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EE214000 Electromagnetics, Fall 2020

Your name: ________________ ID: ________________ Nov. 23rd, 2020

EE214000 Electromagnetics, Fall, 2020
Quiz #10-2, Open books, notes 16 points), due in class, Monday, Nov. 23rd, 2020

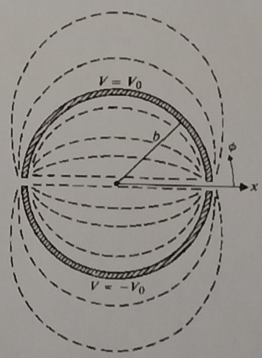
1. In a cylindrical system without longitudinal variation, write the functions of r for which you can't use as solutions for the Laplace equation when involving r = 0 in an electric-potential problem. (2 points)

Ans: r^{-n}

2. In an axially symmetric system (no variation in ϕ) with longitudinal variation, write the functions of r for which you can't use as solutions for the Laplace equation when involving r = 0 in an electric-potential problem. (4 points)

Ans: $K_0(Tr)$, $N_0(Tr)$ (or $Y_0(Tr)$)

3. Try to solve the electric potential in the region r > b for the following problem. (10 points)



$$\begin{cases} V(b,\phi) = V_0 , & 0 < \phi < \pi \\ V(b,\phi) = -V_0 , & -\pi < \phi < 0 \\ V(b,-\phi) = -V(b,\phi) \Rightarrow \text{奇函數} \end{cases}$$

$V(b,\phi) = (Ar^{n} + Br^{-n})\sin n\phi$

for $r > b$, $\Rightarrow A = 0$

$\Rightarrow V(b,\phi) = \sum_{n=1}^{\infty} B_n r^{-n} \sin n\phi$

$V_0 \int_0^{\pi} \sin n\phi \, d\phi = \sum_{n=1}^{\infty} B_n b^{-n} \int_0^{\pi} \sin n\phi \sin n\phi \, d\phi$

$\Rightarrow V_0 \frac{-1}{n} \underbrace{\left(\cos n\phi \Big|_0^{\pi} \right)}_{= (-1)^n - 1} = \sum_{n=1}^{\infty} B_n b^{-n} \times \frac{\pi}{2}$

$$\therefore V(r,\phi) = \begin{cases} \sum_{n=\text{odd}}^{\infty} \frac{4V_0}{n\pi b^{-n}} r^{-n} \sin n\phi \\ 0 , & n = \text{even} \end{cases}$$