ECE 473
Homework Assignment #9
Due: Wednesday, November 14, 2018

1. A piston of diameter 0.5 m is mounted so as to radiate on one side of an infinite baffle into air at 20˚C. For driving frequencies of 100 Hz, 1 kHz and 10 kHz, determine (a) the location of the last axial maximum in pressure, (b) the number of pressure nulls (excluding the one at infinity) on the axis of the piston, and (c) the angular width of the main lobe (to the first null) in the far field.

2. A circular piston sonar transducer of 1.0 m radius radiates 5000 W of acoustic power into sea water (13 ^{o}C) at 10 kHz. (a) What is its beam width at the –10 dB direction? (b) What is the axial pressure level in dB *re* 1 μbar at a distance of 10 m from the face of the transducer?

3. Determine the farfield beam pattern for a annular ring of outer radius a and inner radius $a/2$. Compare amplitude on axis and plot $H(\theta)$ of the annular ring and a piston of radius a such that $ka = 25$.

4. Problem 7.4.4 Kinsler et al. Hint: the approximation assumes that ka is large, use appendix in book for asymptotic expansion of Bessel functions.

5. A flat circular piston of 0.2 m radius is mounted to radiate on one side of an infinite baffle into air at 20 ˚C and at 500 Hz. (a) What must be the speed amplitude of the piston if it is to radiate 1 W of acoustic power? (b) If the piston has a mass of 0.015 kg, a stiffness constant of 1000 N/m, and negligible internal mechanical resistance, what force amplitude is required to produce this velocity amplitude?

6. Problem 7.6.2 Kinsler et al.