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INEL 4151 Problemas sugeridos para el segundo parcial

1. A square conductive loop of side 10.0 cm is centered in the x-y plane. It carries a 10.0 mA current clockwise when viewed from the +z direction. Find **H**(0, 0, 16 cm).

2. Given the field $\mathbf{H} = 3y^2\,\mathbf{a_x}$ find the current passing through a square in the xy-plane that has a corner in the origin and the opposite corner at (2, 2, 0).

3. An very thin metallic cylindrical shell of radius 4.0 cm is centered on the z-axis and carries an evenly distributed current of 10.0 mA in the +z direction. (a) Determine the value of the surface current density on the conductive shell. (b) Plot H as a function of radial distance from the z-axis over the range $0 < \rho < 12$ cm.

4. Prove Stoke's Theorem for the function $\mathbf{H} = y^2\,\mathbf{a_x} + x^2\,\mathbf{a_y}$ A/m using the rectangle ABCD with A(2, 0, 0), B(2, 4, 0), C(0, 4, 0), and D(0, 0, 0). (Clue: differential surface normal should be directed in same direction of line integral circulation.)

5. An infinite length line with a 3.0 A current in the +y direction lies on the y axis. Find the magnetic flux density at P(7, 0 , 0) in (a) Tesla, (b) Wb/m^2, (c) gauss.

6. A 1.0 nC charge with velocity of 100. m/s in the +y direction enters a region where the electric field intensity is 100 V/m $\mathbf{a_z}$ and the magnetic flux density is 5.0 Wb/m^2 $\mathbf{a_x}$. Determine the force vector acting on the charge.

7. How close do you have to be to the middle of a finite length of a current carrying line before it appears infinite in length? Consider a finite line of length 2h centered on the z-axis generating a field $\mathbf{H_f}$ at point P(0, a, 0) and consider an infinte line on the z-axis generating a field Hi at the same point P(0, a, 0). If both lines carry a current I in the positive z direction, plot the ratio H_f/H_i versus the ratio h/a. Use MatLab to make your plot.

8. A solenoid has 200 turns, is 10.0 cm long, and has a radius of 1.0 cm. Assuming a 1.0 A current, determine the magnetic field intensity at the very center of the solenoid. How does this compare with the result if you assume that 10.0 cm >> 1.0 cm?

9. A 4.0 cm wide ribbon of current is centered on the y-axis on the y-x plane and has a surface current density of $\mathbf{K} = 2\,\mathbf{a_y}$ A/cm. Determine the magnetic field intensity at the points P(0, 0, 2 cm) and Q(2 cm, 2 cm, 2 cm).

10. An electron with velocity $\mathbf{u} = (3\mathbf{a_x} + 12\mathbf{a_y} - 4\mathbf{a_z}) \times 10^5$ m/s experiences no net force at a point in a magnetic field $\mathbf{B} = 10\mathbf{a_x} + 20\mathbf{a_y} + 30\mathbf{a_z}$ mWb/m2. Find **E** at that point.

11. A 60 turn coil carries a current of 2A and lies in the plane x + 2y – 5z = 12 such that the magnetic moment **m** of the coil is directed away from the origin. Calculate **m**, assuming the area of the coil is 8 cm^2.

12. A solenoid with length 10 cm and radius 1 cm has 450 turns. Calculate its inductance.

13. A cobalt ring ($\mu_r = 600$) has a mean radius of 30 cm. If a coil wound on the ring carries 12 A, calculate the number of turns required to establish an average magnetic flux density of 1.5 Wb/m^2 in the ring.

14. Express the following phasors in their instantaneous forms:

(a) $\mathbf{A}_s = (4 - 3j)e^{-j\beta x}\mathbf{a}_y$

(b) $\mathbf{B}_s = \dfrac{20}{\rho} e^{-j2z}\mathbf{a}_\rho$

(c) $\mathbf{C}_s = \dfrac{10}{r^2}(1 + j2)e^{-j\phi} \sin\theta\, \mathbf{a}_\phi$

15. Express the following time-harmonic fields as phasors.

(a) $\mathbf{A} = 5\sin(2t + \pi/3)\,\mathbf{a}_x + 3\cos(2t + 30°)\,\mathbf{a}_y$

(b) $\mathbf{B} = \dfrac{100}{\rho}\sin(\omega t - 2\pi z)\,\mathbf{a}_\rho$

(c) $\mathbf{C} = \dfrac{\cos\theta}{r}\sin(\omega t - 3r)\,\mathbf{a}_\theta$

(d) $\mathbf{D} = 10\cos(k_1 x)\cos(\omega t - k_2 z)\,\mathbf{a}_y$

16. An EM wave propagating in a certain medium is described by

$$\mathbf{E} = 25 \sin(2\pi \times 10^6 t - 6x)\mathbf{a}_z \text{ V/m}$$

(a) Determine the direction of wave propagation.

(b) Compute the period T, the wavelength λ, and the velocity u.