**Design of Photo Voltaic System (EEE)**

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| **Course Learning Objectives** | <ul><li>Understand the details of solar photovoltaic systems.</li><li>Impart knowledge of necessary technology and components involved in the design and installation of solar photovoltaic systems.</li><li>Understand and predict PV module behavior under different physical and environmental parameters for a given location.</li><li>Analyze and evaluate the performance parameters involved in the PV system design such as solar irradiance, temperature, series, and shunt resistance.</li><li>Provide hands-on experience in the Design of Solar PV Systems using relevant Software.</li></ul> |
| **Course Outcomes** | <ul><li>Design and model the complete photovoltaic system for **off-grid and on-grid system** including the selection of PV panels, inverter sizing, and battery sizing for a **Solar PV System Project** by using the manual method as well as using software tool.</li></ul> |

**Course Duration:** 45 Hours

**Unit I-Introduction to Solar PV**

Solar Energy-PV Technology-PV Materials-PV Types-PV Module Rating- PV System-Components,

**Unit II-Design & Sizing of PV System**

Design & sizing principles- Sizing of Components- MPPT tracking system for PV array-assembly on layout- Solar panel orientation and tilt angle at various locations.

### Unit III-Simulation using MATLAB

Theory and Background – The Single Diode Model- Reading Datasheets- Building Solar Cell Model in MATLAB and Simulink- Studying the Effects of Irradiance, Temperature- Simulate the IV characteristic-5 exercise for the project

### Unit IV- Grid Connection of Solar

Smart grid components – Metering - On-Grid rooftop- Bi-directional meter-1-phase & 3-phase bi-directional meter- Inverter systems- String inverter- Micro inverter- Power optimizers- Converter systems- boost converter and buck converter-Analysis using MATLAB.

### Unit V-Hardware model of DC- DC Convertor- Solar Panel

Power Circuit- Opto coupler Circuit Operation-IC connections-MOSFET Circuit Operation-Snubber Design- Software circuit & output- Hardware circuit & output- Result Analysis. IOT based MPPT system design.

### Test Projects:

### Industry Used Cases:

### 1. Solar power for drip irrigation system

**Task 1:** Calculate the power requirement for drip irrigation system. The power calculation depends on the pump involved in the system.

**Task 2:** List down the components and materials required for building the drip irrigation system.

**Task 3:** Design the circuit that can generate the power that we calculated. And simulate the circuit in the MATLAB.

**Task 4:** Get the VI characteristics of the designed circuit and evaluate whether the designed circuit matches the power requirement.

## 2. Off Grid-based Solar System

**Task 1:** Do power estimation in home for household appliances.

**Task 2:** Determine the solar cell productivity for this application.

**Task 3:** calculate the excess power value and select the storage system. Building Solar Cell Model and backup system in MATLAB

**Task 4:** Simulate the IV/ PV characteristic for application and storage power and give the report based on load requirement.

**Task 5:** Design the circuit for using power and storing of power. Do the Connection with materials (For current we may use batteries)

## 3. Milk pasteurization using solar

**Task 1:** In an Aavin milk industry daily 1lakh liters of milk thermised between 57c to 68 c for 15 minutes. And also Pasteurization is done two methods. Find and submit a report.

**Task 2:** Replace with solar system. Find the required list of kits required.

**Task 3:** Do the simulation in MATLAB to check feasibility.

**Task 4:** Assemble the kit and do the working conditions(Scaling)

**Task 5:** Submit a comparison report if how much energy can be saved.

## 4. On Grid-based Solar System

**Task 1:** Do power estimation in home with equipment's .

**Task 2:** Make the hand-on layout and mathematical calculation for the requirement

**Task 3:** Building Solar Cell Model in MATLAB

**Task 4:** Simulate the IV/ PV characteristic and give the report based on load requirement.

**Task 5:** Do the Connection with materials other than PV panel.For current you can use battery resources.

## 5. Stereo Cooler Charged by Solar Task

**1:** Do power estimation in Stereo Cooler

**Task 2:** List down all the components required for building a stereo cooler

**Task 3:** Design an solar cell that provide power to make the stereo cooler work

**Task 4:** Build a stereo cooler of your preferred design and connect the components as per the circuit.

**Task 5:** Give input to the stereo unit and evaluate the working of stereo cooler. Also simulate the VI characteristics of the stereo cooler using MATLAB.

## 6. PV Tracker using Solar

**Task 1:** Do power generation estimation in Single PV at different time of a day

**Task 2:** Do research and find the relationship between time and productivity of the solar cell.

**Task 3:** Design a circuit for attaining maximum productivity from the solar cell.

**Task 4:** List down the components required and start building the circuit in real time.

**Task 5:** Place the solar tracker in an open space and evaluate whether the productivity is increased.For current you can use battery resources

## 7. Solar based desalination plant

**Task 1:** Develop the workflow of the desalination plant. And calculate the power required for desalination plant

**Task 2:** List down the components and materials required for building the system

**Task 3:** Design a circuit that can power up the desalination plant. And simulate the circuit in the MATLAB environment

**Task 4:** Start building the circuit with the mentioned components and get the VI characteristics of the system.

**Task 5:** Test the system by giving salt water as the input and evaluate the system by checking salt content in the desalinated water 100

## 8. Solar preheater for boilers

**Task 1:** Wood fired boilers are working under the efficiency of 27%. To increase they found preheating is not enough. So design a solar pv plant above the boiler area.

**Task 2:** Note down all the components required and design a circuit that can produce heat.

**Task 3:** Building Solar plant Model in MATLAB and simulate the VI characteristics

**Task 4:** With the results obtained, start building the solar plant using the required components

**Task 5:** Solar plant should generate 350c of water.

## 9. Army location detection using flexible solar panels

**Task 1:** List down material required

**Task 2:** Building Solar panel of six in a cloth Model with all materials required in MATLAB

**Task 3:** Simulate the IV/ PV characteristic and give the report.

**Task 4:** With the results select PV sizing get materials and do all connections

**Task 5:** Do the erection by stitching on the bag. Track the location using it

## 10. Battery Charger using Solar

**Task 1:** List down material required to do with 30 V battery.

**Task 2:** Building Solar plant Model with all materials required in MATLAB

**Task 3:** Simulate the IV/ PV characteristic and give the report.

**Task 4:** With the results select PV sizing get materials and do all connections

**Task 5:** Charge your emergency light with battery.

## 11. Moveable Solar Power Unit

**Task 1:** List down material required to do the project.

**Task 2:** Building Solar plant Model with all materials required in MATLAB

**Task 3:** Simulate the IV/ PV characteristic and give the report.

**Task 4:** With the results select PV sizing get materials and do all connections

**Task 5:** Check the movable solar PV position in different locations.

## 12. Shrub based on Solar

**Task 1:** List down material required to do the project.

**Task 2:** Building Solar plant Model with all materials required in MATLAB

**Task 3:** Simulate the IV/ PV characteristic and give the report.

**Task 4:** With the results select PV sizing get materials and do all connections

**Task 5:** Assemble all materials appropriately.

## 13. Solar Charging Station- On grid station

**Task 1:** Evaluate the required power to charge TATA nexon EV

**Task 2:** Building Solar plant Model with all materials required in MATLAB

**Task 3:** Simulate the IV/ PV characteristic and give the report.

**Task 4:** With the results select PV sizing and list the materials.

**Task 5:** Submit the report along with cost estimation

### 14. Solar Charging Station- Off grid station

**Task 1:** Evaluate the required power to charge TATA nexon EV

**Task 2:** Building Solar plant Model with all materials required in MATLAB

**Task 3:** Simulate the IV/ PV characteristic and give the report.

**Task 4:** With the results select PV sizing and list the materials.

**Task 5:** Submit the report along with cost estimation

### 15. Automatic Solar system for all seasons.

**Task 1:** Consider two seasons: summer and winter. Both seasons angle may differ. So find data for the last 10 years and average it.

**Task 2:** Depending on the requirement list down material required and program required.

**Task 3:** Building Solar Plant Model with all materials required in MATLAB

**Task 4:** Simulate the IV/ PV characteristic and give the report.

**Task 5:** Erect the system in the college and submit a report on how it works.

### 16. Power Supply based on Solar Energy for green house

**Task 1:** Evaluate the required power consumption of 4 pumps, 5 air blower, 30 LED lights

**Task 2:** Building Solar plant Model with all materials required in MATLAB

**Task 3:** Simulate the IV/ PV characteristic and give the report.

**Task 4:** With the results select PV sizing and list the materials.

**Task 5:** Submit the report along with cost estimation

### 17. Solar Panel for Light Tracking & Servo Controlling

**Task 1:** List down material required to do the project using LDR & servo motor of following spec

- · Operating Voltage is +5V typically.

- · Torque: 1.8 kg-cm (4.8v)

- · Speed: 0.10 sec/60.

- · Gear Type: Plastic.

- · Rotation : 0°-180

**Task 2:** Do research and find the relationship between time and productivity of the solar cell.

**Task 3:** Design a circuit for attaining maximum productivity from the solar cell.

**Task 4:** Start building the circuit in real time and also simulate the VI characteristics for both solar panel with and without light tracking.

**Task 5:** Place the solar tracker in an open space and evaluate whether the productivity is increased.

### 18. Solar Switch for Water Heater

**Task 1:** List down material required to do the project

**Task 2:** Building Solar plant Model with all materials required in MATLAB

**Task 3:** Simulate the IV/ PV characteristic and give the report.

**Task 4:** With the results select PV sizing get materials and do all connections

**Task 5:** Assemble all materials appropriately.

### 19. Solar Inverter Project using SG3525

**Task 1:** Develop the workflow of the solar inverter. And calculate the power required to charge the battery for the inverter.

**Task 2:** List down the components required for building the Solar Inverter using SG3525

**Task 3:** Design a solar cell circuit to charge the battery. Also design a DC to AC converter circuit.

**Task 4:** Build the solar inverter by combining the circuits using the required components

**Task 5:** Pair the inverter with any home appliance and use it.


### 20. Revolving Solar Inverter with Microcontroller

**Task 1:** List down material required to do the project for 50 W.

**Task 2:** Building Solar plant Model with all materials required in MATLAB

**Task 3:** Simulate the IV/ PV characteristic and give the report.

**Task 4:** With the results select PV sizing get materials and do all connections

**Task 5:** Assemble all materials appropriately

### 21. Solar powered medical device sterilizing unit

**Task 1:** Calculate the power required for the sterilizing unit.

**Task 2:** List down the components required for supplying the power for sterilizing unit.

**Task 3:** Design the circuit that is capable of generating power for sterilizer and simulate it in the MATLAB **Task 4:** Get the VI characteristics of the developed system. And evaluate that it matches with required VI characteristics

**Task 5:** Assemble all materials appropriately as per the circuit connection and sterilize the medical devices

## 22. Algae Prevention system with solar energy

**Task 1:** Do research about algae prevention.

**Task 2:** Calculate the power required for the algae prevention system. List down the materials required to do the project

**Task 3:** Design an electronic circuit that is capable of running in a water medium. Also design a solar cell circuit that provides supply to the electronic circuit.

**Task 4:** Combine both the circuits and build the algae prevention set up with the required components

**Task 5:** After completing the connections leave it on a water storage unit or water reservoir

**Student Assessment Plan:**

Each of the above-mentioned test projects will be divided into tasks by the training partner for each specific institution. Such tasks will be jointly evaluated by the faculty and the training partner and the following weightage is to be followed.

- 70% weightage to the external practical assessment.
- 30% weightage to the internal assessment.

**Final Test Project/External Assessment Plan:**

The Final Test Project will be chosen from the list given above, jointly by the college faculty and the Training Partner. The Final Test Project will be assessed on the following tasks, for 70%.

| Details | Marks |
|---------|-------|
| Task: 1 | 20 |
| Task: 2 | 20 |
| Task: 3 | 20 |
| Task: 4 | 20 |
| Task: 5 | 20 |

**Employment Potential:**

This course shall enable mechanical, Electrical and allied domain Engineers to get employment in sectors like Manufacturing, Assembly, Maintenance and Warehousing.