radius R carries a polarization $\vec{P} = k\vec{r}$. Calculate the bound surface charge density. ($\vec{r}$ is the distance from the centre and k is a constant).

   (c) What is electric displacement vector?

   (d) Write down the relation between magnetic permeability and magnetic susceptibility.

   (e) A soap bubble is charged to a potential of 16V. If the radius is doubled, then what is the potential of the bubble?

   (f)

   Find the value of the current in the circuit shown in figure.
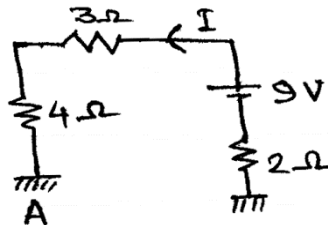
   (g) What is electromagnetic damping?

   (h) State maximum power transfer theorem.

Section-II

Answer *any two* questions: 5×2=10

2. A point charge $+q$ is placed at a distance d from the centre of a grounded conducting sphere of radius a $(a < d)$. Using the method of images, find the potential and field at an external point due to the induced charge on the sphere.   5

3. What is dipole? Derive the expression of force experienced by an electric dipole ($\vec{p}$) in a non-uniform electric field $\vec{E}$. 1+4=5

4. (a) Using superposition theorem, find the current across the 40Ω resistor.
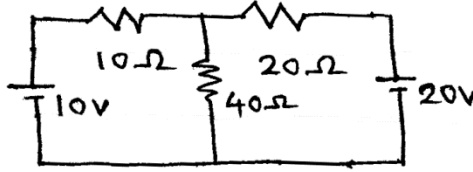
(b) What is the difference between Thevenin's and Norton's theorem? 3+2=5

5. (a) Two coils with self inductances L_1 and L_2 are coupled. Show that $M = k\sqrt{L_1 L_2}$, where M is the mutual inductance between the coils and k is the co-efficient of coupling.

(b) A series LCR circuit consists of an inductance $L = 0.7$H, a resistor $R = 100$Ω and a variable capacitance C. The circuit is supplied with a alternating voltage of frequency 50Hz. Calculate the value of C to achieve the maximum current in the circuit mentioning the condition for maximum current in the circuit. 3+2=5

Section-III

Answer *any one* question: 10×1=10

6. (a) State and write down the mathematical expression of Gauss's law in electrostatics.

(b) Using the law find the electric field inside and outside a volume charge distribution with spherical symmetry given by

$\rho(r) = \rho$ for $0 \leq r \leq a$

$\quad\quad = 0$ for $r \geq a$

Plot the variation of field with distance graphically.

(c) What is magnetic vector potential? Is it unique? Justify your answer. 2+6+2=10

7. (a) Write down the Maxwell's equations in its differential and integral forms. State the physical significance of each equations.

(b) Derive the differential form of Faraday's law of electromagnetic induction. 4+4+2=10

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