January 26, 2018

PHY 712 – Problem Set #4

Continue reading Chaper 1-3 in **Jackson**

1. Consider a two-dimensional charge distribution of the form:

$$\rho(x) = \rho_0 \sin\left(\frac{\pi x}{a}\right) \sin\left(\frac{2\pi y}{a}\right),$$

where ρ_0 represents a density constant and a represents a length constant. In the problem, you are asked to determine the electrostatic potential $\Phi(x, y)$ for $0 \leq x \leq a$ and $0 \leq y \leq a$, which satisfies the Poisson equation for the charge density $\rho(x, y)$. and statisfies the boundary conditions $\Phi(0, y) = \Phi(a, y) = \Phi(x, 0) = \Phi(x, a) = 0$.

   (a) Find the analytic form of the electrostatic potential $\Phi(x, y)$ for $0 \leq x \leq a$ and $0 \leq y \leq a$.

   (b) Using the finite difference method for the two grids discussed in class, find $\Phi(x, y)$ on the grid points.

   (c) Using the finite element method for the two grids discussed in class, find $\Phi(x, y)$ on the grid points.

   (d) Compare the accuracy of the numerical solutions for this example.