**Antenna Theory**
**2nd Midterm Exam**
**November 21, 2005**

Answer the following 3 questions. Questions have equal weight. Any reasonable assumptions necessary to solve the problems will be accepted.

**1.** It is required to produce an endfire antenna pattern with a single null at π/2. Assuming you are free to use any number of elements:
a. What is the minimum number of elements needed and what are the relative currents (amplitude and phase) in the elements.
b. How can you solve the same problem assuming you must use 5 elements.

**2.** An antenna array must produce a main beam and two, smaller side lobes as follows:

$$f(\theta) = \begin{cases} 1, & \frac{\pi}{3} \le \theta \le \frac{2\pi}{3} \\ 0.5, & \frac{\pi}{6} \le \theta \le \frac{\pi}{3} \\ 0.5, & \frac{2\pi}{3} \le \theta \le \frac{5\pi}{6} \\ 0, & elswhere \end{cases}$$

The linear array has a total length of 50 λ. Using the Woodward-Lawson method, find:
a. The number of elements required (you may assume that the total length of the antenna array is the same as the equivalent line source that would produce the same pattern)
b. The excitation coefficients of the elements

**3.** Synthesize a sector pattern with the following requirements:

$$f(\theta) = \begin{cases} 1, & \frac{\pi}{3} \le \theta \le \frac{2\pi}{3} \\ , & elswhere \end{cases}$$

Use the Fourier transform method, assume there are 20 elements in the array and the elements are spaced 0.6λ apart.
Find the current (excitation) coefficients for the elements.