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

Course Details

Course Title: Direct Energy Conversions **Module:** _____
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.

Q 1.	(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
Q 2.	(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
Q 3.	(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:

In Peshawar the average annual of daily solar radiatiance is 4.2kwh/m2 to 4.6kwh/m2 therefore it is sufficient for solar energy utilization. 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.

Pros of solar photo voltaic cell:

- Pollution Free.
- Reduce energy bill.
- Low maintenance.
- Simple installation.
- Innovative technology.
- Infinite energy.
- Free of cost energy when solar energy installed.
- Installed anywhere in field or building.
- Efficiency is always improving.

Cons of solar photo voltaic cell:

- Seasonal Energy.
- Initial cost will be high.
- Installation requirement location sensitivity.
- Need a lot of space as efficiency is not 100%.
- Lower solar production in the winter month.
- No solar power at night so there is need a large battery bank.

Uses:

10kw solar system are suitable for large residential homes and small offices.

Application:

- Led light.
- Fans.
- Fridge.
- Inverter Air conditioner.
- Led TV.
- Water dispenser.

Availability in Market:

They are easily available in karkhano market and everywhere in Pakistan.

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 cells performance, reduce losses and increase efficiency. Back your reasons with valid data, facts and figures.

Answer:

The annual average of daily solar radians in Peshawar is 4.2 kwh/m2 to 4.6 kwh/m2. Performance of a solar pv cell is affected by weather condition including irradiance, temperature and humidity

OVERHEATING EFFECT ON PV EFFICIENCY:

Overheating can affect pv efficiency due to excessive solar radiation and high ambient temperature when the temp reach 0 degree centigrade to 45 degree centigrade in Peshawar the pv efficiency will be affected. When the temp reach above 25 degree centigrade at every 1-degree centigrade efficiency droop by 0.5%.

Cooling technique:

Cooling technique is the one of the most popular method for cooling the photovoltaic panels. The cooling agent, i.e water or air is circulated around the pv panel for cooling the solar cells.

liquid-Based PV system:

When water circulated around the solar photovoltaic cell which increase the solar cells output power by almost 50%.

Air-Based pv system:

When air as a coolant to decrease the solar cell temp by 4.7c and increase the efficiency of solar panel by 2.6%.

Fins cooling:

Used the fins cooling to maintains the temperature of the PV panel.The cooling system was consisted of three aluminum fins (630×100×60mm) with cotton wick attached to the backside of the crystalline silicon PV cells.

The heating rate model:

The heating rate model is used to determine the cooling frequency of pv panel.

Thus calculate the module temp:

$$Tm = Tams + (NOCT-20)E/800.$$

Tamb is ambient temperature

Tm is module temperature

NOCT is nominal operating cell temperature.

The cooling rate model:

Determine the cooling rate of the pv cells, the cooling panel can be specified.

Q gained by cooling water is equal to the heat energy dissipated from the pv panel

Qdessipated from pv panel:

The cooling time t is determine from the following energy balance.

Q gained by cooling water = Q dissipated pv panels

Mw * t* cw*delta Tw = mg *cg * delta Tg

T = mg * cg *delta Tg / mw*cw*delta Tw

Clody weather:

In a cloudy weather the pv module is affected because the power drop and the continuity of load fall to zero. The problem can be solved by adding a capacitor bank in series with the pv module.

Dust Accumulation:

In Peshawar the pollution will be more due to construction or other reason the mud falls on solar system which will affect the efficiency of solar system.

Wind:

Solar panel Is positive effected by wind to increase efficiency of solar panel by cooling through wind.

Effect of humidity on solar pv and how this effect can be reduced:

Humidity level do effect the working of solar panel and can dropdown the efficiency of the solar panelis installed in cities where in the normal

humidity level appearance.

Present Reduction in power = (p(without humidity)-p (with humidity) / p (without humidity)) *100

5% humidity increased

7.499% reduction in power.

10% humidity increased.

15.85% reduction in power.

There is precaution to present humidity from deteriorating solar panel.

Faster, such as edge sealant and using low ionic conductive materials.

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)coating and textures:

5) Rear surface passivation:

6) Thin film materials:

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.

Fuel cell:

Electrochemical energy conversion device, convert the chemical hydrogen and oxygen into water and generate electricity by a chemical reaction.

Types:

Alkaline Fuel Cells (AFC)

Polymeric Electrolyte Membrane Fuel Cells (PEMFC):

Direct Methanol Fuel Cells (DMFC)

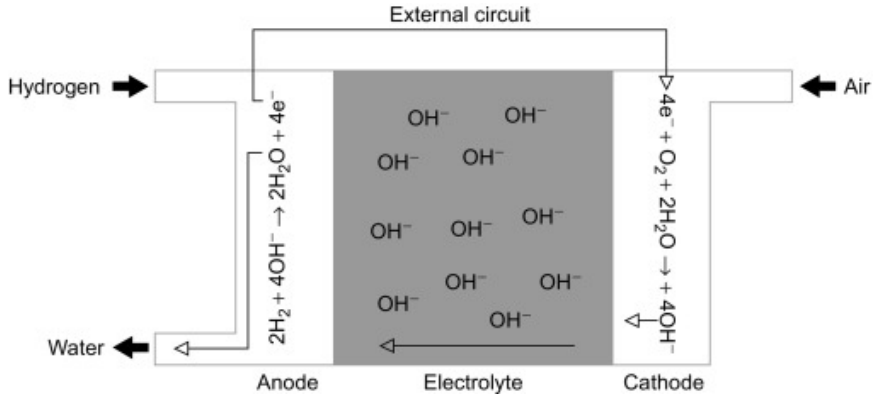
Phosphoric Acid Fuel Cell (PAFC)

Molten Carbonate Fuel Cell (MCFC)

Solid Oxide Fuel Cell (SOFC)

Alkaline Fuel Cells (AFC):

Alkaline fuel cells consume pure oxygen and hydrogen producing potable heat water and electricity Alkaline fuel cell the most efficient. The potential reach 70%. Alkaline fuel cell is the best option but it doesn't power providing 626kw which required for iqra national university therefore we go to the Molten Carbonate fuel cell. Therefore the worst option is AFC and the best option is MCFC.



Molten Carbonate fuel cell MCFC:

Operating temperature:

600-700C

Electrolyte:

Li2CO3-K2CO3 cuteeic mixture immobilized in Y-LiAlO2

Charge carrier in Electrolyte:

CO3^2

Anode reaction:

H2+CO3^2___H2O+CO2+2e-

Cathode reaction.

½ O2 + CO2+2e-_____CO3^2

Electrode Material:

Anode: Ni_5Cr

Cathode: NiO(Li)

Realized Power:

Small power plants 300kw to 3Mw and we need power to Iqra National University average load 626kw therefore the power is in between.

Main Producers:

Fuel cell energy (USA)

Efficiency:

45-50%

Lifetime:

7000--800h

Pros:

High Efficiency

Fuel flexibility

Can use a variety of catalysts

Suitable for CHP

React quickly

CONS:

High temperature corrosion and breakdown of cell components.

Long start up time

Low power density

Matrix Cracking

Contaminants

Application:

Electric utility

Distributed generation

Availability in market:

Easily available in market and everywhere in Pakistan.