

**P. R. Thakur Govt. College**  
**Department of Physics**  
B.Sc. Semester-II Internal Examination(1), 2023  
Paper - **PHSACOR03T**  
Electrostatics

**Time: 30 Minutes**

**Full Marks: 10**

1. Answer any *three* questions from the following: 2 x 3 = 6

- (a) Draw the field lines of an electric dipole consisting of two charges  $q$  and  $-q$  separated by a finite distance.
- (b) State the Gauss's law of electrostatics in integral form.
- (c) Find the electric field at an outside point of a uniformly charged solid sphere of radius  $R$  and charge  $Q$ .
- (d) Calculate the workdone to create a potential difference  $V$  in a capacitor having capacitance  $C$ .
- (e) Write down the electrostatic boundary condition across a surface charge  $\sigma$ .

2. Answer any *one* questions from the following: 4 x 1 = 4

- (a) On what factors does the capacitance of an arrangement depend? Calculate the capacitance of the capacitor formed by two concentric spherical metal shell of radii  $a$  and  $b$  ( $b > a$ ). 1 + 3
- (b) A thick spherical shell carries a charge density

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**P.R. Thakur Govt. College**  $\rho = \frac{k}{r^2}$  ( $a \leq r \leq b$ ), where  $k$  is a constant.

Find the electric field in three regions: (i)  $r < a$ , (ii)  $a < r < b$  and (iii)  $r > b$ . Calculate the total charge on the shell. 3+1

- (c) Calculate the potential due to a perfect dipole of dipole moment  $\vec{p}$  at a far-off point from the center of the dipole. Hence find its electric field at that point. 3+1

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B.Sc. Semester-II Internal Examination, 2022  
Paper - **PHSACOR03T**  
Electricity & Magnetism

**Time: 1 Hour**

**Full Marks: 20**

1. Answer any *five* questions from the following:

2 x 5=10

- (a) Show that the function  $\phi(x, y, z) = 4x^2 + 5y - 4z^2$  can represent the electrostatic potential in a charge free region.
- (b) Define Dirac-delta function  $\delta(x)$ . Evaluate  $\int_0^1 e^{(x-b)^2} \delta(x-a) dx$  where  $a > 1$ .
- (c) Find the electrostatic energy stored in a uniformly charged solid sphere of radius  $R$  and charge  $Q$ .
- (d) Calculate the workdone to create a potential difference  $V$  in a capacitor having capacitance  $C$ .
- (e) Write down the electrostatic boundary condition across a surface charge  $\sigma$ .
- (f) State the Kirchhoff's laws for AC circuit.
- (g) Define time constant in a CR circuit. What is its dimension?
- (h) What is the difference between a voltage source and a current source?

2. Answer any *two* questions from the following:

5 x 2=10

- (a) The electric field in a certain region is given by  $\vec{E}(\vec{r}) = 4r^3 \hat{r}$ . Prove that charge contained within a spherical surface of radius  $R$  and centred at the origin is  $16\pi\epsilon_0 R^5$ .  
Find the potential at a distance  $z$  from the centre of a ring carrying a uniform line charge  $\lambda$ . 2½ + 2½
- (b) Suppose a point charge  $q$  is held a distance  $d$  above an infinite grounded conducting plane. By using the method of image, find the potential above the plane. From this, find the density of surface charge induced on the plane. 3+2
- (c) Determine the interaction energy between two electric dipoles of moments  $p_1$  and  $p + 2$  separated by a distance  $r$ . Hence find the condition for minimum energy. 3+2
- (d) In the circuit below, find the value of  $R_L$  such that maximum power is delivered to it. Also find the maximum power. 3+2

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