6. Derive Laplace's equation. Show that the function $\phi = x^2 - y^2 + z$ satisfies Laplace's equation. 5

7. What is electric image ? Find the potential energy of point charge placed near conducting sheet at zero potential. 5

8. Prove that the line integral of the electric field between two points is path independent. 5

SECTION—C

9. Attempt any *five* :

   (a) What is solenoidal field ? Give one example.

   (b) What is the change in V if displacement is perpendicular to $\vec{\nabla}V$.

   (c) What is the direction of electric field due to uniformly charged infinite wire ?

   (d) What si the significance of negative sign in the equation $\vec{E} = -\vec{\nabla}V$?

   (e) Can we apply Coulomb's law to measure charge in motion ? Explain.

   (f) Show that the electric field $\vec{E} = 6xy\hat{i} + (3x^2 - 3y^2)\hat{j}$ is conservative.

   (g) Given $V = x^2 + y^2 + z^2 + z^2x^2$. Find $\vec{\nabla}V$ at a point P(2, 3, 4). 5×2=10

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PC 11443-NH

AS/2111
ELECTRICITY AND MAGNETISM—I, Paper—C
Semester—I

Time Allowed : Three Hours] [Maximum Marks : 30

Note :– The candidates are required to attempt *two* questions each from Sections A and B. Section C will be compulsory. (Attempt any *five* questions from Section C)

SECTION—A

1. State and prove Green's theorem. 5

2. Using Gauss's law, derive an expression for electric field due to an infinite line charge. 5

3. (a) Given a vector $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, show that $\vec{\nabla}\left(\frac{1}{r^3}\right) = -3\frac{\vec{r}}{r^5}$. 2

   (b) Prove that *divergence* of *curl* $\vec{A}$ or $\vec{\nabla}.\vec{\nabla}X\vec{A} = 0$. 3

4. Derive an expression for electric field due to uniformly charged wire of length ℓ at a point on its perpendicular bisector. 5

SECTION—B

5. Derive an expression for the potential at a point due to continuous charged distribution. On the basis of result derived, explain the terms monopole moment, dipole moment and quadrupole moment. 5