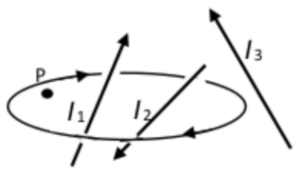
Department of Physics, Bennett University

<u>Tutorial Set-6</u>

1. **Which of the following functions cannot represent a magnetic field?**
   (a) $\vec{F_1} = x^2\hat{i} + 3xz^2\hat{j} - 2xz\hat{k}$
   (b) $\vec{F_2} = xy\hat{i} + yz\hat{j} + 2xz\hat{k}$
   (c) $\vec{F_3} = \frac{\alpha}{(x^2+y^2)}(-y\hat{i} + x\hat{j})$

2. **Three wires are carrying currents** I_1, $I_2 = 2I_1$ **and** $I_3 = 3I_1$ **as shown in the figure.**

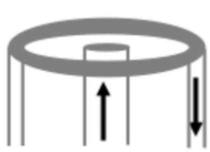


   (a) Write down the value of $\oint \vec{B}.\vec{dl}$ **over the curved path shown.**
   (b) Draw two different paths over which we will get $\oint \vec{B}.\vec{dl} = 2\mu_0 I_1$.
   (c) What will be the values of $\vec{\nabla}.\vec{B}$ **and** $\vec{\nabla} \times \vec{B}$ **at the point P?**
   (d) State whether the following statement is true or false" "*The magnetic field along the curved path shown in the figure is independent of the current* I_3."

3. **A long cylindrical wire of radius** R **carries a current** I **with a volume current density of** $\vec{J} = \alpha r^2 \hat{z}$ **where,** r **is the distance from the axis of the cylinder and** $\hat{z}$ **is the unit vector along the axis of the cylinder.**
   (a) Obtain the magnetic field in all regions.
   (b) Obtain $\vec{\nabla}.\vec{B}$ **and** $\vec{\nabla} \times \vec{B}$ **in all regions.**

4. **Consider a straight cylindrical region of thickness** $(b-a)$ **and having a circular cross-section between inner radius** a **and outer radius** b**. A current** I **flows uniformly through the cross-section of the cylinder.**
   (a) Calculate the magnetic field in all regions.
   (b) Obtain $\vec{\nabla}.\vec{B}$ **and** $\vec{\nabla} \times \vec{B}$ **in all regions.**

5. **Consider a coaxial configuration as shown in the figure.**



   The inner solid cylinder carries a current in the upward direction while the outer annular cylinder (tube) carries the same current in the downward direction. Calculate the magnetic field in all regions. The radius of the inner cylinder is a **and the inner and outer radii of the outer annular cylinder are** b **and** c **respectively. Calculate** $\vec{\nabla}.\vec{B}$ **and** $\vec{\nabla} \times \vec{B}$ **in all regions.**