Reading assignment: Griffiths pages 59-75.

**Problem 1** A thin circular wire ring of radius $R$ lies in the $z = 0$ plane with its center at the origin, and carries a total charge $Q$ distributed uniformly on its circumference. Find the electric field a distance $z$ above the center (on the $z$-axis).

**Problem 2** A flat circular disc of radius $R$ lies in the $xy$ plane with its center at the origin. The disc carries a uniform (constant) surface charge density $\sigma$. Find the electric field a distance $z$ above the center. Check that your answer is the expected one for $z \gg R$. Also give your result in the limit $z \ll R$. In each of these two limiting cases, keep the leading non-zero term.

**Problem 3** A hollow spherical shell carries charge density $\rho = kr^2$ in the region $a \leq r \leq b$. Use Gauss’ Law in integral form to find the electric field in the three regions: (i) $r < a$, (ii) $a < r < b$, (iii) $r > b$. Check your answers by computing $\nabla \cdot \vec{E}$ everywhere. Make a graph of $|\vec{E}|$ as a function of $r$.

**Problem 4** Consider a very thin spherical shell with radius $R$, carrying charge $-2Q$ on its surface. There is also a point charge $Q$ located at $r = 0$ (the center of the sphere). Use Gauss’ Law in integral form to find the electric field everywhere.

**Problem 5** Suppose that in some region of space the electric field is found to be $\vec{E} = kr^2 \hat{r}$, in cylindrical coordinates. ($k$ is some constant.)
(a) What are the metric system units of $k$?
(b) Find the charge density $\rho$ in the region.
(c) Find the total charge enclosed in a cylinder of radius $R$ and length $L$, centered on the $z$ axis, using Gauss’ Law in integral form applied to the given $\vec{E}$.
(d) Find the total charge enclosed in a cylinder of radius $R$ and length $L$, again. But this time do it by integrating the result you found in part (b).