ECE 333 Green Electric Energy

Homework 3

Date set: 09/28/2021

Solution to be uploaded on course website: Tuesday, 10/05/2021

Quiz Date: Thursday, 10/07/2021 (during class)

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

Reading:
Text: From Masters’ 2nd edition
chapter 7 (sections 7.5, 7.6, 7.7.1, 7.7.2 and 7.8)

Solve the following problems:
Text: 7.6, 7.7

Problem a. (i) Sketch the ideal power curve of the turbine with the following characteristics:
• rated speed is 14 m/s
• cut-in speed is 5 m/s
• rated power is 1.25 MW
• furling or cut-out speed is 20 m/s
(ii) Given part (i), calculate the energy produced in one day if the wind blows continuously between 15 and 20 m/s all day
(iii) Can the energy produced in one year be determined if you are told that the average wind speed is 14 m/s? Explain why.

Problem b. Suppose an anemometer is mounted in a countryside area with many trees at a height of 10 m and its measurements indicate a 4.5-m/s average wind speed.
(i) Estimate the average wind power at a height of 80 m, assuming Rayleigh statistics and under the following weather conditions
• 15°C
• -5°C
(ii) Suppose a 1300-kW wind turbine with 60-m rotor diameter is located in those winds. Determine the annual energy production with a 30% wind turbine efficiency for each of the weather conditions
(iii) Evaluate the wind turbine capacity factor for each of the weather conditions