ECE 333 Green Electric Energy

Fall 2021
Prof. George Gross

Homework 2

Date set: Tuesday, 09/21/2021

Solution to be uploaded on course website: Tuesday, 09/28/2021

Quiz date: Thursday, 09/30/2021 (during class)

The quiz has one or more problems based on the assigned problems below

Reading:

Text: From Masters' 2nd edition

chapter 7 (sections 7.1, 7.2, 7.4, 7.5.1)

Solve the following problems:

Text: 7.1, 7.2

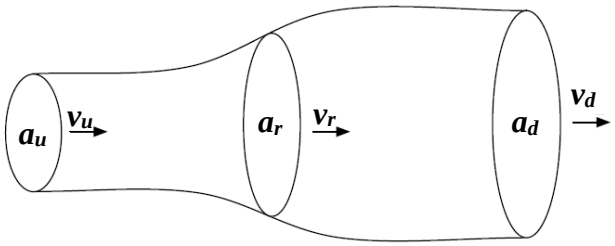
Problem a. **Compare** the total wind energy at 0 ^oC, 1 *atm* of pressure, contained in 1-m^2 surface area under the following wind patterns:

(*i*) 100 *hours* of 10 *m/s* winds;

(*ii*) 50 *hours* of 8 *m/s* winds plus 50 *hours* of 12 *m/s* winds

What are the implications of your findings? Can you draw a generalization concluded on the average wind speed?

Problem b. As illustrated in the figure below, the air flowing in and out of a wind turbine is contained in a tube, where a_u is the tube cross-section upwind the turbine through which air enters, a_r is the tube cross-section where the turbine is located, and a_d is the tube cross-section downwind the turbine through which air exits. Similarly, v_u is the wind speed at the tube cross-section upwind the turbine, v_r is the wind speed at the tube cross-section where the turbine is located, and v_d is the wind speed at the tube cross-section downwind the turbine. Let η_r denote the so-called Betz's efficiency



Among the choices below, which one describes the maximum amount of power that can be extracted from the wind (ρ is the air density) and state your explanation:

(*i*) $\frac{1}{2}\rho a_r v_r^3 \eta_r$

(*ii*) $\frac{1}{2}\rho a_u v_u^3 \eta_r$

(*iii*) $\frac{1}{2}\rho a_d v_d^3 \eta_r$

(*iv*) $\frac{1}{2}\rho a_r v_u^3 \eta_r$