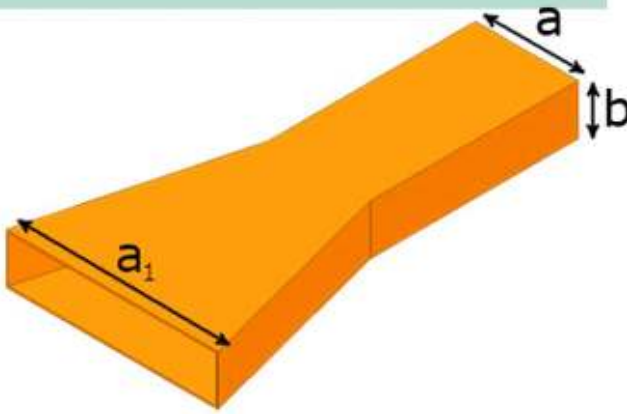
2 Homework Problems

Homework Problem 1

1. Find the flare angle of an H-plane sectoral horn antenna such that the maximum phase deviation across the aperture is 43° and with physical dimensions of $a = 0.4\lambda$, b $= 0.25\lambda$, and $a_1 = 2.5\lambda$

$$\Delta\phi_{max} = k\delta\,(x')\Big|_{x'} = \frac{kx'^2}{2\rho_1}$$

$$2\psi_e = 2\tan^{-1}\left(\frac{a_1/2}{\rho_1}\right)$$



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Homework Problem 2

2. Design a Yagi antenna using a half-wave dipole as the driven element with one reflector and one director, as well as find the $^{F}/_{B}$ ratio given the forward and backward power of $P_f = 15dB$ and $P_b = -2dB$ at 17GHz

$$^{F}/_{B} = 10\log\left(^{P_f}/_{P_b}\right)$$
$$RE = 1.05 * DE$$
$$DI = 0.95 * DE$$

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Homework Problem 3

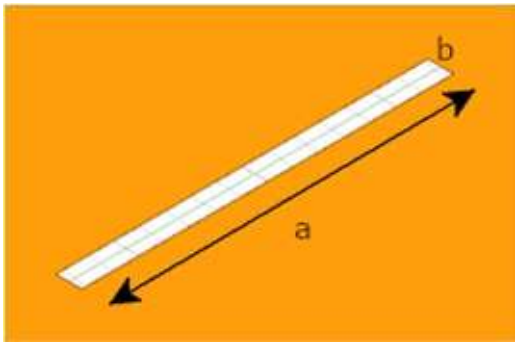
3. With a rectangular aperture situated on a ground plane with a directivity of 40 and a half power bandwidth of 40° at 7GHz, find the dimensions of the aperture

- $D_0 = \frac{4\pi}{\lambda^2} Area = \frac{4\pi ab}{\lambda^2}$
- $ab = \frac{D_0\lambda^2}{4\pi}$
- $a = \frac{D_0\lambda^2}{4b\pi}$
- $HPBW = \frac{50.6}{b/\lambda} \rightarrow b/\lambda = \frac{50.6}{HPBW}$
- $b = \frac{50.6}{HPBW}\lambda = 1.265\lambda$
- $a = \frac{D_0\lambda^2}{4b\pi} = \frac{(40)\lambda^2}{4(1.265\lambda)\pi} = 2.516\lambda$

$$D_0 = \frac{4\pi}{\lambda^2} Area$$

$$HPBW = \frac{50.6}{b/\lambda}$$

$$FNBW = \frac{114.6}{b/\lambda}$$



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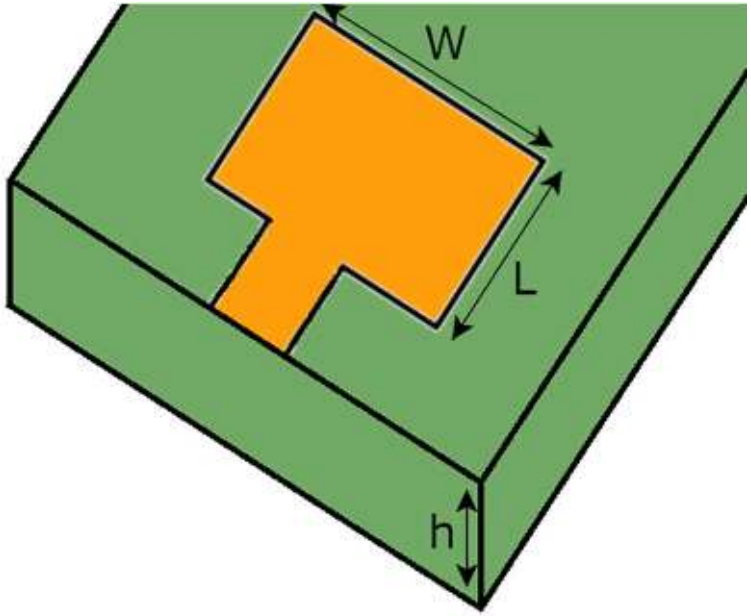
Homework Problem 4

4. Design a rectangular, microstrip patch antenna placed on a substrate with $\varepsilon_r = 5$ and thickness of $h = 5mm$ at 2.5GHz, with no inset feeding



$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2} \frac{1}{\sqrt{1 + 12\,{}^{h}/_{W}}}$$

$$W = \frac{\lambda}{2}\sqrt{\frac{2}{\varepsilon_r + 1}}$$

$$\Delta L = 0.412h \frac{\varepsilon_{reff} + 0.3\left({}^{W}/_{h} + 0.264\right)}{\varepsilon_{reff} - 0.258\left({}^{W}/_{h} + 0.8\right)}$$

$$L = \frac{\lambda}{2\sqrt{\varepsilon_{reff}}} - 2\Delta L$$

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