ELEC-E8422 An Introduction to Electric Energy

Exercise Session 3: Wind Energy and Fuel Cells

EX 1 Wind Power

Speed of the wind is 15 m/s and the air density can be approximated to be 1,2 kg/m^3. What is the power density of the air?

In a wind turbine the length of the blades is 60 m. What is the power of the wind within this area? What is the maximum theoretical power of the blades?

EX 2 Tip Speed Ratio

In a wind turbine the gear ratio is 200 and its cut in speed is 910 rpm. The length of the blades is 5 m and the tip speed ratio is variable. Calculate TSR when wind speed is 10 m/s.

EX 3 Hypothetical Water Power

What is the power of the turbine of Exercise 2 if it is in water, the coefficient of performance of the turbine is 0,3 and other values are as in Exercise 2. Compare the result to Exercise one.

EX 4 Fuel Cells

Polarization curve of a fuel cell can be presented as an equation

$$V = 0.9 - 0.128 \tan(1.2 - I)$$

where *V* is voltage and *I* current of the fuel cell. Draw polarization and power curves as function of current. Derive the maximum power point. In the activation area current increase 10 %, what is the drop in the voltage. What are these voltage drops in the ohmic and mass transportation areas?