G9: The radiation pattern of a horn antenna can be found as the spatial Fourier transform of the aperture distribution. The aperture distribution is approximately the same as in the waveguide feed, i.e. a sinusoidal function in the $x$ direction and uniform in the $y$ direction. An even simpler approximation is that of a uniform aperture distribution in both directions, in which case the normalized far-field magnitude in the plane $\phi = 0$ ($E_{\phi} = 0$) is given by

$$E_{\theta}(r, \theta, 0) = E_0 \frac{e^{-jk_0r}}{r} (\cos \theta + 1) F(\theta, 0)$$

where $F$ is given by

$$F(\theta, \phi) = \int_{-B/2}^{B/2} \int_{-A/2}^{A/2} e^{jk_0(x \cos \phi + y \sin \phi \sin \theta)} dxdy$$

Find the far-field normalized power radiation pattern and identify the main lobe, nulls and side lobe values.

(More problems on the following pages)
U8: For the ATF33143 pHEMT at a bias point of 4 V and 40 mA, design input and output matching circuits in microstrip (FR4 substrate, 60-mil thick) for maximal small-signal gain at 2.45 GHz. Use Microwave Office and start from $S_{11}$ and $S_{22}$ at the design frequency, then adjust the match for the bilateral case using the tuning feature. Plot all 4 S-parameters of your final design over the frequency range of 1 GHz to 5 GHz. Next, design a bias-Tee network at the same frequency using available surface mount capacitors and inductors from ATC (www.atceramics.com) and Coilcraft (www.coilcraft.com). Plot all relevant S-parameters of your design. Finally, add two such bias Tees to your amplifier design and simulate the performance. Comment.