

**Course Title:** Direct Energy Conversion

**Module:** MS (EL.E)

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**Student ID:** 15558

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

Course Details

**Course Title:** Direct Energy Conversions  
**Instructor:** \_\_\_\_\_

**Module:** \_\_\_\_\_  
**Total Marks:** 30

Student Details

**Name:** \_\_\_\_\_

**Student ID:** \_\_\_\_\_

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 System Solar Photo Voltaic 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, application, availability and market. Back your reasons with valid data, facts and figures.***

Pakistan lies in a region where highest solar insolation exists. Direct normal solar radiation. Pakistan has immense solar resources both for Photo voltaic cells and thermal solar power

applications. Annual direct normal solar radiation exists widely in the range 3.5 -7 KWh/m<sup>2</sup>/Day upto 8 KWh/m<sup>2</sup>/Day.

Photo voltaic cells are one of the renewable technologies used to extract solar energy from the direct solar radiation and convert it to electrical energy. Just put them on the roof and forget. The sun won't necessarily produce the energy when we need it, so if we want to use smartly we have to store the electricity or the heat, which is not an easy thing.

Due to availability of immense direct solar radiations one will diffidently prefer PV Cells instead of Fuel cells and I do prefer it for about 10KW for my home town Lakki Marwat. Annual Solar radiation exists in my home town up to 5 KWh/m<sup>2</sup>/Day.

### **Pros:**

- PV panels provide clean & green energy.
- No harmful greenhouse gas emissions.
- Solar PV is environmentally friendly.
- Solar energy is energy supplied by nature, it is thus free and abundant!
- Available everywhere.
- Low initial and operation cost, almost negligible as compared to other renewable energy systems.
- Electrical energy creates in a direct way.
- PV Panels has no mechanically moving parts, that's why It has less breakages and need less maintenance.
- PV panels are totally silent, producing no noise at all; consequently, they are a perfect solution for urban areas and for residential applications.
- Because solar energy coincides with energy needs for cooling, PV panels can provide an effective solution to energy demand peaks – especially in hot summer months where energy demand is high.
- Easy to install on rooftops or on the ground without any interference to residential lifestyle.
- No transportation of fuels.

### **Cons:**

- Most places have no ready supply of hydrogen, and there is no infrastructure to distribute it.
- They are easily contaminated or poisoned by impure hydrogen or air.
- They are expensive.
- You can't put a fuel cell on your roof and produce energy, you have to provide him hydrogen.

### **Users:**

- Solar Water Pumps
- Cooling Fan
- Inverter

- Solar Tubewells
- Solar power Supply to Telecom Towers

### Applications:

- It is very useful in powering space vehicles such as satellites and telescopes.
- PV Cells is a very reliable & economical way of powering objects.
- PV cells has replaced the expensive and cumbersome fuel sources.
- International Space Station.
- Solar powered Vehicles.
- Solar cells also used to power the rovers which are used to examine the surface of Mars.

**PV Cells are very cheap and available even at door steps.**

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### Question No. 02

***PV Cells performance is greatly affected by a locations 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 effects of climate on the cells performance, reduce losses and increase efficiency. Back your reasons with valid data, facts and figures***

My home town is Lakki Marwat where the temperature may touch 45 °C during very shiny day in summer. Climate is hot and dry for most of the year. Sand Storm often observed during the summer. Following are the techniques which are to be applied to increase the efficiency of the PV Cells. Following are the steps which are to be taken to increase the efficiency of PV Cells by reducing losses and improving the performances.

#### **1. Correct Installation of Photovoltaic Panels**

Orientation and tilting of PV Solar cells are very important in regard to its output. It will show poor efficiency if oriented along the north or east. Thus its correct installation is very important. Both the orientation and tilting is very important. Its installation should ensure that it will receive the optimal solar radiations through the day, as well as all through the year. Its orientation for those who live in northern hemisphere should towards south.

Similarly, for those who live in southern hemisphere its orientation should be towards northern hemisphere. Its tilting should be such like to receive solar radiation directly and continuously without any obstruction from 9 a.m. to 3 p.m.

## **2. Avoid Shaded Areas**

Shade has an adverse effect on the output of the PV Cell output. Shading can be mitigated in any way to increase the efficiency of the PV Cell. In case of series cells, shade on any cell will change its function from generation to load, thus it will act as a resistor and hence the output of the neighbours will be drained. This is because it acts as a resistor and helps in determining the total current.

## **3. Cleaning the Surface soiling of PV Cells**

Dust or soiling on the surface of the PV panel will drastically decrease its efficiency. Impact of solar radiations on PV Panels is reduced because the solar radiations are dissipated by the dust. It is therefore very important to ensure less soiling on the glass of PV panels. One possible way is wash the exposed part of PV Panels. It can be washed with water and soap with the help of cloth and sponge. Care should be taken with the wires installed beneath. It is generally assumed that solar panels can lose 15-25% of their efficiency if not cleaned properly. Solar panels that are cleaned once and twice a year produce 3.5% and 5.1% more electricity respectively than those that are left uncleaned

## **4. Prevent an Increase in Temperature**

Temperature is another factor which has a vital role on the efficiency of the PV Panel. The efficiency of your photovoltaic panel is affected by temperature levels. Efficiency drops as the temperature gets higher. Efficiency drops whenever temperature gets higher and vice versa. A sufficient gap between the back of PV Panels and the surface or roof will allow easy passage of air to pass thru. Hence air's easy movement will reduce the ambient temperature of the PV panel which then as a result increases the efficiency or outcome of PV Panel.

## **5. Use a Solar Concentrator**

Solar concentrator is used to concentrate more radiations on the PV panel surface. The more will be solar concentration the more will be the efficiency and vice versa. To concentrate the light falling on a large area into smaller areas large mirrors or other devices are used. Thus, the overall efficiency of solar cells, which are generally very expensive, can be increased. You not only get more energy but also save money.

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## **Question No. 3**

***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) location in Peshawar. Explain your choices base on the pros & Cons, applications availability and market. Back your reasons with valid data facts and figures.***

Being a student of Iqra University Peshawar I have allotted a student ID 15558. As per question I compelled to take the last three digits as the load for Iqra University which becomes 558KW.

Though there are many types of fuel cells based on the construction, working and application. I have given the choice to choose both the best and the worst one among all. After thorough investigation I found that Solid Oxide (SOFC) is one best option to meet the energy demands of University and Alkaline fuel cell (AFC) is one of the worst. Such comparison is made base one the load, type, application, cost, availability, stake size and working temperature.

### **Best option is Solid Oxide fuel cell (SOFC)**

#### **Pros:**

- High Stack size range i.e. 1KW-2MW
- High efficiency
- Fuel flexibility
- Operate on wide range of catalysts
- Solid electrolyte
- Hybrid or GT Cycle
- Suitable for CHHP & CHP

#### **Cons:**

- High temperature corrosion and breakdown of cell components
- High temperature operating requires long start up time and limits

#### **Application:**

- Used as Auxiliary power
- Electric Utility
- Distributed Generation

### **Worst option is Alkaline fuel cell (AFC)**

AFC is choosed one of the worst choice to meet the energy demands of the Iqra university load. It uses the electrolyte Aqueous solution of potassium hydroxide soaked in a matrix

#### **Cons:**

- Low typical stack size

- Multiple stacks to be used to meet INU demand.
- Low operating temperature
- Difficult to manage electrolyte
- Sensitive to CO2

**Application:**

- Not for domestic or commercial use
- Used in space station
- Military Purpose

**The End**

