Assignment-1 Due: submit at the time of Quiz-1

1. Obtain an expression for $\nabla(\mathbf{A}\cdot\mathbf{B})$ in terms of '$\nabla\cdot$' and '$\nabla\times$' of $\mathbf{A}$ and $\mathbf{B}$.

2. Find $\frac{\partial\hat{\mathbf{r}}}{\partial\theta}$, $\frac{\partial\hat{\theta}}{\partial\theta}$, etc, and hence find the *divergence* of a vector field in spherical polar co-ordinates.

3. Prob. 2.36 in Griffiths. Give suitable explanation for your answers.

4. Four particles of charge q each are placed at the four corners of a square. At the center of the square a charge Q is placed such that the total force on each charge q is zero. Find Q. Is this system stable?

5. A spherical volume of radius a is filled with charge of uniform density ρ.

   a) Find the work done in assembling the sphere.

   b) Find the potential energy of the sphere.

   c) Find the total energy contained in the Electric field of the sphere.

6. According to special relativity, a stationary particle of mass m has energy $E = mc^2$, where c is the speed of light. Suppose the electron is a particle of radius a and uniform charge density, and E is also the work done in *assembling* such a particle, find a.

7. A spherical shell of radius 10 cm, initially neutral, is charged to a potential of -1000 V. Find the number of electrons added (or removed) to the shell.

8. Two positive charges, q each, are placed at diagonally opposite corners of a square, and two negative charges, $-q$ each, are placed at the other diagonal ends. Draw, as accurately as possible, equipotential lines on the plane of the square.