GOVERNMENT OF INDIA
MINISTRY OF POWER

सत्यमेव जयते

एन पी टी आई
NPTI
प्रावीण्यं परोपवृत्तिश्च

NATIONAL POWER TRAINING INSTITUTE

Ministry of Power, Government of India

NPTI Corporate Office, NPTI Complex, Sector-33, Faridabad – 121 003, Haryana, India

100% Placement record of previous batches of various PGDC Courses

Loan Facility available from reputed Nationalised Bank

POST GRADUATE DIPLOMA IN RENEWABLE ENERGY & GRID INTERFACE TECHNOLOGIES

01 YEAR (52 WEEKS)

BROCHURE

April, 2024

FOREWORD

DR. TRIPTA THAKUR

Director General, National Power Training Institute
Ministry of Power, Government of India

It gives me a great pleasure to welcome you to the National Power Training Institute (NPTI) under the Ministry of Power, Government of India, which is the National Apex body for training and human resource development in the power sector. For more than five decades, NPTI has worked to enhance human resources in the power sector.

Adequate scientific and technical manpower is required at all levels to provide quality and reliable power to everyone. In order to meet this demand, NPTI successfully conducts job-oriented and technologically advanced Post Graduate Diploma Courses. In today's ever-evolving energy landscape, the imperative to harness renewable sources such as solar, wind, and biomass power, while seamlessly integrating them into existing grids, cannot be overstated.

NPTI is working hard to ensure that our trainees and faculty have access to critical learning, online tools, field visits, and operating resources. Deep learning shaped by the ideals of excellence, hard effort, integrity, and humility inspires trainees to embark on this exciting adventure and make important contributions to the power sector. Our PGDC Programs have an emphasis on learning and education delivery that is not only focused on knowledge growth but also on achieving specific qualities, attributes, and attitudes. Our programs have created significant value in the Power Sector. NPTI continues to provide human resources who are tactical, diligent, and eager to develop organizations functioning in the power sector.

NPTI also covers a wide range of training programs for utility professionals of the Power Sector in the areas of Generation, Transmission, Distribution, Power Management, Renewable Energy, Regulatory aspects, Cyber Security etc.

The students who are going to take admission in PGDC Renewable Energy & Grid Interface Technologies will be exposed to a program that combines technical and managerial thinking with practical exposure in Renewable Energy and Grid Interface Technologies. I sincerely hope that your learning experiences at NPTI will be successful and pleasurable in every way, and that the memories you make here will last throughout your professional careers. Wish you a very enjoyable and rigorous learning experience.

Dr. Tripta Thakur
Director General, NPTI

FIRST SEMESTER SYLLABUS

(Paper Code: PGDC-RE & GIT 101)

1. Evolution of Indian Power Sector, Legislative & Regulatory Framework (04 Weeks)

- Evolution of Indian Power Sector, World Power Scenario.
- Electricity Act 2003.
- Indian Electricity Grid Code 2010.
- Electricity Amendment Bill National Electricity Policies.
- National tariff policy and amendments, Electricity supply codes.
- Availability based tariff & Deviation settlement mechanism.
- Regulatory process impact on Distribution Utilities, Operations, Distribution Franchise.
- Open Access and Inter State Regulations.
- Concept of ARR & Tariff Determination, Multi Year Tariff.
- CEA, Standards/Regulations.
- CERC Regulations governing the Indian power sector.
- Electricity (Amendment) Bill, 2022 (RS).

(Paper Code: PGDC-RE & GIT 102)

2. Power Plant Introduction & Industrial Safety (01 Week)

- Overview of Power Sector: Growth of power Industry after Independence.
- Overview of Generation, Transmission & Distribution.
- Coal to Electricity (Coal /Air / Flue/ Gas/ Water/Steam Path, Brief description of main equipment involved in a Thermal Power plant Station)
- General layout of a Thermal Power Station (Block Diagram of main equipment, Generator and their Auxiliaries)
- Site Selection (Site availability, Raw material, Fuel, load evacuation, Water, Transport, Pit Head Station, Air Pollution, Topography, Skilled manpower).
- Accidents (Causes & Factors, Cost of Accidents , Accidents Prevention, Investigation of Accidents, Reporting and Recording Systems of Accidents)
- First Aid (Basics of First Aid, How injuries are caused in lifting, falls etc.)
- Fire fighting (Fundamentals of Fire, Fire Fighting Equipment and systems, Fire Extinguishing Methods, Demonstration of various fire.)
- Industrial Safety & hazards(Industrial Hazards, Protective Clothing and Equipment, Safe work practices in power Plants, permit to work system, safety in moving and storage of materials, Housekeeping Safety rules)

(Paper Code: PGDC-RE & GIT 103)

3. Power Plant Familiarization and Plant Briefing & Design
(03 Weeks)

- **Steam Cycle Theory** (Carnot cycle, Rankine cycle, with reference to a specific unit 500/210 MW, steam properties)
- **Coal** (Types of coal and their characteristics, Their suitability for different kinds of Boiler, Alterations in firing methods due to change of coal composition)
- **Coal Handling system** (Location and layout, Main Equipment and their functions, Coal transportation, preparation, storage and reclamation, MGR system, safety aspects , Fire prevention and fire fighting in coal handing plant)
- **Combustion Theory** (Definition, Combustion requirements, factor influencing combustion, combustion of fuels, gross and net calorific value)
- **Fuel Oil Systems** (Location and site selection, Type of fuel used, Main equipment and their functions Transportation, handling, storage Fuel oil preparation before firing)
- **Fuel Oil Systems** (Location and site selection, Type of fuel used, Main equipment and their functions Transportation, handling, storage Fuel oil preparation before firing)
- **Boiler Circulation Theory** (water walls boiling phenomena, Nucleate / Film boiling, Natural / Controlled / Forced circulation)
- **Constructional detail** of Super heaters, Re heaters, Economizers, De super heaters.
- **Steam Separation theory** (Boiler Drum & its internals).
- **Draught system** (Theory of natural, induces, balance and forced draught, Drought loss stack effect).
- **Various Fans and their salient features** (Construction detail / lubricating oil system for PA fan, FD, ID fan)
- **Air Pre heaters** (Types And Functions Constructional Details, SCAPH. Soot Blowers.)
- **Ventilation and Air conditioning.**
- **Pulverizes and Feeders** (Classification Of Mills, Constructional features of Bowl mill Pulverization of Coal, factors affecting Milling Plant Performance, Coal feeders and its type)
- **Fuel Firing Arrangements and Burners** (corner front and rear wall firing, Direct and indirect, Details of coal and oil burners Burners tilting Mechanism, Atomization of fuel oil burners and igniters).
- **Electrostatic Precipitator (ESP)** (Need of fly ash separation, working principle, corona effect, constructional details, Rapping mechanism).
- **Ash Handling System** (Fly ash handling system, Bottom ash disposal system, Ash handling plant operation, Ash handling pump, Disposal of ash slurry, utilization of ash).

- **Water Supply System** (soft water, clarified water, cooling water, D. M. water)

Steam Turbines (Classification of Turbines Metallurgical considerations, Working Principles

Description of main components i.e. Turbine casing, rotor steam admission valves, couplings , bearings etc.

- Turbine lubrication Oil System Construction and working Principles of main Oil pumps, Oil coolers).
- Steam condensation and Condensers(film wise/drop wise condensation, Direct/ indirect condensation and vacuum creation)
- **Power Station Pumps** (Classification of pumps, Centrifugal pumps, positive displacement pumps)
- **Boiler Feed Pump** (Function of BFP Constructional details)
- **Circulating Water System** (Open/ Closed system, CW Pumps, Cooling Towers, CT Pumps, CT Fans).
- **Regenerative Feed Heating System** (Working Principle and constructional details of L.P. Heaters, Deaerators, H.P. Heaters GSC, Ejector)

Turbine Governing System (Types of Governing systems. Various components, systems and their functions, Oil circuit for Governing System. Overall working of governing system with reference to load throw off Load raising).

HP/LP Bypass system and PRDS and its utility, Various interlocks and protections

- **Generator Constructional Details** (Basic principle of electricity, generation Development of generator design, Construction details of rotor, stator etc.
- Hydrogen Cooling System and Stator Water Cooling System (Different types of cooling arrangements for rotor and stator, Selection and properties of coolant, Air cooling, Hydrogen cooling, Stator water cooling, H2 Charging/ Purging Cycle).
- Hydrogen Seal Oil System (Details of the system, Function and purpose of differential pressure regulator and pressure oil regulators, Types of Hydrogen seals and their construction details).
- Generator Excitation System and AVR (Principles, Simple arrangements of exciter and its field winding, Classification of excitation system - High Frequency/static excitation system - their merits and demerits, Automatic Voltage Regulator).
- Transformers (Working Principles, Various types of transformers used in a power station, Constructional features of main transformer and accessories, Bucholtz relay and main protections, Types of cooling, Emulsifiers and other fire protection systems.
- **Motors** (Fundamentals, Constructional details of HT/LT Motors, Various motors used in Power Stations.
- **HT-LT Supply system/DC Supply System** (A typical layout of 6.6 KV, 3.3 KV and 415 V supply system in a TPS, DC Supply system in a TPS.

- **Switchyard** (A typical layout of Switchyard of a Thermal Power Station, Bus system, Isolators, CTs, PTs, Earthing, Oil Circuit Breakers, Air Blast Circuit Breakers. SF6 Circuit Breakers).
- **Plant Visit, Scheme Briefing & Power Point Presentation**

(Paper Code: PGDC-RE & GIT 104)

4. Renewable Energy Sources Conversion and Technology
(04 Weeks)

- **Electricity generation using Renewable Energy Sources:** Basic Principles and Applications. (Conversion of Electromagnetic energy and natural energy sources like solar radiation to electricity).
- Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy & Environment.
- Various Methods of using solar energy – Photothermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy.

Renewable energy sources, potential and conversion technology:

- Global and Indian Energy Scenario.
- Renewable Energy Sources and overview Extraterrestrial and terrestrial radiation,.
- Measurement of Solar radiation, Low temperature collectors, HWB collector Model.
- Earth sun energy flux diagram.
- Overview of renewable energy conversion, energy resource assessment: solar, solar thermal collectors, low temperature systems, solar heat pumps & refrigeration, concentrating collectors.
- Overview of solar thermal power systems and photovoltaic energy conversion, Swimming pool Heating, Domestic and Industrial Hot water, Solar Drying, Solar Distillation, Solar pond, Heat Pump and Solar Refrigerator.
- Solar Passive Concepts, Concentrating Collectors, Energy losses in Concentrating Collectors, Useful Power and Efficiency, Useful Energy, Solar Thermal Power general: Solar farm and Central Receiver.

(Paper Code: PGDC-RE & GIT 105)

Solar Photovoltaic Power Plant: Planning, Design and Blalance of Systems
(03 Weeks)

- **Solar photovoltaic Basics:** Fundamentals of solar cell, semiconductors as basis for solar cells materials and properties. P-N junction, sources of losses and prevention. Monocrystalline solar cell technology ingot and water production, processes in solar cells, sawing and surface text uring, diffusion process, metal

contact, thin film solar cells, deposition techniques, evaporation, LPCVD and APCVD, hot wire CVD, ion assisted deposition, amorphous Si solar cell, Cd Te solar cells and solar cell, Concentration and PV cell, PV modules, PV generator.

- **Photovoltaic systems:** Solar cells & panels, performance of solar cells, estimation of power obtained from solar power, solar panels PV systems, components of PV systems, performance of PV systems, design of PV systems, applications of PV systems, concentrating PV systems.

- **Solar Photovoltaic Power Plant:** Planning and Design: Estimating power and energy demand, site selection, land requirements, shadow analysis of siteselection of modules, economic comparison, balance of systems, off grid systems, grid interface, DPR preparation, Supporting structures, mounting and installation, junction boxes, battery storage, power condition unit, selection of cables and balance of systems, planning with software, maintenance and schedule, SCADA system, Sensors, Data logger, Monitoring, Data Management, Analysis and Performance. Financial Analysis, Life Cycle Costing, Environmental Analysis and Social Costs, worksheet, etc.

- **Economics and financing:** Financial evaluation and RE viability, basics of engineering economics, social cost benefit analysis, technology dissemination models, dynamics of fuel substitution, fiscal, financial, and other benefits of renewable energy systems, financing of RE systems, carbon financing of renewable energy, software evaluation, case studies.

(Paper Code: PGDC-RE & GIT 106)

6. Overview of Wind Energy, Biomass Energy and Microgrid, Hybrid Energy System and Integration, Overview of Hydro Power Plant
(04 Weeks)

Wind Energy:

- Wind Energy Scenario in India.
- Properties of wind, Wind velocity and wind rose diagram.
- Estimation of power in wind.
- Types of wind turbine, characteristics, construction of wind mill,.
- Aerodynamic consideration of wind mill design, wind stream profile, rotor blade profile and cross section , Drive system gear, wind electric generator, regulating and control system for wind mills.
- Performance evaluation and recent technologies of wind energy conversion system.
- Wind energy potential estimation and site selection: wind farm, cost estimation of the energy from wind energy conversion system.

Biomass Energy:

- Biomass forecasting, biomass sustainability.
- Biomass Generation and utilization.
- Properties of biomass, Agricultural Crop & Forestry residues used as fuel.
- Biochemical and Thermo-Chemical conversion, Bio-chemical conversion, Electro chemical conversion: solid oxide, bio coal torrefaction.
- Combustion, gasification, Biomass gasifies and types etc.
- Application of Gasifies to thermal power and engines.
- Biomass as a decentralized generation source for villages.
- Concept of bio energy, Bio-fuel, Bio- based chemicals and materials, Co-Generation, Tri- Generation & Waste Energy Recovery, Waste Heat Recovery.
- Use of Biogas and pellets in energy generation.
- Biomass co-firing in thermal power plant: set up.
- O&M, case studies.
- Energy efficiency calculations.
- Co firing energy analysis, scope of renovation in co-firing in existing thermal power plants.

Microgrid, Hybrid Energy System, and Integration

- Introduction to Microgrids: the concept of Microgrids with its main components.
- Microgrid operation and control. The main power electronic converter types implemented in microgrids, the hierarchical control of microgrids.
- The differences between islanded mode and grid connected mode operation of Microgrids, droop control methods implemented in microgrids.
- Voltage and frequency control algorithms in microgrids, power control methods in islanded or grid connected mode operation.
- Energy management systems (EMS) in Microgrids.
- Tackle different challenges related to Microgrid EMS, EMS in centralized or decentralized microgrids.
- Effect of data forecasting in Microgrid EMS.
- Energy management and storage systems in Microgrids.
- Economically Optimal Mix and Size of Technologies for Microgrids and Distributed Energy Resources.
- Hybrid Generation fundamentals and challenges System Planning with Strategic Power Controllers.
- Application of FACTS Controllers in Hybrid Energy Systems. Governing Factors of Hybrid Energy System's Reliability and Advance Technology Solutions.
- Existing Control Methodology in Hybrid Energy Systems: Analytical Assessment. Intelligent Control Concepts for Hybrid Energy Systems.
- Smart Power Flow Controllers for Hybrid Energy Systems: Layered Architecture.

Overview of Hydro Power Plant:

- Overview of Hydro Power Plant
- Overview of Mini, Micro and Small Hydro Power Plant.
- Small, Micro & Mini Hydro Power Basics-Planning and investigation of hydro schemes- General, selection of site
- Hydrological data assessment of hydro potential- Topographical surveys. Head, hydraulic losses and geological investigation.

(Paper Code: PGDC-RE & GIT 107)

7. Renewable Energy Grid Integration & Concept of Smart Grid
(02 Weeks)

- RE Generation the present, the future and the integration challenges.
- Grid codes, State of the art in integrating large capacity RE & technical solutions.
- Modeling of variable Energy Resources.
- Forecasting Renewable.
- Connecting Renewable Energy to Power Grids.
- Demand Response and Distributed Energy Resources.
- Solar Energy Integration, Standards for large-capacity RE integration.
- Enabling and Disruptive Technologies for Renewable Integration: issues, challenges, (Variability and Intermittency and unpredictability) causes and Impact-case studies, fault ride through (LVRT/HVRT).
- Wind Energy Integration.
- Practical Management of variable and Distributed Resources in Power Grid, Balancing Renewable Generation, Big Data, Data Mining and Predictive.
- Grid connected Solar roof top SPV generation, challenges, issues in its implementation;.
- Solarization of agriculture feeder, DER etc.
- Analytics and High-Performance Computing, SCADA and Telemetry, Commercial Mechanism Implementation, REC & RRF Mechanism.
- Electrical Energy Storage (EES), other storage system Small island grid and micro grid, PLL, Sampling effect, commutation etc..
- Modulation type, Dimensioning LC filters, Harmonic cancellation by modulation, Active Network Devices, Control and FACTS Technology- Theory and operation principle of FACTS, AC/DC Drive Control, Functional analysis of power converters main topologies.
- Micro- Grid: Resources evaluation and needs, Dimensioning integration systems, Optimization integration system, Integration system control.
- Smart Grid: Integration of mini and micro generation in distribution grid, V2G integration, Supply guarantee automatism, control devices, IEDs, Measurement and control communication, Protective Devices: Introduction, Over current protection, Distance protection, Differential protection, Protection coordination, Renewable energies protection, Solar Data Analysis.

(Paper Code: PGDC-RE & GIT 108)

8. Business Communication & Personality Development
(01 Week)

- Definition of Business Communication.
- Barriers in communication, Business correspondence, Business Etiquette with other countries.
- Report writing.
- Interviewing, E mail/Fax / diary writing.
- Effective Listening, Case study/Practice sessions.
- Personality Grooming sessions, Theories of Personality Development, Professional dressing, Psychometric test, case studies.
- Attitude development sessions, Positive attitude, Stress management, Change Management, Conflict management, Assertiveness, Self and business awareness sessions.
- Decision making, Business Ethics, Moral & Social Responsibility.
- Leadership styles, Skill development sessions, Interpersonal skill, Team Building skills, Negotiation skills, Time Management skill, Motivation, Presentation skill, Group discussion.

9. Wind Energy Technology and Rotational On-Job Training
(NIWE) (03 Weeks)

- Wind Energy Basics, Introduction to Wind Energy Technology and its Status
- Overview of Wind Turbine Components
- Practical – Nacelle, Small Wind Turbine, Water Pumping Wind Mill
- Measurement Lab. & Visit to Mast International Standards on Wind Turbines.
- Measurement Lab. Visit –Lidar and Sodar
- Wind Turbine Testing & Measurement Techniques.

On shore & off shore – Wind Turbine Generator & Types - Controls & Wind Forecasting. Wind Energy Fundamentals:

Type Certification of Wind Turbines:

- Wind Speeds and scales,
- Terrain, Roughness,
- Wind Mechanics, Power Content, Class of wind turbines.
- Atmospheric Boundary Layers, Turbulence, Instrumentation for wind measurements
- Wind data analysis, tabulation,

Wind Resource Assessment and Site Selection for Wind Monitoring Station

- Betz's Limit, Turbulence Analysis

Aerodynamics Theory:

- Airfoil terminology, Blade element theory, Blade design, Rotor performance and dynamics, Balancing technique (Rotor & Blade), Types of loads; Sources of loads

Wind turbines types:

- Vertical Axis Type, Horizontal Axis, Constant Speed Constant Frequency, Variable speed Variable Frequency, Up Wind, Down Wind, Stall Control , Pitch Control, Gear Coupled Generator type, Direct Generator Drive /PMG/Rotor Excited Sync Generator

Wind Turbine Technology & Components of WTG: 1) Gear Coupled Generator Type [Const. Speed], 2) Direct Coupled Generator Type [Variable Speed Variable Frequency]: Multipole Synchronous / PMG Generators.

Wind Turbine Towers and Foundation: Gear Coupled Generator Wind Turbine Components and their construction:

- Electronics Sensors /Encoder /Resolvers, Wind Measurement : Anemometer & Wind Vane, Grid Synchronization System, Soft Starter, Switchgear [ACB/VCB], Transformer, Cables and assembly, Compensation Panel, Programmable Logic Control, UPS, Yaw & Pitch System : AC Drives, Safety Chain Circuits, Generator Rotor Resistor controller (Flexi Slip), Differential Protection Relay for Generator, Battery/Super Capacitor Charger & Batteries/ Super Capacitor for Pitch System, Transient Suppressor /Lightning Arrestors, Oscillation & Vibration sensing.

Direct Rotor Coupled Generator (Multipole) [Variable Speed, Variable Freq.]:

- Excited Rotor Synch. Generator / PMG Generator, Control Rectifier, Capacitor Banks, Step Up / Boost Converter (DC-DC Step Up), Grid Tied Inverter, Power Management, Grid Monitoring Unit (Voltage and Current), Transformer, Safety Chain Circuits

Doubly Fed Induction Generator and Power Control:

Details of Pitch System & Control Algorithms, Protections used & Safety Consideration in Wind turbines, Wind Turbine Monitoring with Error codes, SCADA & Databases: Remote Monitoring and Generation Reports, Operation & Maintenance for Product Life Cycle, Balancing technique (Rotor & Blade), FACTS control & LVRT & New trends for new Grid Codes.

Concept of Wind Farms and project cycle:

- Project planning, Site selection, Project execution, Operation and maintenance, Environmental concerns: Pollution free power; Noise; birds; Aesthetics; Radio

waves interference; Rainfall & Cost Economics: Wind resource assessment and R & D costs, Fixed and variable costs, Value of wind energy, Life cycle costing and cash flow of wind power projects, Wind project owners /developers, Wind energy market.

- Control and Protection of Wind Turbines. Testing and Measuring Techniques of Power Curve Measurement with Safety and Function test. Concept of Solar and Wind Hybrid Systems

ROJ-NIWE

First Semester Exam
(01 Week)

Proposed visits as per availability of Sites/Premises during First Semester

- Thermal Power Plant
- Gas Power Plant
- Solar Power Plant
- NISE
- Solar Roof Top
- 11/33 KV Sub-Station
- 220 KV Sub-Station
- 400 KV Sub-Station
- 765 KV Sub-Station
- GIS Sub-Station
- HVDC Sub-Station
- SCADA Lab, NLDC
- Transformer Repairing Workshop
- SCADA Center
- Hydro Power Plants & Small Hydro Plants

SECOND SEMESTER SYLLABUS

(Paper Code: PGDC-RE & GIT 109)

1. Solar Thermal Applications-1: Low and Medium Temperatures
(01 Week)

- **Principles of Solar Energy:** General Principles of Solar Thermal Systems, Heat Transfer Fundamentals.
- Solar Collectors: Flat Plate, Evacuated Tube Collector, Characteristic Equations, Standardization, Comparison of Collector Systems.
- Optics and Materials for Solar Thermal, Solar Thermal Collectors, Solar Thermal Components, Storage and loads, Solar Radiation and Augmentation, Energy Storage, Solar
- Drying Process, Solar Steam and Industrial Process Heat. Heating, Solar Hot water Systems: Storage Tank, Connecting Pipes, Mounting, Pump, Valves, Control Un

Low Temperature Application:

- Fundamental Principles, Swimming Pool it, Heat exchanger etc., Space heating Systems, Process Heat, and Types of Systems: Thermo siphon, Forced Flow, Expansion Tank, Absorber Coatings, Cover, Insulation, Galvanization.
- Flat Plate Collector, Hot Air Collector, Evacuated Tube Collector, Parabolic, Compound Parabolic and Fresnel Solar Concentrators, Central Receiver System.
- Thermal Analysis of Solar Collectors Performance of Solar Collectors, Solar Water Heating Systems (Active & Passive), Solar Space Heating & Cooling Systems, Solar Industrial Process Heating Systems, Solar Dryers & Desalination Systems, Solar Thermal Power Systems.

Storage Tank:

- Material (Steel, Stainless Steel, Plastic), Combi - Storage, Non-pressurized and Pressurized Tanks, Solar System Storage Tank, Storage with Stratification, Storage Tank with Gas as auxiliary.

Connecting Pipe:

- Size, Plumbing Techniques, Expansion tank sizing, Safety valves, Nonreturn valves, Return Flow Preventer.

Heat Exchangers:

- Basic of Thermodynamics, Type of Heat Exchangers, Materials, Corrosion Protection, Dimensioning.

Heat Pump and Solar Air-Conditioning:

- Thermodynamics, Vapor Compression System, Solar Absorption System, Choice

of System, Sizing.

Planning and Designing:

- Planning process, Estimates of Components' sizing, Site selection, Detailed Calculations, Collector, Heat Exchanger, Storage Tank, Expansion Tank, Mounting, piping, Pump, Control unit, Detailed Cost Estimates, Mounting and Installation, planning with Software Commissioning, Checks & Maintenance.

(Paper Code: PGDC-RE & GIT 110)

2. Solar Thermal Applications-2: Concentrators and Solar Thermal Power Plants (02 Weeks)

Concentrating Collectors:

- Basic concentration concepts, Mirror optics: Solar and Brightness Distribution, Errors in Concentration, Flux density and concentration, Ideal concentrators, Parabolic Geometries, Other Geometries, Central Receivers: Scaling Relationships, Shading calculations, Flux Density Distribution at Receiver, Design Issue and Constraints: System level Performance, Layout.

Solar thermal power plants:

- Concentration and temperatures, error in concentration, parabolic geometries, paraboloid geometries (dish), heliostats, lay out, central receiver, factors influencing power and energy, design process and parameters, thermodynamic basis for receiver design, tube receiver concept.
- Volumetric receiver, direct absorption receiver, receiverloss calculations, thermal storage for solar power plants, experience on solar thermalpower plants, techno economic evaluation, market considerations.

Aspects of Solar Power Plant Engineering:

- Solar and conventional Power plant: Similarities and Differences.
- Engineering Aspects: Collection, Energy conversion, Characterization and Physical Properties of Solar Power Plant, Design Aspects: Factors influencing Power and Energy Performance, Design Objectives, design Process and Parameters.

Thermal Receivers:

- Principle and concepts of energy Transfer, Thermodynamic basis for Receiver Design, Receiver Designs; Tube Receiver Concepts, Volumetric Receiver Concept, Direct Absorption Receiver Concept, Design and Type of Applications, Measurement Technique, Receiver Loss Calculation: Examples.

Thermal Storage for Solar Power Plants:

- Impact of Storage on Solar Power plant: Capacity Factor and Solar Multiple.

- Media for Thermal Storage: Sensible Heat Storage, Latent Heat Storage, Chemical Storage, Thermal Storage for Solar Power Plant, Oil-Cooled, Steam Cooled, Molten Salt Cooled, Sodium Cooled, Gas Cooled.

Experience on Solar Thermal Power Plants:

- Line Focusing Collectors, Point Focusing Collectors, Central Receiver Plants, Individual Dish Solar Power Plant, Performance Comparison, Performance Model, Economic Analysis.

Analysis of Solar Power Plants:

- SPP technologies in Comparison, Investment O&M, Economic Analysis, Market Considerations.

Solar Fuel and Hydrogen:

- Receiver reactors for Solar Chemistry, High Temperature Processes and conversion, Reforming of Methane, high temperature processes by direct absorption, Electrolytic Production of Hydrogen.

(Paper Code: PGDC-RE & GIT 111)

3. Tide Wave Energy, Fuel Cell, Waste to Energy, Hydel Energy, E-Mobility, Green Hydrogen Energy, Energy Storage, Cyber Security
(05 Weeks)

Tide and Wave Energy: Availability of Tide and Wave Energy and Distribution, Recovery of Tide and Wave Energy, Various Types of Systems to Extract Energy for Tide and Wave Energy , Sustainability of Tide and Wave Energy, Economics of Tide and Wave Energy.

Hydrogen Energy: Hydrogen as a renewable energy source, Sources of Hydrogen, Fuel for Vehicles.
Hydrogen Production: Direct electrolysis of water, thermal decomposition of water, biological and biochemical methods of hydrogen production.
Storage of Hydrogen: Gaseous, Cryogenic and Metal hydride.

Fuel Cell: Principle of working, construction and applications.

Hydel Energy: Potential, Hydropower Generation and Distribution, Mini and Micro hydel Power (MHP) Generation: Classification of hydel plants, Concept of micro hydel, merits, MHP plants: Components, design and layout, Turbines, efficiency, Status in India. Integrated Energy systems and their cost benefit analysis.

Co-generation, Tri-generation & Waste Energy Recovery: Co-generation & Tri-generation: Definition, need, application, advantages, classification, saving Potential.

Waste Heat Recovery: Concept of conversion efficiency, energy waste, waste heat recovery classification, advantages and applications, commercially viable waste heat recovery devices. Concept of E-Mobility & E-Vehicle, V2G, G2V Integrations,Energy Storage and Components, Different Energy Storage Devices, Concept of Cyber Security and its different Rules & Regulations.

4. SIMULATOR - SCADA & SMART GRID AND RENEWABLE ENERGY
(02 Weeks)

- Overview of SCADA & Smart Grid System
- EMS and Transmission System
- DMS System and its architecture
- OMS & ADMS System, its components and architecture & system integration.
- Smart Meter and AMI System.
- Renewable Energy Integration and Load Fetching indexing in SCADA & Smart Grid System.

(Paper Code: PGDC-RE & GIT 111)

5. Small, Mini and Micro Hydro Power Technology
(02 Weeks)

- Small, Micro & Mini Hydro Power Basics-Planning and investigation of hydro schemes- General, selection of site
- Hydrological data assessment of hydro potential- Topographical surveys. Head,hydraulic losses and geological investigation.
- Design of Flood discharge and Tail Race water rating and Arrangements &Run off River Schemes - Tariff design and Issues in Small/Micro hydro
- Dam Structure - Canal& Pondage- structures associated with hydro schemes, components of a dam- Barrage Power House Structure
- Types of turbines- construction details- Kaplan, Pelton andFrancis turbines - Classification of turbines., impulse and reaction turbine.
- Low Head Turbines - Types& drive system -Bulb Type Turbine- Construction & Principle of Operation
- Gates ,Valves&Governors –Construction & Principle of Operation
- Auxiliary Systems -Cooling Water System, Lubrication System, Governor Oil System, Dewatering System - Use of Gear Box, Generator Brake and Jack System, SpeedSensors, SpeedMonitors, SpeedRelays proximity Switches and ItsSettings.
- Hydroelectric Generators and voltage regulators –Switchgear&protection
- Power Evacuation System & Switchyard Arrangements

- Feeders and it's protection system. Feeder synchronization testing.
- Testing, Commissioning, Operation and Maintenance

6. Micro Grid Lab Experiments
(02 Weeks)

- Experiment of Solar kits and Demonstrations
- Experiment of Wind kits and Demonstrations
- Experiment of Microgrid Kits and Demonstrations
- Experiment of Smart Grid Kits and Demonstrations
- Experiment of HVAC Kits and Demonstrations
- Experiment of HVDC Kits and Demonstrations

7. Biomass Technologies (Biomass Energy & Conversion, Concept of Co-Generation & Waste Energy Recovery) and Rotational on-job-training-2
(02 Weeks)

8. Solar Energy Technologies and Rotational on-job-training-3
(02 Weeks)

9. Project Industrial Internship (08 Weeks)

10. Second Semester Examination (01 Week)

VIVA AND PROJECT REPORTS

Viva

- Simulator Training.
- SCADA & SMART Grid Lab
- Micro Grid Lab Experiments

Project Reports

- Wind Energy Technologies and Rotational On-Job Training – 1
- Bio-Mass Technologies (Bio Mass Energy & conversion, Concept of Co-Generation & Waste Energy Recovery) and Rotational On-Job Training – 2
- Solar Energy Technologies and Rotational On-Job Training – 3
- Small Hydro Power plant Technologies and Plant Visit
- Project Industrial Internship

FEE STRUCTURE

Sr. No.	Category	Fees
1.	Non-sponsored candidates	Rs. 2,30,000/- plus GST@18% per participant (fees will be paid in two installments)
2.	Sponsored candidates	Rs. 3,60,000/- plus GST@18% per participant (fees will be paid in two installments)

***** *To be deposited at the respective Institute On-line by SBI Collect.*
Note: - There is no Fee concession to any category of students
(Loan Facility available from reputed Nationalised Bank)

ELIGIBILITY CRITEREA

- **B.Tech. / B.E. all branches or its equivalent with minimum 60% marks**
- **There is no age limit for admission to PGDC courses.**
- **Applicants must submit their final degree/provisional degree certificate at the time of Counseling/Reporting.**

LIFE AT NPTI







Contact us

NPTI Badarpur (Northern Region)
Venkata Subbiah | Deputy Director
Mobile: 9741811574 | Email: venkatasubbiah.npti@gov.in
NPTI (Northern Region) Badarpur, Mathura Road, New Delhi-110044

NPTI Shivpuri
Rohit Gupta | Assistant Director
Mobile: 9358283163 | Email: rohitgupta.npti@gov.in
Shyampur, Satanwada, AB Road District, Shivpuri-MP

NPTI Neyveli (Southern Region)
Dr. J. Raja | Assistant Director
Mobile: 8800124789 | Email: jrajaj1980@gmail.com
Block No. 14, NLC Township, Neyveli-607803, Tamil Nadu

NPTI Alappuzha
R. Ramar | Deputy Director
Mobile: 8610802949 | Email: ramar.nptisr@yahoo.com
Pallipuram, Kerala-688541

Follow us

National Power Training Institute - NPTI

nptimopgoi | NPTI

National Power Training Institute, Faridabad

National Power Training Institute, MoP

nptifaridabad

NATIONAL POWER TRAINING INSTITUTE
Ministry of Power, Govt. of India
NPTI Complex, Sector-33, Faridabad - 121 003, Haryana, India
www.npti.gov.in