

NATIONAL POWER TRAINING INSTITUTE

POST GRADUATE DIPLOMA COURSE IN THERMAL POWER PLANT ENGINEERING

SCHEME OF STUDY

1st SEMESTER – 26 WEEKS

S.No.	Modules/Subjects	Hours/Week		
		L	T	P
1.1	Basic Concepts and Off Site Facilities	3	2	2
1.2	Steam Generators	3	2	3
1.3	Turbines and Ancillaries	3	2	3
1.4	Electrical Machines and Systems	2	2	3
1.5	Management			

MID TERM EXAMINATION-12 TH WEEK

FIRST SEMESTER EXAMINATION-25TH WEEK

24th week-Exam preparation holidays

26th week-After first semester holidays

2nd SEMESTER – 26 WEEKS

S.No.	Modules/Subjects	Hours/Weeks		
		L	T	P
2.1	Erection and Commissioning	2	1	2
2.2	Control, Instrumentation & Information Technology	2	1	3
2.3	Operation & Performance Monitoring	2	1	3
2.4	Power Plant Maintenance	4	2	6
2.5	Seminar	0	1	0

MID TERM EXAMINATION-12 TH WEEK

SECOND SEMESTER EXAMINATION-26TH WEEK

25th week-Exam preparation holidays

Simulator training for two weeks will be imparted at Badarpur/Nagpur/Faridabad in the second semester. This will be additional to the second semester syllabus of 26 weeks.

NATIONAL POWER TRAINING INSTITUTE

POST DIPLOMA COURSE IN THERMAL POWER PLANT ENGINEERING

SCHEME OF STUDY

1st SEMESTER – 22 WEEKS

S.No. Modules/Subjects	Hours/Weeks		
	L	T	P
1.1 Basic Concepts and Off Site Facilities	3	2	2
1.2 Steam Generators	3	2	3
1.3 Turbines and Ancillaries	3	2	3
1.4 Electrical Machines & Systems	2	2	3

FIRST SEMESTER EXAMINATION

2ND SEMESTER – 22 WEEKS

S.No. Modules/Subjects	Hours/Weeks		
	L	T	P
2.1 Erection and Commissioning	2	1	2
2.2 Control, Instrumentation & Information Technology	2	1	3
2.3 Operation & Performance Monitoring	2	1	3
2.4 Power Plant Maintenance	4	2	6
2.5 Seminar	0	1	0

SECOND SEMESTER EXAMINATION

Simulator training for two weeks will be imparted at Badarpur/Nagpur/Faridabad in the Second Semester. This will be additional to the Second Semester syllabus of 26 weeks.

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POST GRADUATE DIPLOMA COURSE IN THERMAL POWER PLANT ENGINEERING

SCHEME OF EVALUATION

1st SEMESTER – 26weeks

S.NO.	MODULES/SUBJECTS	SURPRISE	MID	SESSIONALS	FINAL	TOTAL
		TEST	SEMESTER		EXAM.	
1.1	Basic Concepts & Off Site Facilities	10	20	30	40	100
1.2	Steam Generators	10	20	30	40	100
1.3	Turbines and Ancillaries	10	20	30	40	100
1.4	Electrical Machines & Systems	10	20	30	40	100
1.5	Managemment	10	20	30	40	100

2nd SEMESTER – 26weeks

S.NO.	MODULES/SUBJECTS	SURPRISE	MID	SESSIONALS	FINAL	TOTAL
		TEST	SEMESTER		EXAM.	
2.1	Erection & commissioning	10	10	25	30	75
2.2	Control, Instrumentation & Information Technology	10	20	30	40	100
2.3	Operation and Performance Monitoring	10	20	30	40	100
2.4	Power Plant Maintenance	20	40	60	80	200
2.5	Seminar	0	0	0	0	25

1.1 Basic Concepts & Off-Site Facilities

L	T	P
3	2	2

- Power Scenario in India
- Electricity Laws, Rules and Standards
- Coal to Electricity
- Resources for Power Generation
- Site Selection
- Fuels used in Thermal Power Stations – their classification and properties
- Indian Bituminous Coal and Coal benefaction
- Fuel Oil/Gas handling systems
- Coal handling systems
- Water Treatment
- C.W. System – Types, C.W. Pumps and Cooling Towers
- Compressed Air Supply System
- Power Plant Layout
- Steam Cycle Theory
- Fire Fighting Systems and Equipment
- Industrial Safety & Hazards including Permit to work System
- Causes of Injuries, their remedies and First Aid
- Non Conventional Energy Resources for Power Generation

PRACTICAL

Part-I

Scheme Tracing

- Overview of Thermal Power Plant
- Coal Handling System
- Fuel Oil/Gas Handling System
- Water Treatment Plant
- Compressed air supply System
- Circulating Water System
- Fire Fighting System

Part-II

Hands – on – Practice

- Sampling of Steam/Boiler water/Condensate water and its testing
- Sampling and analysis of Coal and Fuel Oil
- Operation of Fuel Oil and Coal Handling System
- Operation of Water Treatment Plant
- Checks and Operation of C.W. Pumps/Cooling Tower Pumps and Fans
- Starting/Stopping of compressors and their routine checks
- Checks on dehumidifying unit and regeneration
- Checks and operation of different types of extinguishers and system of extinguishing of different types of fires
- First Aid Kits and Practice
- Practice on personal safety devices in Industry

1.2 STEAM GENERATORS

L	T	P
3	2	3

- Function, Workshop Principles, Classification and Constructional features of Boiler.
- Boiler Pressure Parts : Economizer, Boiler Drum, Water Walls, Superheater, Reheater and Desuperheaters.
- Coal Feeders & Pulverizers
- Fuel Firing and Equipment
- Furnace Draft, Boiler Air and Flue Gas System
- Boiler Fans: ID/FD/PA/GR Fans
- Seal air, Igniter Air & Scanner Air Fans
- Air Pre-heaters and Steam Coil Air Pre-heaters
- Pre-checks, Startup, Shutting down and routine checks of Boiler and its auxiliaries (Mills & Feeders, ID/FD/PA Fans and Air Pre-heater)
- Boiler Firing – Initial Light – up and pressure raising
- Measurement of different Boiler parameters like Level, Flow, Temperature & Pressure
- Protections and Interlocks of Boiler and its auxiliaries
- Ash Collecting Devices – ESP
- Dry fly Ash Collection
- Ash disposal Systems
- Ash Utilization – various options
- Environmental Aspects of T.P.S.

PRACTICAL

Part-I

Scheme Tracing

- Boiler Water and Steam Circuits
- Boiler Flue Gas and Air Systems – ID/FD/PA & Air preheaters
- Milling Plant System
- Fuel Oil System
- Fuel Firing Equipments : Coal Burner/Oil Burners/Igniters/Scanners/Auxiliary and Fuel Air Dampers
- HP/LP Chemical Dosing System
- Boiler Drains/Vents/Safety Valves
- Ash disposal System
- Soot Blowing System
- Auxiliary Steam/Pressure Reducing and Desuperheating Station

Part-II

Hands – on – Practice

- Operation of boiler Fans ID/FD/PA Fans and Air Pre-heaters
- Operation of Mills and Feeders
- Checks on fuel firing equipments during initial start up and normal operation
- Charging and isolation of Boiler Drum gauge glasses
- Checks and operation of Boiler Drains & Vents
- Charging and isolation of Auxiliary Steam Vents
- Charging and isolation of de-superheating Station

- Charging and isolation of Steam Coil air Pre-heaters
- Starting, Stopping and normal checks of Ash disposal System

1.3 TURBINES AND AUXILIARIES

L T P
 3 2 3

- Function, Working Principle, Classification and constructional features of Steam Turbines.
- Turbine Bearing and Couplings.
- Turbine Lubricating Oil System and Equipment
- Turbine Gland Sealing System
- Condensate and Condenser vacuum system.
- General description of pumps used in Thermal Power Station.
- Boiler Feed Pumps and Condenser Extraction pumps.
- Regenerative Feed Heating System
- Deaerator-Functions and Working Principles.
- Turbine Bypass Systems(HP/LP Bypass).
- Turbine Governing Systems : Functions, working Principle and Types.
- Turbine Protections and Interlocks.
- Boiler Feed Pumps, Condensate Extraction Pumps and Drip pumps - Pre-checks, Normal checks, start up and shutting down.
- Charging and isolation of :
 - Turbine Lub Oil System
 - Gland Sealing System
 - Regenerative Feed Heating System.
- Pre-checks, Start up and Shutting Down of Turbine.
 - Combined Gas Cycle and Co-generation.

PRACTICAL

Part-I

Scheme Tracing:

- Steam line connections to Turbine Extraction lines, isolating/Protection/Control Vales.
- Condenser connection and its vacuum pulling systems.
- Regenerative feed heating system-LP/HP Heaters, Deaerator, gland cooler and drain cooler.
- Boiler Feed Pumps, condensate Extraction Pumps, Feed Water Regulating Station, condensate flow control station and condensate hot well make up systems.
- Steam Turbine Bypass system (HP/LP Bypass)
- Auxiliary Steam Supply System (Pressure reducing and de-superheating station)
- Turbine Lubrication and Governing Oil System
- Turbine flash Tanks/Unit Drain Tanks and their connections.
- Combined Cycle Power Plant.

Part-II

Hands – on Practice:

- Charging of auxiliary Steam/Pressure Reducing and Desuperheating Station.
- Deaerator filling, deaerator heating and steam charging.
- Starting, Stopping and routine checks of Turbine Lub Oil System.
- Starting, stopping and routine checks of Turbine gland Sealing System.

- Barring gear operation.
- Checks and operation of vacuum pulling systems.
- Charging and isolating of regenerative feed heating System.
- Charging and isolating of Gland Sealing System.
- Charging HP/LP bypass system
- Turbine Start up and shutting down operation

1.4 ELECTRICAL MACHINES AND SYSTEMS:	L	T	P
	2	2	3

- Working Principle, development and constructional feature of Generators.
- Generator cooling and sealing system
- Generator Excitation System, types and Automatic Voltage Regulator (AVR)
- Generator Synchronization
- Working Principle & Constructional features of HT/LT Motors
- Switchgear – HL/LT
- Auxiliary Power Supply System AC & DC
- Switchyard Equipments and their Layout
- Transmission and Distribution of Power/HVDC
- Electrical Protections for Generators, Transformers, Bus Bars and Transmission Lines.

PRACTICAL

Part-I

Scheme Tracing:

- Generator, its excitation system Generator Cooling & Sealing systems
- 6.6 KV/3.3 KV/415 V Auxiliaries Power Supply System
- 220 KV/400 KV Switchyards
- 220 KV/33 KV/11 KV Feeders arrangement in Sub-Station
- Switchyard of HVDC Transmission System

Part-II

Hands – on Practice:

- Checking of insulation resistance of Electrical Machines (Generators/Motors/ Transformers)
- Checking of Generator Seal Oil System and Hydrogen Cooling System
- Charging of Hydrogen in Generator
- Excitation Control and Synchronization
- Change over of power supply from station to unit and vice versa
- Change over of Breaker positions
- Checks on HT/LT Switchgears and their operation
- Checking and recording of Transformer Operating Parameters
- Routine checks of Transformer
- Operation of Isolators/Breakers/Switches
- Prechecks, starting/stopping, normal checks of switchyard compressors.

2.1 ERECTION & COMMISSIONING

L	T	P
2	1	2

- Introduction to metallurgy and its relevance in Power Station
- Ferrous and non-ferrous metals and alloys
- Non metallic material (rubber/plastic/coating/adhesives/gaskets/seals etc.)
- Selection of material for different equipment in Power Stations
- Corrosion and scale formation in Power Plant and protective surface treatment
- Introduction to welding and types of welding
- Welding machines, types of electrodes, precautionary measures during welding, Welding defects
- Commissioning Test Procedures and Performance Guarantee Test
- Erection and commissioning of :
 - Boiler, Turbine, Generator and their Auxiliaries
 - Switchyard Equipment
 - Fuel (Coal, Oil & Gas) Handling Plant
 - CW Pumps & Cooling Towers
 - Electrostatic Precipitators
- Commissioning of Control & Instrumentation Systems and Equipment

PRACTICAL

Part-I

- Demonstration of various tools and equipments used in Material Science Laboratory Workshop
- Demonstration of various Tools and Equipments used in Welding Shops for both Arch Welding and Gas Welding
- Practice on DC/AC Arc Welding and Gas Welding
- Practice on Horizontal, flat, Vertical and Overhead Welding and Single/Double/Multi run welding.
- Edge preparation of welded joints such as V, double V and double U.
- Pipe welding
- Flame cutting
- Preparation of Schedule and checks during erection and commissioning of Boiler, turbine, Generator and their auxiliaries
- Checking for various steps in Erection and Commissioning of Switchyard Equipment.

2.2 CONTROL, INSTRUMENTATION AND INFORMATION TECHNOLOGY

L	T	P
2	1	3

- Concept and layout of C&I Equipments in Typical Large Power Station
- Measurement System and measuring instruments – Level, Flow, Pressure, Temperature and dryness fraction
- Pneumatic Instruments and pneumatic System
- Transducers
- Water and Gas Analyzers – Steam and Water Analysis System
- Turbovisory Instrument – Primary Sensors
- Calibration and Maintenance of different instruments
- Introduction to auto control system with different logic gates
- Auto Control loops in thermal power stations – basic concepts
- Data Acquisition System
- Distributed Digital Control System
- Concept of Computing System and recent trends in Net Working System and Information Technology
- Introduction to Operation System – DOS/WINDOWS 95/98
- Introduction to Application Software – MS Office – MS Word, MS Excel
- Role of Computers in Power Plant Operation and Maintenance
- Management of Information System

PRACTICAL

PART-1 (C&I)

- Calibration of pressure gauges with dead weight tester
- Calibration of Draft Gauge with Manometer
- Calibration of Thermocouple and Temperature Gauges
- Calibration of Temperature Recorder (LPR & LBR)/Temperature Transmitters
- Calibration of Level Gauges
- Water flow measurement by orifice – plate and manometer
- Air Flow measurement by Pilot tube and orifice – plate
- O₂, CO and CO₂, Analyzers – Calibration and testing
- Practical on Basic Electronic Principles
- Tuning of Auto Controller

PART-II (Information Technology)

- Practical on Logic Gates/Flip Flops/Counter/Shift Register
- Hands on Practice on Computer using MS DOS & WINDOWS 95/98
- Hands on Practice on MS Office – MS Word, MS Excel
- Programming Exercises on Pay Roll/Inventory

2.3 OPERATION AND PERFORMANCE MONITORING

L	T	P
2	1	3

General Guidelines

- Safety Factors
- Issue/Cancellation of Permit to Work for Power Plant Equipment/Systems
- Fire Protection
- House Keeping
- Role of Operators/Engineers in Thermal Power Plant Operation

UNIT OPERATION

- Unit Protections and Interlocks of Boiler, Turbine, Generator and their Auxiliaries
- Unit Start up and loading
 - Preparation (Pre-start checks, Availability of fuel and other essential Services)
 - Boiler light up and pressure raising
 - Establishing Turbine Lubricating System and putting on barring gear
 - Steam admission to Turbine – rolling up to rated speed
 - Synchronization and loading
 - Cold/Ward/Hot start of unit
- Normal/Routine Checks : (On Loads Activities)
- Off – loading and Scheduled/Emergency Shut Down
- Emergency Operation and Trouble Shooting in Boiler, turbine, Generator and their Auxiliaries
- Generator operation under variable load conditions
- Load dispatch and grid operation

- Energy Audit
- Power Plant Performance (Boiler Efficiency, overall Turbo Alternator heat rate, Auxiliary Consumption and Overall Unit Heat Rate Monitoring)
- Monitored variables and efficiency control parameters
- Effect of abnormal parameters on performance and life of the Power Plant equipments
- Performance monitoring (PLF, Availability Factor, Station Heat Rate, Auxiliary Consumption, make up water consumption, specific oil consumption, specific coal consumption and Air & Water Pollution Control)
- Tips for maintaining optimum operating parameters to ensure better plant performance and machine life.

PRACTICAL

- Operation of Boiler, Turbine, Generator and their Auxiliaries from Unit Control Desk
- Supervision of Operation of : Boiler & its Auxiliaries, Turbine and its Auxiliaries, Generator and other Electrical System
- Isolation of Plant equipment's/systems for Permit to Work
- Calculation of boiler efficiency, THR, UHR and SHR and optimum operating parameters
- Data logging and efficiency calculation
- Visit to Power Plant Simulator

2.4 OPERATION AND PERFORMANCE MONITORING

L	T	P
4	2	6

Mechanical

- General Procedures in Power Plant Maintenance – aims and Objectives.
Different Maintenance Systems and Maintenance Planning
- Maintenance of
 - Boiler pressure parts and buck stays
 - Boiler Auxiliaries – ID/FD/PA fans
 - Pulverizers
 - Different pumps in TPS – BFP/CEP
 - Valves including Safety valves and their setting
 - Turbine – HP/IP/LP rotors/cylinders
 - Condenser – cleaning and air tightness test
 - Turbine Lub Oil and Governing Oil System
 - Bearing and Couplings
 - Compressor
- Alignment of rotor and rotating equipment
- NDT and its application in Power Station, NDT methods
- Leakage detection in Heat Exchangers

ELECTRICAL

Maintenance of :

- Generator – Stator/Rotor and Cooling/Sealing System
- Motor-Stator/Rotor/Control Circuits

- Transformers-Insulation testing/Drying out process and other routine maintenance
- Switchgears
- Relays
- Cable jointing techniques

PRACTIAL

Mechanical

- Checking of various tools/tackles/lifting equipments/consumables and spares related with Boiler/Turbine maintenance
- Preparation of Bar Charts
- Checking of Boiler Drum Internal and Mounting
- Measurement of Tube wall thickness
- Magnetic practice test
- Dye Penetration Test
- Ultrasonic test for welded joints
- Detection of crack in Boiler Tubes
- Maintenance of ID/FD Fans
- Vibration Monitoring of ID Fans and its balancing
- Maintenance of Mill – Adjustment of Roller Gap with Bull Ring Segment and Adjustment of classifier vanes.
- Maintenance and checking of pumps including BFP and CEP
- Lapping of valves/maintenance of valves/safety valve maintenance

- Bearing and its maintenance
- Alignment of rotors in general
- Compressor maintenance

ELECTRICAL

- Checking of Insulation Resistance (IR) and Polarization Index Value (PI Value) of Generator Stator winding
- Checking of earthing system of generator
- Maintenance of motors – Insulation checking – Stator winding repair, different tests during overhauling
- Routine tests of transformers – IR value and PI value of Transformer winding
- Measurement of breakdown voltage (BDV) of Transformer Oil – Calibration of Level/Temperature gauges
- Routine Tests of Switchgear

Testing & Calibration of different relays ; Earth fault relay – Differential Protection Relay

2.5 OPERATION AND PERFORMANCE MONITORING

- | | L | T | P |
|--------------------------|---|---|---|
| ➤ | 4 | 2 | 6 |
| ➤ Cable joining Practice | | | |

2.6 OPERATION AND PERFORMANCE MONITORING

L	T	P
0	1	0

Each Student/Group of students shall be allocated a topic for the Seminar of his/their interest, at the beginning of second semester. He/they will make a presentation on that subject at the end of second semester.