

PHGN511 Homework #12  
Due Wednesday, Dec. 1, 2004 at the beginning of class  
Show your work.

- 1) Butkov 9.9 A little detective work showed that the definition being used by the author of  $J_{-m}$  where  $m$  is an integer is the one on page 358 where  $J_{-m} = (-1)^m J_m$ . This isn't really needed for the problem, but it's useful to know the expression is correct for a particular definition. In general, however, it's good to stay away from negative integral Bessel functions.
- 2) Butkov 9.13 The solution the author gives isn't really for the "next mode" in the sense of it being the mode with the lowest cutoff frequency. It's for the next mode with the same azimuthal symmetry as the plane wave. The plane wave is cylindrically symmetric, so go ahead and assume you are looking for the next mode which is cylindrically symmetric.
- 3) In class we solved (or by Monday the 22nd will have solved) the problem of a long, grounded, conducting cylinder of radius,  $a$ , centered on the  $z$ -axis and extending from  $z = 0$  to infinity. At  $z = 0$  the cylinder was closed by a plate held at constant potential  $\Phi_0$ . Now I want you to make numerical plots of:
  - a) the potential as a function of  $r$  when  $z = 0.25a, z = 0.5a, z = a, z = 1.5a$  for  $0 < r < a$ .
  - b) the potential as a function of  $z$  when  $r = 0, r = 0.5a, r = 0.75a$  and  $r = 0.9a$  for  $0 < z < 2.5a$I would suggest plotting the potential in units of  $\Phi_0$  and measuring distance in units of "a."
- 4) Butkov 9.18 We won't get to modified Bessel functions until Monday after Thanksgiving, but this one isn't too complicated so you should be able to work it out from the explanations given in the text.