SNS COLLEGE OF ENGINEERING
(Autonomous)
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

19EC504 – TRANSMISSION LINES AND ANTENNAS

III YEAR/ V SEMESTER

UNIT 3 – ANTENNA FUNDAMENTALS AND ANTENNA ARRAYS

Magnetic vector potential

Magnetic fields are generated by steady (time-independent) currents & satisfy Gauss' Law

$$\nabla \cdot \mathbf{B} = 0$$

Since the divergence of a curl is zero, ***B*** can be written as the curl of a vector ***A*** as

$$\mathbf{B} = \nabla \times \mathbf{A},$$

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Any solenoidal vector field (e.g. *B*) in physics can always be written as the curl of some other vector field (*A*).

The quantity *A* is known as the **Magnetic Vector Potential**.

From Ampere's law

$$\nabla \times \mathbf{B} = \nabla \times \nabla \times \mathbf{A} = \nabla(\nabla \cdot \mathbf{A}) - \nabla^2 \mathbf{A} = -\nabla^2 \mathbf{A},$$

$$\nabla . \mathbf{A} = 0$$

Therefore the equation $\nabla \times \mathbf{B} = \mu_0 \mathbf{j}$.

can be written as $\nabla^2 \mathbf{A} = -\mu_0 \mathbf{j}$.

This equation is similar to Poisson's equation, the only difference is that **A** is a vector.

Each component (e.g. along x, y, z axes) of **A** must satisfy the differential equation of the type

$$\nabla^2 A_x = -\mu_0 j_x,$$

A unique solution to the above Poisson's equation can be found
(By combining the solutions for components on x, y, z).

It specifies the magnetic vector potential **A** generated by steady currents.

In electromagnetic theory,
several "gauges" have been used to advantage depending on the specific types of calculations

The choice of a particular function ψ or a particular constant c is referred to as a choice of the gauge.