Department of Electrical Engineering
Assignment
Date: 20/04/2020

Course Details

Course Title: Direct Energy Conversions **Module:** 3rd
Instructor: Shayan Tariq. **Total Marks:** 30

Student Details

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Note: Plagiarism of more than 20% will result in negative marking.
Similar answers of students will result in cancellation of the answer for all parties.

Q1.	(a)	In Renewable Energy Systems Solar Photo Voltaic and Fuels Cell are among the popular choice of technologies used for Direct Energy Conversion. For your home town of (State your city), which will be the better option to power a 10 KW load. Explain your answer based on its pros & cons, users, applications, availability and market. Back your reasons with valid data, facts and figures.	Marks 10
Q2.	(a)	PV Cells performance is greatly affected by a location's climate factors which include irradiance, temperature, humidity and wind. Different locations have different climate conditions. For your home town of (State your city and climate conditions), based on its average climate conditions what techniques will you apply to a PV cell to reduce the effects of climate on the cells performance, reduce losses and increase efficiency. Back your reasons with valid data, facts and figures.	Marks 10
Q3.	(a)	Fuel Cells have many types based on temperature, electrolyte and fuel. What would be the best option and the worst option among the types of fuel cell for providing power to Iqra National University (Take the last 3 digits of your student ID to be the average load KW of INU) located in Peshawar. Explain your choices based on the pros & cons, applications, availability and market. Back your reasons with valid data, facts and figures.	Marks 10

Question No 01:

In Renewable Energy Systems Solar Photo Voltaic and Fuels Cell are among the popular choice of technologies used for Direct Energy Conversion. For your home town of (State your city), which will be the better option to power a 10 KW load. Explain your answer based on its pros & cons, users, applications, availability and market. Back your reasons with valid data, facts and figures.

Answer:

Solar Photo Voltaic cell.

A device which is converting solar radiation into electricity. In our area in Peshawar there is a mostly using solar system which is very good and running cost free and working very well. Now The annual average of daily solar radians in Peshawar is 4.2 kwh/m2 to 4.6 kwh/m2 which is sufficient for solar energy utilization. Because this is not costly as compared to fuel cell and some that type areas where the dropping of electricity lines and voltage drops is in very high rate such as villages so in that areas the solar system is very good for us. Fuel cell required a lot of energy to make it distribute hydrogen and hydrogen element nature make it a difficult fuel to transport and store therefore we install 10kw solar photo voltaic cell in our home town Peshawar.

Advantage of solar photo voltaic cell.

- Fairly high net energy.
- Work on cloudy days.
- Quick installation.
- Easily expanded or moved.
- No CO2 emission.
- Low environmental impact.
- Last 20—40 years.
- Low land use (if on roof or built into walls or windows).
- Reduces dependence on fossil fuels.

Disadvantage of solar photo voltaic cell.

- Need access to sun
- Low efficiency.
- Need electricity storage system or backup.

- High land use (solar-cell power plants) could disrupt desert areas.
- High costs (but should be competitive in 5-15 years).
- DC current must be converted to AC.

Uses:

10kw solar system are suitable for domestic and small offices.

Application:

Now solar fans and much more appliances of solar cells and Air-condition of solar cell easily accessible and very economical. It's a very long life as compared to fuel cell.

- Fans.
- Air-condition.
- Freezer.
- Water pump.
- Led light.
- Led TV.
- Water dispenser.

Availability in Market:

In current time there is a lot of solar component and appliances easily available in the market.

Question No 02:

PV Cells performance is greatly affected by a location's climate factors which include irradiance, temperature, humidity and wind. Different locations have different climate conditions. For your home town of (State your city and climate conditions), based on its average climate conditions what techniques will you apply to a PV cell to reduce the effects of climate on the cell's performance, reduce losses and increase efficiency. Back your reasons with valid data, facts and figures.

Answer:

PV Cells performance is affected by a location's climate factors including irradiance, temperature, and humidity.

In Peshawar region weather is in between 25 to 35 degree centigrade in which the pv module is working well. But in summer season the weather in hot and temperature is reach up to 45 to 50-degree centigrade which effect the efficiency of pv module so that why we used the following technique to minimize the effect on pv module.

OVERHEATING EFFECT ON PV EFFICIENCY:

- Install panels a few inches above the roof so convective air flow can cool the panels.
- Ensure that panels are constructed with light-colored materials, to reduce heat absorption.
- Move components like inverters and combiners into the shaded area behind the array.

Heat sink cooling system:

Heat sink is one of the cooling ways which uses a high thermal conductivity metal to remove the heat from the photovoltaic cell y the temperature reduction of the PV panels during a clear day of summer by using different arrangements of ribbed wall heat sink of air and passive cooling. It was found that the maximum temperature of the panel for the angle 45° was less than that for the angle 135°. The study found that the maximum power produced by PV panel in case of using heat sink was increased by 6.97% and 7.55% compared to the reference case, for angles of the ribs from 90° and 45°, respectively.

Air channels cooling system:

the performance of the PV cells with active cooling by using air channels connected to the back of the PV panel It was noticed that the electrical efficiency was decreased when the cells operating temperature increased for both cooling and non-cooling cases, but for the cooling case the electrical efficiency was higher so air is cooled the pv panel so that's why the air cooling system is used.

Water spray cooling system:

The impact of water spray cooling on the performance of the PV panel in highest solar irradiation level environment. Both sides of the PV panel were cooled at the same time by utilizing twenty nozzles, ten on each side. The results were measured for three different cases of cooling: front side cooling, rear side cooling and both sides together and compared with non-cooling case so in this technique the pv module is cooled.

Fins cooling system:

The performance of the PV cells using different types and shapes of fins. Used aluminum fins combined with cotton wick as a passive cooling system to maintain the temperature of the PV panel. The cooling system was consisted of three aluminum fins (630 × 100 × 60 mm) with cotton wick attached to the back side of the crystalline silicon PV cells through which the pv module is cooled.

Hot weather:

In hot summer season PV Module temperature sometimes raise to more than 60 degree centigrade for that reason it is suggested to have a continuously water is sprayed on PV module. In very hot weather the pv module is too hot causes decreasing efficiency on the other hand cooler solar panel improve efficiency.

Dust Accumulation:

We are living in plan areas which remains throughout the air so that dust fall on the solar panels which reduces solar efficiency so for dust accumulation solar panel is washed properly.

Humid/Moisture:

Humidity also effects the solar efficiency greatly due to moisture in environment. The rays of the sun are diverted back which also effects the solar cells greatly to

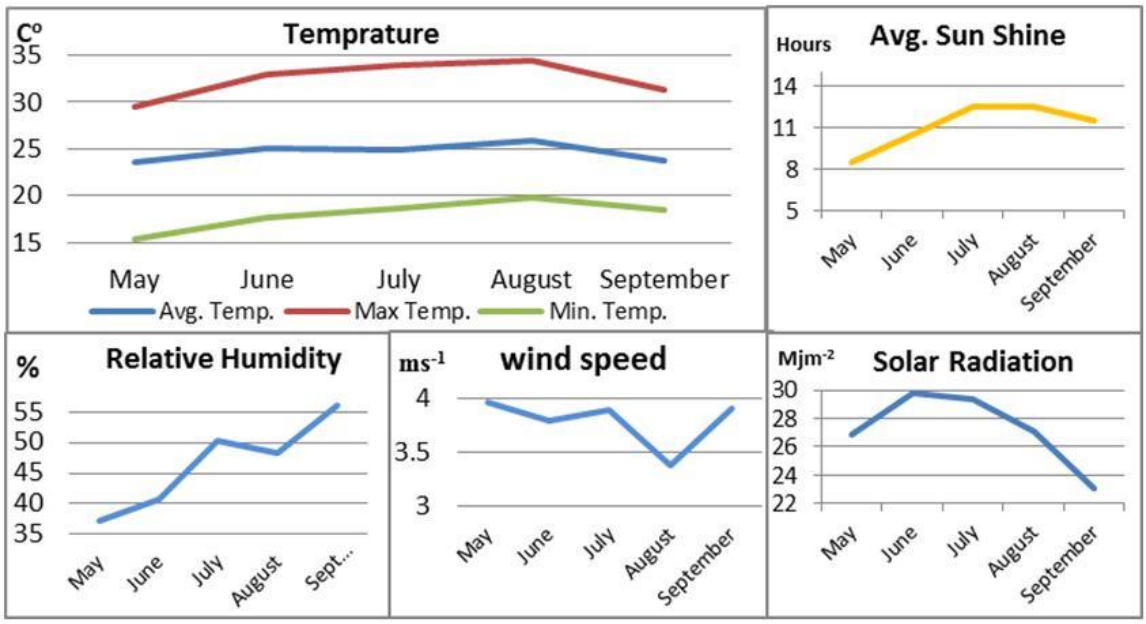
reduce this problem edge sealants and ionic conductive material are used but this problem does not occur in our areas.

Wind:

Wind have positive effect on solar panel it keeps the solar panel cool which increase solar efficiency. For this solar panel is keep inclined so that air can pass around it. The solar panel cooled by 1 degree Celsius are 0.05 percent more efficient. This percentage add up over time.

Technical Method of improving efficiency and reduce losses.

1) Choosing optimum transparent conductor.
2) Promoting light scattering in the visible spectrum.
3) Radioactive cooling.
4) Anti-reflective coating and textures.
5) Rear surface passivation.
6) Thin film materials.



Graph:

Question no 03:

Fuel Cells have many types based on temperature, electrolyte and fuel. What would be the best option and the worst option among the types of fuel cell for providing power to Iqra National University (Take the last 3 digits of your student ID to be the average load KW of INU) located in Peshawar. Explain your choices based on the pros & cons, applications, availability and market. Back your reasons with valid data, facts and figures.

Answer:

Fuel cell:

Electrochemical energy conversion device. Converts the chemicals hydrogen and oxygen into water. Generates electricity by a chemical reaction. Every fuel cell has two electrodes, one positive and one negative, cathode and anode respectively. The reactions that produce electricity take place at the electrodes.

Types of fuel cell.

Alkaline Fuel Cells (AFC)

Polymeric Electrolyte Membrane Fuel Cells (PEMFC):

Direct Methanol Fuel Cells (DMFC)

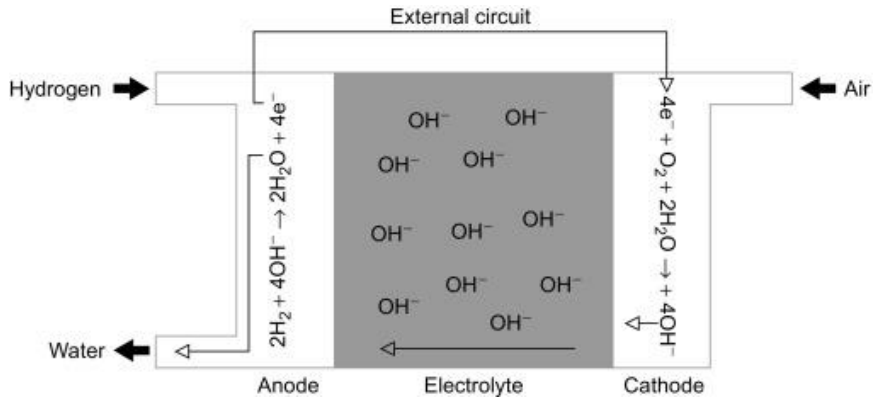
Phosphoric Acid Fuel Cell (PAFC)

Molten Carbonate Fuel Cell (MCFC)

Solid Oxide Fuel Cell (SOFC)

Alkaline Fuel Cells (AFC):

Alkaline fuel cells have as electrolyte an aqueous solution of Potassium hydroxide. Usually, this solution has a concentration of around 30%. It is necessary to insert the hydrogen gas at the anode and to insert the oxygen gas at the cathode Even though the overall reaction is still an oxidation reaction reaction between hydrogen and oxygen, the partial equations representing the reactions at the anode and cathode have a small difference compared with other fuel cells.



Now here we know that the power providing to iqra national university is high and the alkaline fuel cell is much lower power providing but it is very low temperature to do good.

Which is operating temperature is less than 100 degree C and in our area the temperature is in between 30 to 40 degree C and the power is in between 5 to 150kw and our range is power providing is 627kw which is very high.

Phosphoric Acid fuel cells (PAFC):

Use phosphoric acid as the electrolyte.

Efficiency ranges from 40 to 80 percent, and operating temperature is between 150 to 200 degrees C (about 300 to 400 degrees F). Existing phosphoric acid cells have outputs up to 200 kW, and 11 MW units have been tested. PAFCs tolerate a carbon monoxide concentration of about 1.5 percent, which broadens the choice of fuels they can use. If gasoline is used, the sulfur must be removed. Platinum electrode-catalysts are needed, and internal parts must be able to withstand the corrosive acid.

Electrolyte:

H3PO4 immobilized in Sic Metrix

Electrode Material:

Anode: Pt, PtRu

Cathode: Pt

Application:

Combine heat and power for decentralized stationary power system.

Now in this fuel cell the operating temperature is 150 to 200 degree C and the power providing to university is 627KW which is in between in 200kw to 11Mw and their life span is good which is greater than 50,000h.

So now the good option is to choose for power providing to university is PAFC phosphoric acid fuel cells because its temperature, power providing and life span is much good as compare to alkaline and other fuel cell.

The worst option is AFC Alkaline fuel cell.

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