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B.Sc. 2nd Semester (CBCS) Examination 2020
Sir Gurudas Mahavidyalaya
Physics -Honours

SUBJECT-PHSA
FULL MARKS-45

PAPER: CC-3
TIME- 2.00 hrs

Theory Examination(25 Marks)

Answer the following question any FIVE

5X5=25

1. (a) Find coulomb's theorem from Gauss's theorem. (b) Show that the electric field produced by a polarized dielectric can be given by the contribution from a bound charge density $\sigma = \vec{P} \cdot \hat{n}$ and a volume density of charge $\rho = -\nabla \cdot \vec{P}$ 2+3

2. (a) The distance between the plates of parallel plate air condenser is 'd'. A dielectric slab of thickness 'x' is introduced in the air gap. Show that the capacity of condenser will be double if the dielectric constant of slab $k = \frac{2x}{2x-d}$. (b) Two identical point charge are separated by a distance '2d' in air and an insulated uncharged conducting sphere of radius 'a' is placed midway between them. If $a < d$, prove that the introduction of the sphere reduces the force experienced by either point charge to $[1 - \frac{24a^5}{d^5}]$ of its original volume. 2+3

3. a) A dipole of moment \vec{M}_1 is fixed at the origin of the co-ordinates. Another a co-planer dipole of moment \vec{M}_2 is placed at the position \vec{r} and is free to rotate. Show that for equilibrium $\tan\theta_2 = -\frac{1}{2} \tan\theta_1$ where θ_1 and θ_2 are the angles that \vec{r} makes with \vec{M}_1 and \vec{M}_2 respectively.
(b) Calculate the potential and field due to an electric dipole of dipole moment 4.5×10^{-10} C-Meter at a point at a distance of 1 meter from the negative charge on its axis. 2+3

4. Write down Ampere's circuital law. Applying this law find out the magnetic flux due to an infinite solenoid. 2+3

5. Define self inductance and mutual inductance. Find out the relation between them. 2+3

6. (a) Find out the differential form of Ampere's circuital law. (b) Two parallel wires carrying the same current I in the opposite direction are separated by a distance d in air. The length of the wire are much larger than d. Find the self inductance per unit length. 2+3

7.) (a) A point charge of 1 C is located at a point $(3\hat{i} + 4\hat{j} + 5\hat{k})\text{m}$. Find the electric field due to it at the point $5\hat{i} + 4\hat{j} + 3\hat{k})\text{m}$. (b) A spherical charge distribution has been expressed as:

$$\rho = \rho_0(1 - r^2/a^2) \text{ for } r \leq a$$

$$= 0 \text{ for } r > 0$$

Find the electric field intensity and potential inside ($r < a$) the charge distribution. 1+4

Practical Examination(15 Marks)

Answer the following question any **THREE**

5X3=15

1. (a) Write down the working formula of L-C-R circuit with suitable circuit diagram. (b) Define Quality factor and band width. Write down the relation between them. 2+3
 2. (a) Draw the circuit diagram of Mutual inductance using ballistic galvanometer. (b) Define the coefficient of mutual inductance? What is its unit? (c) On which factor does the value of M depends on? 2+(1+1)+1
 3. Write down the working formula to determine the average resistance per unit length of the meter bridge wire by Carey-Foster's method and hence determine an unknown resistance with suitable circuit diagram. (b) Why do you note the null point with direct and reversed current?(c)What is the principle of operation of the bridge? 3+1+1
 4. (a) Write down the working formula to determination of horizontal component of the Earth's magnetic field.(b) Define dipole moment of magnetic field. How does dipolar field vary with distance? 3+2
 5. (a) Define non-inductive coil. (b) Calculate the mutual inductance of two co-axial solenoid. (c) Derive the differential form of Faraday's law. 1+2+2
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Internal Examination(5 Marks)

Answer the following question any **one**

5X1=5

1. (a) Find out the differential form of Ampere's circuital law. (b) Find the magnetic flux density at the centre of toroid. 3+2
2. (a) Show that electrostatic field is conservative in nature. (b) Express Gauss's theorem in differential form. 3+2