Mechanical and Energy Engineering Department
Senior Design Projects

2020-2021
T2201-T2202

Table 1. List of SDP team members and advisors

SDP code	SDP title	Students Names	Advisor
ENRG-2001	Design a heat extraction system for High Concentration Photovoltaic (HCPV) driving a water desalination system.	1. Ahmed Taha Okasha 2. Anas Ahmed 3. Abdullah Ghamdi	Dr. Fahad G. Al-Amri
ENRG-2002	Modular solar panel design and development	1. Hassan Abu Shoumi 2. Feras AlDuhaim 3. Fahad walid aldossary	Dr. Muhammad Saleem
ENRG-2003	Portable Autonomous Desalination Unit	1. MOHAMMED HANI ALWAHEED 2. Faisal Ali Alzahrani 3. Abdallah Omar Almalki	Dr. Farooq Saeed
ENRG-2004	Design of fuzzy logic control-based MPPT charge controller for stand-alone PV system	1. Mohammed Al-Talib 2. Ali Jaffer AL Qatari 3. Ali Al-Ghanim	Dr. Nagmeldeen Hassanain
ENRG-2005	Automation and performance evaluation of a split air conditioner via Android smart phone	1. Abdulilah Almahdi 2. Abdulmohsen Olaiwat 3. Nasser Al-Ibrahim	Dr. Amro Owes
ENRG-2006	Design a cogeneration system using High Concentration Photovoltaic (HCPV) for power generation and desalination.	1. Ghaith Alfalah 2. Ali Al-Matar 3. Abdulrahman	Dr. Taher Maatallah
ENRG-2007	DESIGN AND IMPLEMENTATION OF A TUBULAR CLAY MEMBRANE FOR USE IN WATER DESALINATION SYSTEM	1. Hassan Al-Safwan 2. Ihsan Al-Hamoud	Dr. Sajid Ali Khan Zada
ENRG-2008	Experimental Investigation of different cleaning methods for Dust Accumulation on PV panel Using an autonomous Robot	1. Abdulrahman Ashraf Ashour. 2. Saleem Khalid AlAwad 3. Ali Mohammed AlQarni	Dr. Nasir Hariri
ENRG-2009	Smart cooling Method of PV Module using Shape Memory Alloy	1. Zaid Al khateeb Ali 2. Nawaf Anwar 3. Mohammad Ibrahim Alosayl	Dr. Nasir Hariri

Design a heat extraction system for High Concentration Photovoltaic (HCPV) driving a water desalination system.

SDP code: ENRG-2001

Students: Ahmed Taha Okasha; Anas Ahmed; and Abdullah Ghamdi

Advisor: Dr. Fahad G. Al-Amri

ABSTRACT

In the literature, various passive and active cooling setups have been employed to thermally manage the operation of the single-cell and/or densely array High Concentration Photovoltaic system (HCPV). In the current project, a new design of cooling mechanism is developed and designed based on an integrated heat pipes at the bottom surface of a Copper substrate behind the cell surface area. The proposed design, that had never been applied, will be numerically simulated and experimentally tested under indoor and outdoor conditions. The amount of heat that has been effectively extracted away from the solar cell domain will be used for driving a water desalination system based on clay membrane.

SDPI Scheduling:

Task	Duration (wks)	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14
1. SDP-I Documentation	8														
2. Literature review	4														
3. Design	4														
4. Simulation	7														
5. SDP-I drafting Report	2														
6. Presentation preparation	2														

Modular solar panel design and development

SDP code: ENRG-2002

Students: Hassan Abu Shoumi; Feras AlDuhaim; and Fahad Walid Aldossary

Advisor: Dr. Muhammad Saleem

ABSTRACT

The objective of the senior design project is to develop a modular solar panel design. The past SDP groups successfully developed the prototype. The objective of this group would be to do large scale testing and develop a cleaning mechanism along with studying the economic feasibility of the proposed modular design. The students will investigate the durability testing, thermal and environmental performance and the economic impact of reducing e-waste generated by the non-recycling of solar panels. Furthermore, students will also develop understanding of energy mix and policies needed for developing renewable growth.

Portable Autonomous Desalination Unit

SDP code: ENRG-2003

Students: Mohammed Hani Alwaheed; Faisal Ali Alzahrani; and Abdallah Omar Almalki

Advisor: Dr. Farooq Saeed

ABSTRACT

A portable autonomous desalination unit powered by a standard 240-Watt Photovoltaic panel is desired. The unit should be able to draw water from available source (sea water, brackish water, pond or lake or from a well), filter and process it for drinking purposes using a small-scale desalination unit powered by solar energy. The unit should be portable and use locally available off-the-shelf components such as water pump, plumbing, water filters, etc., for keeping the system price down. The design should be based on any applicable Engineering Standards. The usefulness of such a unit is in its portability to remote and coastal areas and localities or where access to clean water is limited as well as provide emergency water in famine or drought-stricken areas.

Design of fuzzy logic control-based MPPT charge controller for stand-alone PV system

SDP code: ENRG-2004

Students: Mohammed Al-Talib; Ali Jaffer AL Qatari; and Ali Al-Ghanim

Advisor: Dr. Nagmedeen Hassanian

ABSTRACT

Solar cells have the major drawbacks of low photo-conversion efficiency. The current-voltage characteristics of the solar cells depend on solar insolation level and temperature, which leads to the variation of the maximum power point (MPP). Stand-alone PV system usually consists of PV modules and batteries, which are connected through charge controllers. To improve PV system efficiency, and increase the lifetime of the battery, charge controller with maximum power point tracker (MPPT) will be designed for harvesting the maximum power available from the PV system under given insolation and temperature conditions. Fuzzy logic control is one of the MPPT techniques, which gives excellent results.

In this project, a maximum power point tracker will be designed using fuzzy logic as controller. The system consists of stand-alone photovoltaic solar module connected to a DC-DC converter and lead acid batter.

The mathematical model of the system with fuzzy logic control will be developed and modelled using Matlab/ Simulink software.

The system will be designed and implemented using Arduino uno.

Automation and performance evaluation of a split air conditioner via Android smart phone

SDP code: ENRG-2005

Students: Abdulilah Almahdi; Abdulmohsen Olaiwat; and Nasser Al-Ibrahim

Advisor: Dr. Amro Owes

ABSTRACT

Nowadays, the smart phone has a capability of communicating with most electronics equipment. Therefore, the main objective of this project is to control a split air conditioner and measuring its performance by using android application. The air conditioning unit is controlled based on Bluetooth input signal received from the android smartphone. The control system includes three main components: a Microcontroller, a Bluetooth module for signal transfer, and a Smartphone with the Android application to control the appliances. The main aspect of the control system is the sensory system that collects the different parameters which are used to evaluate the performance of the conditioner such as: temperature, humidity, pressure, energy consumption, % of CO2, air quality. The corresponding data from various sensors will be sent to the microcontroller. The construction of the prototype of this control model can be achieved as: select the components and software, design the electronic circuit, connect the sensors to the microcontroller board, program the microcontroller, program the mobile, integrating the Bluetooth module with the microcontroller, test and debug the application.

This kind of systems provides a comfortable and smart climate as well as more efficient power management.

Design a cogeneration system using High Concentration Photovoltaic (HCPV) for power generation and desalination

SDP code: ENRG-2006

Students: Ghaith Alfalah; Ali Al-Matar; and Abdulrahman

Advisor: Dr. Taher Maatallah

ABSTRACT

The cogenerated energy fluxes produced by a High Concentration Photovoltaic system (HCPV) cannot only promote for higher effective optical Concentration Ratios (CRs), but also, improve the exegetic efficiency of the HCPV. In the current work, a novel design of a cooling mechanism for a cogeneration HCPV system is developed. The cooling setup is based on an immersed heat pipes in a stagnant water embedded in a copper millimiter-scale heat sink behind a Multi-Junction Solar cell (MJSC) under High CRs

SDPI Scheduling:

Task	Duration (wks)	W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10	W 11	W 12	W 13	W 14
7. SDP-I Documentation	8														
8. Literature review	4														
9. Design	4														
10. Simulation	7														
11. SDP-I drafting Report	2														
12. Presentation preparation	2														

DESIGN AND IMPLEMENTATION OF A TUBULAR CLAY MEMBRANE FOR USE IN WATER DESALINATION SYSTEM

SDP code: ENRG-2007

Students: Hassan Al-Safwan; and Ihsan Al-Hamoud

Advisor: Dr. Sajid Ali Khan Zada

ABSTRACT

Ceramic membrane has the advantage of longer life and higher mechanical strength over the polymeric membrane. One of the limitations in utilizing the ceramic membrane in MD processes is the fact that they are hydrophilic in nature. In the current SDP, it has been proposed to design a tubular clay membrane for saline water desalination by imparting hydrophobicity through grafting of suitable polymer. Before imparting hydrophobicity, tubular membrane will be manufacture by either slip casting method or injection molding. The membrane will be applied in saline water desalination using airgap membrane distillation (AGMD) process. AGMD setup will be designed and established for this purpose.

Tasks:
Task 1: Literature Review (Membrane desalination techniques, Flat vs Tubular membrane, Tubular clay membrane manufacturing methods)
Task 2: Membrane Design (Optimum length, Diameter, Thickness)
Task 3: Membrane Manufacturing (Design & manufacturing of mold, Slip casting or injection molding)
Task 4: Designing & Establishing of AGMD Setup
Task 5: Experiments
Task 6: Numerical Simulations (If possible)
Task 7: Writeup

Experimental Investigation of Different Cleaning Methods for Dust Accumulation of PV Panel Using an Autonomous Robot

SDP code: ENRG-2008

Students: Abdulrahman Ashraf Ashour; Saleem Khalid AlAwad; and Ali Mohammed AlQarni

Advisor: Dr. Nasir Hariri

ABSTRACT

In recent days, using renewable energy has become very common in many countries, especially in Saudi Arabia. Using the PV panels in Saudi Arabia is the most renewable resource that it can depend on it. Although, due to the climate nature in the country, the PV panels can be less efficient due to the dust accumulation over time. Saudi Arabia has large deserts with a low rate of rainfall which means a high quantity of dust accumulation, and that leads to reduce the efficiency with the time is equal to 3%–40%. The experiment has been done under different situations starting from the cleaned PV, then adding dust by specific amounts (density). This proofs that the dust significantly affects the efficiency of the PV module. Hence, the main objective of the experiment is to develop an efficient, automated, and economic cleaning system in comparison with existed cleaning methods that are available in the market.

Smart Cooling Method of PV Module using Shape Memory Alloy

SDP code: ENRG-2009

Students: Zaid Al khateeb Ali; Nawaf Anwar; and Mohammad Ibrahim Alosayl

Advisor: Dr. Nasir Hariri

ABSTRACT

Over the past several years, using (PV) has been rapidly increased as a green energy source, because the PV system has great potential for producing electricity and saving money for the consumer. However, the main drawback of using such a system is low efficiency due to external factors such as cloudy weather, shading effect, and high temperature. This research project will explore the feasibility of implementing an innovative design for cooling of PV modules using Shape Memory Alloy material. The proposed system utilizes a hot-spot smart sensing technique of a PV system with the integration of a smart material for the actuation mechanism of the proposed cooling system. This study will focus on designing and experimentally fabricating the introduced actuation mechanism with different air-based and water-based cooling methods. In this project, a numerical solution for the proposed cooling PV system was designed and explored by using Solidworks and Ansys software to describe the temperature distribution with and without a proposed cooling system. Based on the numerical results presented in this project, the temperature of the PV was reduced by 40.3% by using a water flow rate and 600 W/m2. Also, an experience application has been done to study the shading effect circumstances as a function of temperature for PV cells. It was found that the shading effect leads to a hot spot to occur and make power dissipation.