苏. 汤 源. 2019010448 天线 HW4

1.

err < 10% : $r/\lambda > -4.7\,dB$

< 1% : $r/\lambda > 0.5\,dB$

2.

$$\vec{S}(x,y,z;t) = \vec{E}(x,y,z;t) \times \vec{H}(x,y,z;t)$$

$$= Re[\tilde{\vec{E}}(x,y,z)e^{j\omega t}] \times Re[\tilde{\vec{H}}(x,y,z)e^{j\omega t}]$$

$$Re[\tilde{\vec{H}}(x,y,z)e^{j\omega t}] = \frac{1}{2}[\tilde{\vec{H}}(x,y,z)e^{j\omega t}) + \frac{1}{2}[\tilde{\vec{H}}^*(x,y,z)e^{-j\omega t}]$$

$$\therefore \vec{S}(x,y,z;t) = \frac{1}{2}Re[\vec{E} \times \vec{H}^*) + \frac{1}{2}Re[\tilde{\vec{E}} \times \tilde{\vec{H}} e^{j2\omega t}]$$

$$\vec{S}_{av}(x,y,z) = \frac{1}{T}\int_0^T \vec{S}(x,y,z;t)\,dt$$

$$= \frac{1}{2}Re[\tilde{\vec{E}} \times \tilde{\vec{H}}^*] + 0$$

$$= \frac{1}{2}Re[\tilde{\vec{E}} \times \tilde{\vec{H}}^*]$$

3.

a) 35dB

b) $10^{3.5} \approx 3162.$)

3.2

$U = \sin\theta\sin\phi$

$$U_{av} = \int_\Omega U\,d\Omega \Big/ \int_\Omega d\Omega = \int_\Omega \sin\theta\sin\phi\sin\theta\,d\theta\,d\phi \Big/ 4\pi$$

$$= \int_0^\pi \sin\phi\,d\phi \int_0^\pi \sin^2\theta\,d\theta \Big/ 4\pi = \pi/8$$

$D = U_{max}/U_{av} = 8\pi$ ($\theta = \phi = 90^\circ$)

b) $\theta = 90^\circ$ 时. $\sin\phi = \frac{1}{2} \Rightarrow \phi = 30^\circ$

beamwidth = $2 \cdot 30^\circ \cdot \lambda/180^\circ = \frac{1}{3}\lambda$

$\phi = 90^\circ$ 时 同理

beamwidth = $\frac{1}{3}\lambda$