EE540 Advance Electromagnetic Theory & Antennas

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Review of Maxwell's Equation

- First Maxwell's equation+
- Gauss law for electric field
- Integral form $$\oint_S \vec{D} \bullet d\vec{s} = \int_V \rho_v dv$$
- Differential form $$\nabla \bullet \vec{E} = \frac{\rho_v}{\varepsilon}$$
- Physical meaning:
    - the electric flux through any closed surface is equal to algebraic sum of extraneous charges embraced by this surface

+Maxwell's equations are named as 1st, 2nd , 3rd & 4th equations for convenience & easier understanding, there is no hard and fast rule in this ordering and it can be always altered

Review of Maxwell's Equation

- Second Maxwell's equation
- Gauss law for magnetic field
- Integral form $\oint_S \vec{B} \bullet d\vec{s} = 0$
- Differential form $\nabla \bullet \vec{B} = 0$
- Physical meaning:
  - the flux of magnetic field through any arbitrary closed surface is always equal to zero

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Review of Maxwell’s Equation

- Third Maxwell’s equation
- Modified Ampere’s law
- Integral form $\oint_C \vec{H} \bullet d\vec{l} = \int_S \left(\vec{J} + \frac{\partial \vec{D}}{\partial t} \right) \bullet d\vec{s}$
- Differential form $\nabla \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$
- Physical meaning:
  - Circulation of magnetic field vector around any arbitrary closed contour is equal to the total current through any arbitrary surface bounded by this contour

Review of Maxwell's Equation

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- Fourth Maxwell's equation
- Faraday's law
- Integral form $\oint_C \vec{E} \bullet d\vec{l} = -\int_S \left(\frac{\partial \vec{B}}{\partial t} \right) \bullet d\vec{s}$
- Differential form $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$
- Physical meaning:
  - Circulation of electric field vector around any closed contour is equal to the minus sign of the time derivative of the magnetic flux linkage through any arbitrary surface bounded by the given contour