场波公式整理

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Chapter 3&6

$\vec{D} = \epsilon_0 \vec{E} + \vec{P}$ *polarization vector*

$\vec{D} = \epsilon_0(1 + \chi_e)\vec{E} = \epsilon_0 \epsilon_r \vec{E} = \epsilon \vec{E}$ *relative permittivity*

$\vec{p} = qd$ *electric dipole*

$\vec{H} = \frac{\vec{B}}{\mu_0} - M$ *Magnetizationvector*

$\vec{B} = \mu_0(1 + \chi_m)\vec{H} = \mu_0 \mu_r \vec{H} = \mu \vec{H}$ *Relative permeability*

$\vec{m} = \vec{a_z} I \pi b^2 = a_z IS = \vec{a_z} m$ *magnetic dipole*

Chapter 4

$\nabla^2 V = -\frac{\rho}{\epsilon}$ *Poisson's Equation*

$\nabla^2 V = 0$ *Laplace's Equation*

Chapter 5

$\vec{J} = \rho u$ *Conversion current density*

$\vec{J} = \sigma \vec{E}$ *Ohm's law*

$\nabla \bullet \vec{J} = -\frac{\partial \rho}{\partial t}$ *Equation of continuity*

$\vec{P} = \int_v \vec{E} \bullet \vec{J} dv$ *Joule's Law*

$$\left.\begin{array}{c}\nabla \bullet \vec{J} = 0 \quad \nabla \times \dfrac{\vec{J}}{\sigma} = 0 \\ \displaystyle\int_s \vec{J} \bullet ds = 0 \quad \int_c \frac{\vec{J}}{\sigma} \bullet d\vec{l} = 0\end{array}\right\} Boundary\ conditions$$

Chapter 7

$V = \frac{d\Phi}{dt} \quad V' = \int_c (u \times \vec{B}) \bullet d\vec{l}$ 法拉第电磁感应定律

$$\left.\begin{array}{r}\nabla \bullet \vec{D} = \rho \\ \nabla \bullet \vec{B} = 0 \\ \nabla \times \vec{E} = -\dfrac{\partial \vec{B}}{\partial t} \\ \nabla \times \vec{H} = \vec{J} + \dfrac{\partial \vec{D}}{\partial t}\end{array}\right\} Maxwell's\ Equation$$

$\vec{E} = -\nabla V - \frac{\partial A}{\partial t}$ $\quad vectorV\ A$

$$\left.\begin{array}{r}\nabla^2 \vec{E} + k^2 \vec{E} = 0 \\ \nabla^2 \vec{H} + k^2 \vec{H} = 0\end{array}\right\} Homogeneous\ vector\ Helmholtz's\ equations$$

$\epsilon_c = \epsilon - j\frac{\sigma}{\omega}$ $\quad complex\ permittivity$

$\tan\delta_c = \frac{\epsilon''}{\epsilon'} = \frac{\sigma}{\omega\epsilon}$ $\quad loss\ tangent$

Chapter 8

$\eta_0 = \sqrt{\frac{\mu_0}{\epsilon_0}} = 120\pi = 377$ $\quad intrinsic\ inpedance$

$$\left.\begin{array}{r}\alpha = \dfrac{\omega\epsilon''}{2}\sqrt{\dfrac{\mu}{\epsilon'}} \\ \beta = \omega\sqrt{\mu\epsilon'}[1 + \dfrac{1}{8}(\dfrac{\epsilon''}{\epsilon'})^2]\end{array}\right\} loss\ electric$$

$\gamma = \alpha + j\beta = j\omega\sqrt{\mu\epsilon}\left(1 - \frac{\epsilon''}{\epsilon'}\right)^{\frac{1}{2}} = j\omega\sqrt{\mu\epsilon'}[1 - j\frac{\epsilon''}{2\epsilon'} + \frac{1}{8}(\frac{\epsilon''}{\epsilon'})^2]$

$\alpha = \beta = \sqrt{\pi f \mu \sigma} \qquad good\ conductor$

$u_p = \frac{\omega}{\beta} \qquad phase\ velocity$

$u_g = \frac{1}{d\beta/d\omega} \qquad group\ velocity$

$P_{av} = \frac{1}{2}Re\{\vec{E} \times \vec{H}^*\} \qquad Poynting's\ vector$

$\Gamma = \frac{\vec{E}_{r0}}{\vec{E}_{i0}} = \frac{\eta_2 - \eta_1}{\eta_2 + \eta_1} \qquad reflection\ coefficient$

$\tau = \frac{\vec{E}_{t0}}{\vec{E}_{i0}} = \frac{2\eta_2}{\eta_2 + \eta_1} \qquad transmission\ coefficient$

$\alpha = \arctan\sqrt{\frac{\epsilon_2}{\epsilon_1}} = \arctan(\frac{n_2}{n_1}) \qquad Brewster\ angle$

$\theta_c = \arcsin\sqrt{\frac{\epsilon_2}{\epsilon_1}} = \arcsin(\frac{n_2}{n_1}) \qquad total\ reflection\ critical\ angle$

Chapter 10

$$\left.\begin{aligned} \gamma &= \sqrt{(\frac{n\pi}{b})^2 - \omega^2\mu\epsilon} \\ f_c &= \frac{n}{2b\sqrt{\mu\epsilon}} \end{aligned}\right\} Parallel-plate\ waveguide$$

$$\left.\begin{aligned} \gamma = j\beta &= j\sqrt{\omega^2\mu\epsilon - (\frac{m\pi}{a})^2 - (\frac{n\pi}{b})^2} \\ (f_c)_{mn} &= \frac{1}{2\sqrt{\mu\epsilon}}\sqrt{(\frac{m}{a})^2 + (\frac{n}{b})^2} \end{aligned}\right\} Retangular\ waveguide$$

$f_{mnp} = \frac{\mu}{2}\sqrt{(\frac{m}{a})^2 + (\frac{n}{b})^2 + (\frac{p}{d})^2} \qquad resonant\ frequency$ 谐振腔截止频率

$Q = \omega\tau = \frac{\omega W}{P} = \frac{\lambda}{\Delta\lambda}$品质因数