EE60101: Advanced Sensing Techniques
Assignment 1

1.

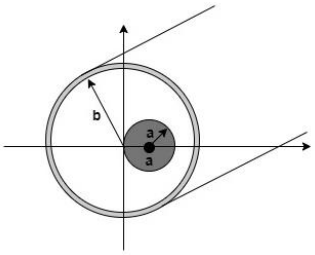

Fig. 1

Fig.1 shows a cable arrangement with eccentric core. The outer radius of the cable is b = 10 cm and it is wrapped by a metal sheath of negligible thickness. The inner core is a copper conductor of radius a = 2cm and located eccentrically as shown in the figure. The space between the core and the sheath is filled up by a dielectric of relative permittivity (ε_r =5.0). Find the capacitance of such a cable of length 10 m.

2. Two concentric conducting spheres are of radii *a*= 3cm and *b*= 5cm. The interior portion between the spheres is filled up with two dielectrics such that for $0 < \theta < \frac{\pi}{2}, \varepsilon_r = 1.0$ and for $\frac{\pi}{2} < \theta < 2\pi, \varepsilon_r = 8.0$. Find the capacitance between the spheres. Derive any formula used. (ε_0= 8.854X 10^{-12} F/m)

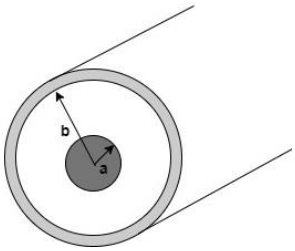

Fig. 2

3. A co-axial underwater cable is having radii a = 10mm and b = 20mm as shown in Fig. 2. The cable is made of super conducting material (σ = ∞) and is 10km long and operates at 480V. Because of a leak, sea water (σ = 4 S/m) entered the cable, filling the space between the conductors. What is the resistance seen across the two terminals?

4. Given a potential V (x,y,z) = 5xy + y^3z + 5kz^2, find an expression for k so that V (x,y,z) satisfies Laplace's equation. Is the solution unique? Explain.

5. Consider the 2D-square region shown in Fig. 3. The applied potentials at the boundary regions are shown. Divide the region into (4X4) grid and using the iterative technique for solution of Laplace equation, find the approximate values of potential at each grid point after first iteration. Explain each step clearly.

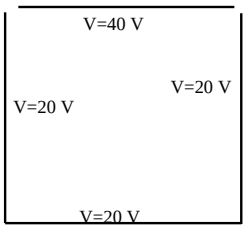

Fig. 3

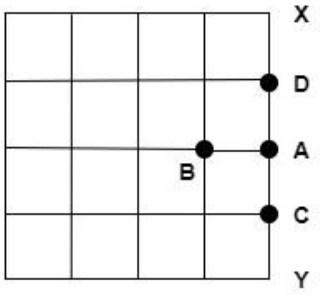

Fig. 4

6. Fig. 4 shows a part of the grid arrangement for Finite Difference modelling to obtain electrical potential distribution of a certain region. The right hand boundary of the region XY follows Neumann boundary condition. Suppose the potentials at points *B*, *C* and *D* are 19.23V, 21.28 V and 26.52 V respectively, then estimate the potential at point *A*. Derive any formula used.