# <u>Maxwell's Equations</u>

## Sinusoidal Steady-State Time-Varying Fields:

| | Integral Form | Differential Form |
|---|---|---|
| Faraday's Law | $\oint_c \hat{\overline{E}} \cdot d\overline{l} = -j\omega \int_s \hat{\overline{B}} \cdot d\overline{s}$ | $\overline{\nabla} \times \hat{\overline{E}} = -j\omega \hat{\overline{B}}$ |
| Ampere's Law | $\oint_c \hat{\overline{H}} \cdot d\overline{l} = \int_s \hat{\overline{J}} \cdot d\overline{s} + j\omega \int_s \hat{\overline{D}} \cdot d\overline{s}$ | $\overline{\nabla} \times \hat{\overline{H}} = \hat{\overline{J}} + j\omega \hat{\overline{D}}$ |
| Gauss' Law | $\oint_s \hat{\overline{D}} \cdot d\overline{s} = \int_V \hat{\rho}_v \, dV$ | $\overline{\nabla} \cdot \hat{\overline{D}} = \hat{\rho}_v$ |
| | $\oint_s \hat{\overline{B}} \cdot d\overline{s} = 0$ | $\overline{\nabla} \cdot \hat{\overline{B}} = 0$ |

## Sinusoidal Steady-State Time-Varying Fields & Simple Media:

| | Integral Form | Differential Form |
|---|---|---|
| Faraday's Law | $\oint_c \hat{\overline{E}} \cdot d\overline{l} = -j\omega\mu \int_s \hat{\overline{H}} \cdot d\overline{s}$ | $\overline{\nabla} \times \hat{\overline{E}} = -j\omega\mu \hat{\overline{H}}$ |
| Ampere's Law | $\oint_c \hat{\overline{H}} \cdot d\overline{l} = (\sigma + j\omega\varepsilon) \int_s \hat{\overline{E}} \cdot d\overline{s} + \int_s \hat{\overline{J}} \cdot d\overline{s}$ | $\overline{\nabla} \times \hat{\overline{H}} = (\sigma + j\omega\varepsilon) \hat{\overline{E}} + \hat{\overline{J}}$ |
| Gauss' Law | $\oint_s \hat{\overline{E}} \cdot d\overline{s} = \frac{1}{\varepsilon} \int_V \hat{\rho}_v \, dV$ | $\overline{\nabla} \cdot \hat{\overline{E}} = \frac{\hat{\rho}_v}{\varepsilon}$ |
| | $\oint_s \hat{\overline{H}} \cdot d\overline{s} = 0$ | $\overline{\nabla} \cdot \hat{\overline{H}} = 0$ |