



# **CCEK – NSQF ALIGNED PROGRAM**

## **COURSE SYLLABUS**

### **FOR**

### **Renewable Energy**

## CCEK - NATIONAL SKILL DEVELOPMENT TRAINING PROGRAM

### Renewable Energy

CCEK – NSDC course package covers the following Qualification Packs and leads to the following NSDC certifications. The students who successfully completed the course programs are entitled to get NSDC certification after undergoing the assessment process of NSDC as per the rules and regulations stipulated by NSDC from time to time.

SL. NO.	QUALIFICATIONS PACK	QUALIFICATIONS PACK CODE	NSQF LEVEL
1	<p><b><u>Renewable Energy</u></b></p> <p><b>Brief Job Description:</b></p> <p>This unit is about contributing to the design of software products and applications where both the business impact and technical complexity are low.</p>	<b>SGJ/Q4008</b>	<b>4.5</b>

**COURSE DETAILS****Renewable Energy****EXAMINATION DETAILS**

COURSE NAME		COURSE CODE	ELIGIBILITY	DURATION	
Renewable Energy		G47	Completed 1st year of 3-year/ 4-years UG,12th,10th	310	
SL. NO.	EXAM	EXAM CODE	MAXIMUM MARK	INTERNAL	TOTAL MARK
<b>THEORY PAPERS</b>					
1	Renewable Energy Resources	T001	100	50	150
<b>PRACTICAL PAPERS</b>					
1	Wind Resource Assessment Lab	L001	100	50	150
<b>TOTAL MARKS</b>					
1	Total Examination Marks (Theory Online + Practical Examination)				200
2	Total Internal Marks				100
3	<b>Total Marks (Total Internal Marks + Total Examination Marks )</b>				<b>300</b>

**Renewable Energy**

**INTERNAL MARK CRITERIA FOR EACH**

SL NO.	MODULE	MODULE CODE	MAXIMUM MARK	INTERNAL MARK	TOTAL MARK
1	Renewable Energy Resources	T001	100	50	150
2	Wind Resource Assessment Lab	L001	100	50	150
	TOTAL		200	100	300

ATTENDANCE	GENERAL PERFORMANCE	INTERNAL EXAMINATIONS/ PROJECTS/ ASSIGNMENTS	TOTAL MARKS
5	5	40	50

# **COURSE SYLLABUS**

**FOR**

**Renewable Energy**

<b>COURSE</b>	Renewable Energy	
<b>TOTAL MARKS</b>	Mark: 450	Internal Mark: 150
<b>TOTAL HOURS</b>	310 Hrs	

**DEFENITION OF CREDIT**

1 Credit	15Hrs Theory/ 30Hrs Practical
Skill Components	60 – 70 % of Total Credit

**MODULES INCLUDED IN THIS SUBJECT**

<b>SL NO</b>	<b>MODULE NAME</b>	<b>CREDIT BREAKUP</b>
1	Module 1: Basics of Solar Photovoltaic Plant	<b>1</b>
2	Module 2: Basics of Wind Power Plant	<b>1</b>
3	Module 3: Identification of Tools and equipment	<b>1</b>
4	Module 4: Solar Photovoltaic Plant Installation Testing and Commissioning	<b>1</b>
5	Module 5: Wind Turbine Installation Testing and Commissioning	<b>1</b>
6	Module 6: Planning and Designing of Wind and Solar	<b>2</b>
7	Module 7: Operation and Maintenance of Wind and Solar	<b>2</b>
8	Module 8: Health and Safety Practices	<b>1</b>
	Total	<b>10</b>

## **Training Outcomes**

- Adequate knowledge of solar and wind energy.
- Installation on grid, off-grid, and hybrid plants
- Designing of Solar plant.
- Installation of wind turbine.
- Knowledge of software like AutoCAD, PV Syst, Windpro.
- Operation and maintenance of Solar and Wind plant.
- Best industry practices and standards.

## MODULES

### **Module 1: Basics of Solar Photovoltaic Plant**

#### THEORY

- Explain the Terms and Definition of Solar.
- Explain the Sun Path Diagram and Solar Radiation
- Discuss Components of a Solar PV System.
- Explain the types of Solar Photovoltaic Systems
- Discuss Technical Parameters and Performance of Solar PV Panel
- Understand Ohm's Law
- Understand the basics of electricity and electrical concepts;
- Perform simple calculations to derive power and energy
- Explain and understand DNI, GHI, and Diffused Irradiance and irradiation.
- Understand the movement of the sun and its effect on the performance of the plant;
- Understand Terminology used in the Solar Industry.
- Identify the different components of a Solar PV system and explain its basic operation.
- Explain the working of different types of Solar PV systems.
- Describe the different types, sizes, and specifications of modules, inverters, charge controllers, cables, conduits, junction boxes, solar batteries, and allied accessories.
- Explain the manufacturing data specification sheets of different types of solar PV components.
- Read and interpret various certification requirements for solar PV system components

#### PRACTICAL

- Identify the Components used in Solar Photovoltaic plants.
- Demonstrate how to interpret signs, notices, and/or cautions at the project site.
- Perform simple calculations to illustrate the fundamental concepts of power and energy.
- Demonstrate how the movement of the sun affects the performance of the solar power plant
- Show pictures and videos of solar plants.
- Analyze the different types, sizes, and specifications of solar modules, inverters, charge controllers, cables, conduits, junction boxes, solar batteries, and allied accessories.
- Analyze the manufacturing data specification sheets of different types of solar PV components.
- Demonstrate how to acquire know-how of different types, sizes, and specifications of foundations/ footings
- Demonstrate to selection of the right footing/foundation as per site location including suitability of roof condition or suitability of soil
- Demonstrate to selection of the right footing/foundation as per site location including suitability of roof condition or suitability of soil

## Module 2: Basics of Wind Power Plant

### THEORY

- Identify different types of Wind technology and overview of the Wind energy sector in India
- Understand key insights in the sector through various market research reports and magazines.
- Identify different types of wind power plants, their components, and working principles.
- Explain the benefits of wind energy over conventional sources of energy.
- Describe the typical specifications, functioning, operating principle, warranties, and safe operating & handling procedures of different Wind power plant components like Blades, towers, motors, monitoring systems, and other components.
- Identify various ways to optimize material, energy/electricity consumption across processes and follow specified processes for waste disposal.
- Explain how to analyze project site conditions.
- Explain how to collect data on local weather conditions such as temperature range, flooding (in case of onshore), wind speed, humidity, wind direction, pressure, and rainfall and assess its impact on wind energy generation.
- Discuss and analyze the wind data collected from the met mast for estimating wind potential.

### PRACTICAL

- Identify the Components used in Wind plants.
- Show pictures or videos of the working of the Wind Power plant.
- Analyse detailed site information.
- Demonstrate how to analyze the daily, monthly, and annual wind resource data of the project site to evaluate the potential for wind energy generation.
- Analyze the pre-site selection baseline data for project execution suitability.
- Demonstrate how to verify the wind potential with other resources such as NREL/ATLAS.
- Demonstrate how to prepare a contour map of the proposed wind plant site.
- Demonstrate how to carry out route surveys.
- Demonstrate how to prepare detailed site survey reports using GPS/DGPS and wind data analysis software.

## Module 3: Identification of Tools and equipment

### THEORY

- Discuss the electrical tools used in Solar plants for installation, operation, and maintenance.
- Discuss the mechanical tools used in Solar plants for installation.
- Discuss the electrical tools used in Wind for installation, operation, and maintenance.
- Discuss the mechanical tools used in Wind for installation.
- Discuss checking and detection of Damaged tools.

- Discuss Basic Hand Tools used in Solar Photovoltaic power plants.
- Discuss the Measuring and Testing Instruments used in Solar and Wind plants.
- Discuss the Cordless drill used for different purposes.
- Discuss about Anemometer used in Wind plants.

### **PRACTICAL**

- Identify the tools used in Solar Photovoltaic plants.
- Demonstrate how to use tools.
- Illustrate how to Select the right tools at the right place
- Show how to Identify all the tools & equipment needed for the erection of wind power plant components.
- Prepare a toolkit list for installation, testing and commissioning, Operation and Maintenance.
- Demonstrate how to use Spirit Level and where to use
- Demonstrate the use of Tri square
- Illustrate how to use Tripod Laser Beam for marking to get accuracy.
- Demonstrate how to use Water Level Pipe.
- Show how to use Socket Wrench.
- Show the use of anemometer in Wind and Solar plant

## **Module 4: Solar Photovoltaic Plant Installation Testing and Commissioning**

### **THEORY**

- Process of installing the solar panel
- Discuss the best Installation Methods
- Overview of grid-tied PV systems and their benefits
- Understanding off-grid and hybrid PV systems
- Read and Interpret the Single Line Diagrams, Layouts, and drawings
- Understand the DO's and Don'ts of material handling
- Read and interpret the Bill of Material to verify the delivery of components on-site and understand performing quality checks of material
- Understand and acquire know-how in installing electrical components including inverters, batteries, junction boxes, energy meters, and other electrical components along with performing pre-installation checks
- Identify and acquire know-how of installation of cables and conduits.
- Understand the dos and Don'ts of DC wiring;
- Identify and understand the use of tools & tackles used for cable and conduit installation.
- Understand Different types of Earthing and its installation.
- Understand and identify the significance and types of earth faults as per standards.
- Explain about the test related with string such as voltage, short circuit current test, continuity, Polarity & Cable Insulation, AC voltage (L-N, L-E, N-E)
- Explain all the test related with MMS.
- Explain all the test related with Inverter.
- Explain how to do commissioning of Inverter.
- Explain all the test related with earth resistance and continuity test.

## PRACTICAL

- Demonstrate how to assess the site conditions for the safe installation of a Solar system.
- Demonstrate how to assess the load to be connected to the Solar PV system and how to prepare the load profile.
- Show anti-islanding protection of the inverter.
- Install on-grid Solar Photovoltaic System.
- Install Solar panels on the slanted roof.
- Install off-grid Solar Photovoltaic Systems.
- Install other Balance of System (BOS) such as ACDB, DCDB, inverter and install on a wooden plyboard maintaining proper distance.
- Show how to use the End Clamp and Mid Clamp.
- Installation of the module mounting structure in the proper orientation.
- Demonstrate how to do the Alignment of the module.
- Measure the orientation of the roof as well as the structure.
- Measure the tilt angle of the Module Mounting Structure as well as the deviation from the actual.
- Show how to measure the distance between the Inverter, ACDB, and DCDB.
- Show how to install the Module Mounting Structure according to the AutoCAD drawing.
- Show how to strip the wire
- Show how to crimp the lugs
- Show how to properly connect the MC4 connector with the cable.
- Demonstrate all the test related with string and module mounting structure.
- Demonstrate all the test related with inverter.
- Show how to commission the inverter.
- Demonstrate earth resistance and continuity test.
- Perform commissioning of solar plant.

## **Module 5: Wind Turbine Installation Testing and Commissioning**

### THEORY

- Discuss best Installation Methods.
- Explain to identify the relevant technical and schematic drawings.
- Explain how to carry out the alignment of the turbine hub gearbox assembly with the turbine generator gearbox assembly
- Explain how to ensure the readiness of plant and equipment for erection.
- Identify the relevant technical drawings and schematic drawings.
- Explain how to prepare the site for the erection of mechanical components.
- Explain how to conduct a route survey for each WTG base point.
- Discuss how to carry out the erection of the tower shells as per standard operating procedures.
- Explain to perform torquing of the joints to ensure optimum tightness.
- Discuss to carry out the correct placement of the nacelle assembly at the top of the tower shell.

## **PRACTICAL**

- Installation of Wind Turbine
- Show to identify relevant technical and schematic drawings.
- Demonstrate to identify and mark the area where the tower is to be installed
- Demonstrate how to select the appropriate PPE (Personal Protective Equipment) to carry out the specific activity.
- Show how to arrange all tools, tackles, equipment, and associated components
- Perform to carry out routine cleaning of tools, machines, and equipment.
- Show to install anemometer as per schematic drawing.
- Demonstrate to identify ways to optimize the usage of material including water in various tasks/activities/processes.
- Analyze the single-line diagram, technical drawings/wiring/circuit diagrams, and schematic diagrams.
- Analyze the related manuals, blueprints, and schematic diagrams to determine the tasks, tools, equipment, and parts needed.
- Demonstrate to arrangement of all the tools, tackles, and associated components needed
- Show how to perform the route survey for laying of O/H line or U/G cables.
- Demonstrate to identify ways to optimize the usage of material including water in various tasks/activities/processes
- Show to carry out routine cleaning of tools, machines, and equipment
- Show how to do Testing of Wind Turbine.
- Show how to detect faults in the wind turbine system.
- Show how to perform commissioning of Wind turbine system.
- Show how to detect faults using drone.

## **Module 6: Planning and Designing of Wind and Solar**

### **THEORY**

- Explain the parameter to be kept in mind before designing an ON grid Solar Photovoltaic Plant.
- Explain how to design the solar plant using an Excel sheet and perform all the calculations.
- Explain how to do Site feasibility using Google Earth Pro for a given Site Location.
- Explain the designing of off-grid and hybrid solar plants.
- Discuss how to do plant design using PV Syst software.
- Discuss the financial analysis and payback period calculation of the Solar Plant.
- Explain how to design a solar plant using helioscope software.
- Discuss the difference between helioscope and PV Syst Software.
- Explain how to draw an Electrical Single Line diagram using AutoCAD.
- Discuss how to draw plant layouts using AutoCAD.
- Discuss how to use Wind Pro software used for wind farm designing.
- Discuss about Mean Power density curve from Wind Atlas.
- Explain about Wind Rose diagram.
- Discuss about the Mean wind speed.

## PRACTICAL

- Demonstrate how to draw the layout of the plant for a given site location using Google Earth Pro and select the best area for Solar plant installation.
- Calculate shadow free area available and download the kmz file.
- Show how to read electricity bills.
- Design a Solar Photovoltaic plant for a given site location and also define the maximum capacity of the plant on an Excel sheet.
- Design a Solar plant using PV Syst and perform shadow analysis.
- Calculate the performance ratio and Capacity Utilization Factor.
- Draw a Single line diagram of a plant.
- Show how to do a load assessment of a building.
- Illustrate how to read a single-line diagram.
- Design a wind plant using Wind Atlas.
- Show how to download and read the Wind rose diagram and download the wind frequency, wind speed, and wind power diagram.
- Show to download and read mean wind speed at different heights.
- Show how to view and download the Energy Yield calculation using Wind Atlas.

## **Module 7: Operation and Maintenance of Wind and Solar**

### THEORY

- Explain how to do Visual Inspection using drone technology.
- Explain Thermography analysis
- Discuss how to forecast the generation.
- Discuss types of maintenance and its importance.
- Discuss physical cleaning of components.
- Discuss electrical cleaning of contacts.
- Different faults in Solar Power plant.
- Identify required approvals and permit to work (PTW) from the concerned authority
- Discuss to ensure that the system is shut down before carrying out work
- Explain how to carry out maintenance activities for mechanical components of WTG as per standard operating procedures
- Explain how to carry out testing of WTG and associated components on a universal testing machine (UTM), and compression testing machine (CTM).
- Arrange for tools and replacement equipment from the supervisor if required
- Explain the importance of performing repair or replacement of faulty mechanical components of wind power plants as per standard operating procedures
- Explain how to conduct readiness tests on post-replacement equipment

## **PRACTICAL**

- Inspect Solar and Wind power plants using drones and also do visual inspection.
- Demonstrate IV curve tracing over on the PV panel with SEAWARD PV 220/200.
- Demonstrate thermography analysis on solar panels.
- Carry out testing of Strings, module mounting structure and Inverter.
- Perform troubleshooting and rectify the faults in the plant.
- Show to do the cleaning of the inverter fan and other components.
- Show how to identify faults in the inverter.
- Carry out operation of mechanical components of wind power plant
- Carry out maintenance of mechanical components of wind power plant
- Demonstrate to select the appropriate PPE (Personal Protective Equipment) to carry out the specific activity
- Demonstrate perform visual inspection of the mechanical components of a wind power plant and record any defects
- Demonstrate to measure and record parameters post-maintenance activities.
- Demonstrate how to report to the supervisor in case of any deviations from standard values.
- Demonstrate how to carry out repair or replacement of faulty mechanical components of a wind power plant as per standard operating procedures.

## **Module 8 : Health and Safety Practices**

### **THEORY**

- Explain to identify the requirements for a safe work area.
- Identify a contact person for reporting the violation of safety policies at the workplace and provide information about the incident/violation.
- Explain purpose,uses, care, maintainance and storage of all the tools and equipment together with their safety implications.
- Explain the importance of administering first aid.
- Identify the personal protective equipment used for the specific purpose.
- Identify the hazards associated with photovoltaic installations including electric shock and required mitigating measures;
- Identify work safety procedures and instructions for working at height and handling heavy material.
- Explain the importance of occupational health and safety standards and regulations for installation of Solar PV systems.
- Incorporate good housekeeping practices and infection control guidelines.
- safe operating & handling procedures of different Wind power plants.
- Discuss how to use the personal protective equipment required at the workplace.
- Explain how to ensure personal hygiene at the workplace.
- Discuss how to identify the location of first-aid materials and how to administer first-aid
- Explain how to report immediately to concerned authorities regarding signs and symptoms of illness □

- Explain the safety operating procedures for the collection, segregation, and transportation of recyclable waste
- Explain the processes specified for the disposal of hazardous waste from the project site as per organizational norms

### **PRACTICAL**

- Demonstrate to identify the requirements for a safe work area.
- Demonstrate how to administer first aid.
- Demonstrate the usage of personal protective equipment for ensuring safety during installation and O&M work.
- Show work safety procedures and instructions for working at height and handling heavy material
- Demonstrate good housekeeping and infection control & prevention practices.
- Demonstrate how to use appropriate Personal Protective Equipment (PPE) while performing work.
- Demonstrate how to ensure personal hygiene at the workplace.
- Demonstrate how to identify the location of first-aid materials and how to administer first-aid.
- Demonstrate how to participate in emergency and evacuation drills to be able to take necessary action in case of accidents, fires, and natural calamities
- Perform the steps to clean and disinfect material, tools, equipment, and other supplies before starting work and after completing the job.
- Show how to report immediately to concerned authorities regarding signs and symptoms of illness at the project site.
- Show the safety operating procedures for the collection, segregation, and transportation of recyclable waste
- Show the processes specified for the disposal of hazardous waste from the project site.