Problem 1. Consider a pair of wind turbines, each with rotor radii of $r_r = 20\,\text{m}$, hub heights of $z = 60\,\text{m}$. At the site the roughness height is $z_0 = 0.3\,\text{m}$. For both wind turbines, the design torque coefficient is $C_T = 0.88$. The free-stream wind speed is $U_\infty = 12\,\text{m/s}$.

1. For this system, based on the Jenson (1983) analytical wake model described in the chapter on wind farms, determine the spanwise distance, $y/D$ of the downwind turbine (B) so that it is not affected by the wake of the upstream turbine (A) for positions of Turbine B of $x/D = 4$, 7 and 10.

2. Repeat Part 1 with $C_T = 0.80$ for Turbine A.

3. How did this lowering of the design torque coefficient affect the energy density (power-per-square-area) of the wind farm?
Problem 2. A community wishes to replace an existing wind turbine with another with a higher rated power. The original wind turbine had a sound pressure level in the audible range measured at the hub height of 100dB. The new higher powered wind turbine has a sound pressure level that is 10dB higher. The hub height for both wind turbines is 50 ft.

Assuming an atmospheric absorption of $\alpha = 0.005$, perform the following.

a. For the original wind turbine, plot the sound pressure level as a function of the ground distance for up to 1000 ft. from the base of the wind turbine.

b. Plot the sound pressure level as a function of the ground distance from the base of the wind turbine for the new wind turbine.

c. How much further from the new wind turbine compared to the old turbine, must homes be to meet the Suburban night time sound level restriction of 30dB?