Minoufiya University

Faculty of Engineering

Post Graduate Course, Master

Electrical Engineering Dept.

Course:Power Generation from Renewable Sources

Code Symbol: ELE 612, 600-LEVEL

Date of exam:28/5/2018

Examination Hours: 3 hours

Minoufiya University

Answer the following questions:

Question 1: *40 Marks*

Assessment of hybrid wind-fuel cell system to supply a part of Egyptian distribution system with daily load curve in table(1) for an area with monthly wind speed in table (2) .The designed wind farm has 4-rotor-diameter tower spacing along its rows, with 7-diameter spacing between rows ($4D \times 7D$).Use wind generators in table (3).The following assumptionsare taken into account through carrying this applications: the capital cost is 340 \$/m^2,the annual maintenance and operation cost is 5 ¢/kWh of the annual energy produced ,the interest rate and life-time are 12% and 15 years and 35% wind turbine efficiency.The design parameters of fuel cell areas shown in table (4).

Table (1) load curve

Day hours	0	4	8	12	16	20	24
Power (Mw)	16	13	23	26	28	32	16

Table (2) Mean wind speed through the year months

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
V_m (m/s)	3.6	4.63	6.69	6.17	6.17	6.17	6.69	6.17	6.17	6.17	4.63	5.14

Table (3) Wind turbine parameters

Rated power (kW)	850	1500
Rotor diameter (m)	52.0	83.7
Hub-height (m)	44.0	67.0
Cut-in wind speed (m/s)	4.0	4.2
Rated wind speed (m/s)	16.0	18.5
Cut-out wind speed(m/s)	25.0	25.5

Table(4) The design parameters of fuel cell

No. of stacks	P_{st}(W)	V_{st}(V)	I (A)	J_c (A/cm^2)	V_c(V)	A(cm)	RT(h/year)	N
--	5000	72	69.99	1	0.6	69.44	3000	120

Question 2: *25 Marks*

2-1) Write about different types of fuel cells.

2-2) Write about the different types of EESS.

Question 3: *35 Marks*

Design the best stand-alone PV array with a suitable energy storage system to supply three houses rated at 15.75 kWh/m^2/day under standard conditions. Module nominal operating cell temperature is 37C^0 in summer. DC power output at the MPP drops by 0.5%/°C above the cell temperature of 25C^0 ,there is a 3% array loss due to mismatched modules, dirt loss is 4%, and the inverter has an efficiency of 90%,the array is south-facing and the available roof area for each house is100 m^2. The peak sun hours per day are 8 hours.(Use modules in table (5)).

Table (5) PV modules

Pv module	1	2
Power(dc)	110	150
Voltage(V)	16.9	34
Current(A)	7.1	4.45
Volume mm	1425/652/52	1587/790/15.4
efficiency	12.7%	15%