Faculty of Engineering

Minufiya University

Post Graduate Course, Master

Electrical Engineering Dept.

Course: Power Generation from Renewable Sources

Code Symbol: ELE 612, 600-LEVEL

Date of exam.:25/8/2020

Examination Hours: 3 hours

Answer the following questions:

1-1) Draw the wind power probability density function?

1-2) 9*(600-kW generator, 48-m rotor) wind turbines are mounted on a 50-m tower in an area with 7 m/s average windspeed at 10-m height. Assuming air density = 1.22 kg/m^3, the friction coefficient α for ground is estimated to be 0.15, and an overall efficiency of 25 %.Estimate the annual energy (kWh/y) delivered , suppose that a wind farm has 4-rotor-diameter tower spacing along its rows, with 6-diameter spacing between rows ($4D \times 6D$). Assume an array efficiency of 80%. Find the annual energy production per unit of land area.

2-1) Draw the speed-power characteristics.

2-2) A wind farm project has 10 * 1500-kW turbines with 64-m blades. Capital costs are $60 million and the O&M cost is $1.9 million/yr. The project will be financed with a $22.5 million, 20-yr loan at 10% plus an equity investment of $7.5 million that needs a 15% return, turbines wind speed are 8.5 m/s. Suppose that the owner of the wind turbines leases the land from a rancher for $20 per m per year. What is the cost per kWh generated from this farm?

3-1) Writeabout: Gibb's free energy, basic operation of fuel cell ,types of fuel cell.

3-2) Find the equation of power generated from wind turbine?

3-3) Writeabout: economical and technical model of wind.

4) Design a wind-farm to fed 3Mw load in Egyptian area. The wind speed is shown in table 1, use wind turbine in table2, take the following assumptions, the capital cost is $ 750/1 m^2 of area, the operation cost is 3.0 c/kWh of the annual generation, the lifetime and interest rate are 20 years and %10 and α=1/7.

Table 1

Month	1	2	3	4	5	6	7	8	9	10	11	12
Wind speed	7.4	7.6	7.7	7.3	7.4	7.7	6.7	6.5	7.4	6.2	6.4	7.5

Table 2

Rated power	Cut-in wind speed	Rated wind speed	Cut-out wind speed	Rotor Diameter	Hub height
1500KW	3.0 m/s	11.8 m/s	20.0 m/s	77.0 m	57 m