

كلية الهندسة

جامعة المنوفية

المادة :- تحويل الطاقة

التاريخ :- ٦ / ٦ / ٢٠١٥

ماجستير الدراسات العليا تمهيدي

الزمن ثلاث ساعات للجزأين

قسم هندسة القوى الميكانيكية

### Part 1

1 ) A)- Explain the multi-stage flash distillation and its use in solar power plant in diurnal.

B) -Describe with suitable sketch:-

Solar refrigeration n system and Solar furnace.

2)-A flat plate collector having two glass cover is installed in Marsa Matrohat 12:00 on 15/8/2009, with the following data :

Collector tilt angle	45°
Azimuth angle	-35°
Plate to cover spacing	3.5 Cm
Ambient air and sky temperature	37C°
Wind speed	3.5 m/sec
Back insulation thickness	4 Cm
Insulation conductivity	0.075 W/m.c
Mean plate temperature	85 C°
Cover temperature	45 C°
Plate emittance	97%
Marsamatroh latitude angle	31.22°

Calculate:- 1 ) The angle of incidence of beam radiation.

2 ) The top loss coefficient.

**Question 1 (30 Marks)**

(a) Indicate how the angle of attack of a horizontal axis wind turbine is kept constant along its blade/s from tip to base. Discuss the reason/s for keeping this angle constant.

(5 Marks)

(b) It is required to supply a touristic village at the red sea with electrical energy for lighting. There are 2000 lamps in the village each 25 Watt. It is intended to use wind energy for covering this load. The wind speed at the site of the village is 7m/s all day long and 8.5 m/s at night. Electricity generated during day time is used to produce hydrogen, which is stored to be utilized at night to generate electricity using fuel cells. You are requested to design a scheme containing a wind turbine and a fuel cell with their ancillary components. Applying a survey show how these elements are linked with each other. In designing the wind turbine, determine:

- (i) Number of blades
- (ii) Rotational speed
- (iii) The turbine diameter
- (iv) Tangential force
- (v) Axial thrust

Determine the amount of hydrogen to be stored and the power of the fuel cell (Calorific value of the hydrogen is 150,000 kJ/kg). Assume any missing data you, may involve in the calculations. You must make reasonable assumptions about the efficiencies of the wind generator, inverter, electrolyzer and fuel cell.

(15 Marks)

(c) Select a fuel cell type that is appropriate to be used in the task (b) and explain how it works. Propose a method for determining the capacity of the selected fuel cell.

(5 Marks)

(d) Show how the hydrogen is stored for further use by fuel cell.

(5 Marks)

**Question 2 (20 Marks)**

A new hotel built in a remote area is to be provided with air conditioning system. It is intended to utilize solar irradiation in this area to run a double effect absorption refrigeration system. For this purpose parabolic trough collectors can be utilized for collecting solar radiation to create enough heat to be applied for heating the generator of the refrigeration system. The air conditioning load of the building is 116 kW during 12 hours of the night and it is doubled during the 12 hours of the day time. If the refrigeration machine can produce constant capacity during 8 hours of the day time, determine:

- (a) The capacity of the appropriate double effect absorption refrigeration system.
- (b) The capacity of the cold storage system.
- (a) Choose the appropriate cold storage system to be employed with the absorption refrigeration system and demo by the tending of a

sketch how this scheme works.

**Wind turbine**

$$P_i = \frac{1}{2} \rho A V^3$$

$$C_p = 4a(1-a)^2$$

$$F_{tx} = \frac{1}{2} \rho A V_i^2 [1 - (1-2a)^2]$$

$$\lambda_{opt} = \frac{4\pi}{n}$$