

# wind and solar energy course

**Pre-request:** General Knowledge about electrical engineering

**Course duration:** 24 Hours

**On completing this course you will be able to:**

- **Understand** the difference between different types of electrical power plants
- **Understand** the operation of wind Turbine Design and types
- **Understand** the types of generators And speed control of wind turbines
- **Understand** the Solar Thermal Heating and Solar Thermal Power plant
- **Understand** the Effect of Temperature and radiation on PV cell
- **Understand** the Maximum Power Point Tracking techniques
- **Able to** calculation of Thermal Heating and Solar Thermal Power plant
- **Able to** calculation of Pv array and solar batteries and Charge controller And solar inverter
- **Able to** design for Stand-alone and grid connected PV systems
- **Able to** simulation of wind Turbines and PV systems

## Course Content:

### Lecture 1( Electrical power plants )

#### Part 1 Types of electrical power plants

##### Frist type Nonrenewable energy

- Steam-turbine plants
- Gas-turbine plants
- Combined cycle steam-gas power plants
- Diesel power plants
- Nuclear Power Station

## **Second type Renewable energy**

- Hydraulic Power Stations
- Tidal Power Stations
- Wave Energy
- Geothermal Energy
- Biomass Energy
- Fuel cell
- Wind Power Station
- solar cell power plants

## **Part 2 Energy conversion**

## **Part 3 problems of energy**

## **Part 4 statistics of energy**

## **Lecture 2 ( Wind Energy part 1 )**

- Part 1 Overview of renewable energy systems
- Part 2 Why renewable energy
- Part 3 Status of WECS Worldwide
- Part 4 Wind Turbine Development
- Part 5 Types of Wind
- Part 6 Characteristics of Wind Speed
- Part 7 Wind Turbine Design

## **Lecture 3 ( Wind Energy part 2 )**

### **Part 1 Power in the wind**

- Average speed and power in wind
- Efficiency of wind turbine
- Wind turbine power curve

### **Part 2 Power regulation of wind turbines**

- Pitch and Passive and Active speed control

### **Part 3 Wind turbines generators**

- synchronous generator
- induction generator
- Permanent Magnet Alternators

### **Part 4 Speed control of wind turbines**

- Fixed-speed wind turbines
- Limited variable speed wind turbines
- Variable speed wind turbines using partial scale converter
- Variable speed wind turbines using full scale converter

### **Part 5 Simulation of wind Turbines**

### **Lecture 4 ( Solar Thermal plants )**

- Part 1 History of solar energy
- Part 2 Fundamental of Solar light
- Part 3 Solar radiation
- Part 4 Pv Vs thermal
- Part 5 Solar Thermal Energy Basic Principles
- **Part 6 Solar Thermal Heating**

**types of solar water heating ( Direct- indirect - passive - active )**

- **Part 7 Solar Thermal Power plant**
- Parabolic trough designs
- Power tower designs
- Dish designs
- Fresnel technologies
- Micro CSP
- Enclosed parabolic trough
- **Part 8 Thermal Energy Storage**

## Lecture 5 ( PV cells )

- Part 1 Silicon ( Band gap Energy - charge carrier .... )
- Part 2 Photovoltaic materials
- Part 3 Manufacturing and design rules of Crystalline Silicon
- Part 4 The Most Important Solar Statistics
- Part 5 Equivalent circuit of solar cell
- Part 6 PV equivalent circuit with Series and shunt resistance

## Lecture 6 ( PV Systems )

- Part 1 From solar cell to solar modules
- Part 2 Effect of Temperature and radiation on PV cell performance
- Part 3 Output Power and Conversion Efficiency of a PV Cell
- Part 4 Solar tracking system
- Part 5 MPPT Maximum Power Point Tracking Techniques  
**Indirect and Direct MPP Tracking Techniques**
- Part 6 Types of Pv systems( Stand-alone Grid connected and Hybrid )
- Part 7 Elements of PV Systems

## Lecture 7 ( Design of Pv systems part 1 )

### **Part 1 Solar batteries**

- Elements of battery
- Types of Primary and secondary cells ( lead acid -gelled- *Nickel Cadmium* )
- calculation of solar batteries (C-rate – efficiency of storage - lifetime )
- Basic Charging Methods
- Protections of Battery

### **Part 2 Charge controller and Types of Chargers**

### **part 3 Inverters in PV Systems (DC-AC converters)**

#### **Types of solar inverter**

- Current source inverters (CSI)
- Voltage source inverters (VSI)

- central inverters
- module inverters or micro inverters
- string inverters
- multi string inverters

### **Characteristics of a solar inverter**

## **Lecture 8 ( Design of Pv systems part 2 )**

### **Part 1 Stand-alone Pv systems design**

#### **Calculations of Stand-alone Pv system**

- Load demand and Accounting losses
- Equivalent sun hours
- Pv array and Battery design
- Charge controller and Inverter design

### **Part 2 Grid connected Pv systems design**

#### **Calculations of Stand-alone Pv system**

- Load demand and Accounting losses
- Equivalent sun hours
- Pv array and Inverter design

### **Part 3 Connection of Pv system on grid**

### **Part 4 Simulation of Pv systems**