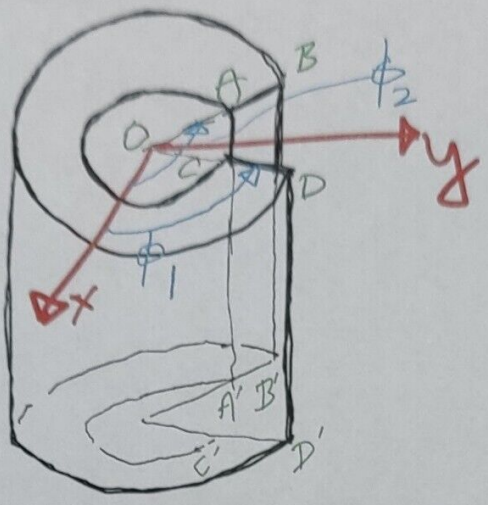
Mid Term Exam | PHN-005 Electrodynamics and Optics | Autumn 2022-23

Time: 1.5 hours | Max marks: 25

Note: Attempt all questions. All symbols have their standard meanings as discussed in the lectures

1. Consider a cut cylindrical shell with a finite thickness and an angular deficit $\phi_2(=\angle AOx) - \phi_1(=\angle COx) \neq 0$. The thick lines are the portions visible, and the light thin lines are the portions not visible.



Consider a vector: $\boldsymbol{A}(\rho, \phi, z) = A_\rho(\rho)\hat{\boldsymbol{a}}_{\boldsymbol{\rho}} + A_\phi(\phi)\hat{\boldsymbol{a}}_{\boldsymbol{\phi}} + A_z(z)\hat{\boldsymbol{a}}_{\boldsymbol{z}}$.

(i) Verify the Gauss's divergence theorem for the volume bounded by the cut cylindrical shell. **[5]**

(ii) Verify the Stokes theorem for the Horse-shoe region bounded by ABDCA. **[5]**

2. Is the vector potential corresponding to a constant magnetic field, (i) solenoidal, (ii) irrotational? **[2.5+2.5]**

3. A plane wave of amplitude E_0, whose propagation vector $\vec{k}$ is in the xz-plane, makes an angle of 30^0 to the z-axis. The correct expression of the electric field is

A. $E_0 \exp\left[i\left(\frac{\sqrt{3}}{2}kx + \frac{1}{2}kz - \omega t\right)\right]$

B. $E_0 \exp\left[i\left(\frac{\sqrt{3}}{2}kz - \frac{1}{2}kx - \omega t\right)\right]$

C. $E_0 \exp\left[i\left(\frac{\sqrt{3}}{2}kz + \frac{1}{2}kx - \omega t\right)\right]$

D. $E_0 \exp\left[i\left(kx + \frac{1}{2}kx - \omega t\right)\right]$ **[2]**

4. The state of polarization of a wave whose x and y components of the electric field are given by $E_x = E_0 \cos(\omega t - kz)$ and $E_y = E_0 \sin\left(\omega t - kz + \frac{\pi}{2}\right)$, respectively, is

A. Linearly polarized
B. Right Circularly polarized
C. Left circularly polarized
D. Elliptically polarized **[2]**

5. The state of polarization of a wave whose x and y components of the electric field are $E_x = E_0 \cos(\omega t - kz)$ and $E_y = \frac{E_0}{\sqrt{2}} \sin(\omega t - kz + \pi)$, respectively, is

A. Linearly polarized
B. Left circularly polarized
C. Right circularly polarized
D. Elliptically polarized **[2]**

6. If a circularly polarized light is passed through a polarizer then the transmitted light intensity will be

A. Doubled
B. Halved
C. One-fourth
D. unchanged **[2]**

7. The orientation of the resultant electric field with respect to x-axis for a wave whose x and y components of the electric field are given by $E_x = E_0 \cos(\omega t - kz)$ and $E_y = E_0 \cos(\omega t - kz + \pi)$, respectively, will be

A. 45°
B. 135°
C. 90°
D. 60° **[2]**