Mansoura University.
Faculty of Engineering.
Electrical Engineering Dept.

Renewable Energy Systems.
Time allowed: Three Hrs.
Date: 8 -9-2013.

Final Examination ---- Preliminary Course of Master Degree.

Answer All Following Questions.

رجاء ممنوع استعمال القلم الرصاص في الحل (يستعمل فقط في الرسومات التوضيحية).

First Question:

1-a) Show the importance of the *I-V* curves of the PV cells, and demonstrate the following:

- **i)** The practical electrical circuit used in deducing *I-V* curve, and the important points on it,
- **ii)** Basic construction of the PV cell, module, and array,
- **iii)** Equivalent electrical circuit of PV cell and the mathematical model used in executing the *I-V* relations, and
- **iv)** The factors affecting the *I-V* curves. *(10 marks)*

1-b) Discuss the Kelly cosine curve and the factors used into consideration in deducing the "Array Design" and the methods used in achieving the peak power point operation. *(5 marks)*

Second Question:

2-a) Demonstrate the essential advantages of the photovoltaic power. *(5 marks)*

2-b) In the PV cells technologies, explain the single-crystalline silicon, poly crystalline and semi crystalline.

Demonstrate the single-crystalline making by Czochrolski, Amorphous silicon, and concentrated cells. *(10 marks)*

Third Question:

3-a) Prove that the power in the wind is: $P_W = \frac{1}{2}\rho A V^3$, and the power extracted by the wind turbine = $C_p P_W$.

Find the relation of : $C_p = f(V, V_o)$ *(5 marks)*

3-b) i) Show graphically the relation of C_p vs. (V_o/V) ratio and the maximum practical value of C_p and the ratio of (V_o/V) at C_{pmax}.

ii) Show graphically the rotor efficiency vs. tip speed ratio at different number of blades, and the number of blades achieving the highest efficiency. *(10 marks)*

3-c) Demonstrate the Weibull probability distribution function at specific value of scale parameter "C" and shape parameter of K=1, 2, and 3. *(5 marks)*

3-d) Explain the probability distribution with shape parameter K=2 and the scale parameter ranging from 8 to 16 mile/hr. *(5 marks)*

Fourth Question:

4-a) Show and demonstrate the principle operation of the grid-connected PV power system, and the grid-connected wind power system. *(10 marks)*

4-b) Draw the electrical components layout of the grid-connected wind turbine power system. *(5 marks)*

4-c) Discuss the vital importance of the synchronizing with grid. *(5 marks)*

Fifth Question:

5-a) Show the synchronizing circuit using three synchronizing lamps or the synchronoscope. *(5 marks)*

5-b) Discuss the synchronizing process specifically runs for the wind turbine generator, and remember the advantages and disadvantages of the inrush current. *(10 marks)*

5-c) Explain the operation limit of the renewable power plant connected to grid via transmission line link using the equivalent circuit. *(5 marks)*

5-d) Prove that the maximum efficiency of a power system is achieved when: $L_o = K P^2$ where L_o = Fixed loss and KP^2 = variable loss. *(5 marks)*

Good Luck.

Prof. Dr. Mohamed Adel El-Sayes