Long Term Courses:

26 week PGDC in TRANSMISSION AND DISTRIBUTION SYSTEMS

Context & Objectives

The main objective of the course is to create a technically trained manpower readily available for recruitment by the power companies in the area of Transmission & Distribution of Electrical Power

Outline

The course content complies with the syllabus for Engineers and Supervisors for Operation & Maintenance of Transmission & Distribution Systems as per Safety and Electrical Supply Regulations 7(3) of Govt. of India

SYLLABUS

1. **GENERAL INTRODUCTION ,Power Generation -Thermal, Hydro, Nuclear and Gas ,Renewable Energy Sources**
   Generation, Transmission & Distribution Scenario of India
   Types of generation: Conventional and Renewable, Thermal Power Plant, Hydro Power Plant, Gas Power Plant, Nuclear Power Plant, Co-generation.
2. **Power Transmission Line Engineering**
   EHV Transmission system in India, Tower types, Conductors, Earth wire, Insulators, Statutory clearances, Surveying, Route Alignment, Tower erection, Tower Testing, Stringing, Transmission Line Commissioning, Maintenance of transmission line, Thermo vision scanning, Hot line maintenance.
3. **EHV Substation Planning & Engineering**
   Substation Planning, Site selection, Layout of substation & Civil works, Selection of main equipment, Selection of switchgear, Electrical clearances, Instrument transformers-selection & Performance, Control & Instrumentation in Substations, Substation auxiliaries, Substation grounding practices, Demo on grounding.
4. **Power System Studies**
   Power System Modelling, Load flow studies, Tutorial on load flow studies, Study state fault analysis, Tutorial on Fault Analysis, Transient stability studies, Relay Co-ordination studies, Tutorials, EMTP Studies.
5. **High Voltage Testing of Power System Equipment**
   Philosophy of HV Testing, Generation and Measurement of HVs, Testing of Power Transformers, Testing of Insulators, Testing of Surge Arrestors, Testing of Switchgear, Testing of Transformer oil, Dissolved Gas Analysis, Partial Discharges.
6. **Power System Protection**
   Overview of Power System Protection, CTs and PTs, Generator Protection, Transformer Protection, Transmission Line Protection – distance schemes, Transmission line protection – unit schemes, Bus Bar Protection, Motor Protection, Over voltages in Power Systems, Protection against over voltages, Insulation Co-ordination
7. **Operation and Maintenance of EHV Substation Equipment**
   Transformers-Construction, Connections, Tap Changing Mechanism & Parallel Operation, Testing and Protection of transformers, O&M of Transformers, Selection, Sizing, performance Analysis of HV Circuit Breakers, Transformer Neutral Earthing, O&M of HV Circuit Breakers, Operation and Maintenance of Distribution Transformers, Operation and Maintenance of Distribution Switchgear.
8. **HVDC Transmission Systems**
   Introduction to HVDC Transmission, Principles of HVDC Conversion, HVDC Lines, HVDC Sub Stations, Reactive Power Management in HVDC Stations, AC & DC harmonics and filtering, HVDC System operation, control and maintenance, HVDC Protection, Insulation Co-ordination, Emergencies and case studies
9. **Distribution System Engineering**
   Distribution systems overview, Planning, Design and selection of pole structures conductors insulators etc., Pole erection, conductors stringing, Layout of earth wire, neutral wire guarding, jointing of conductors, jumpering etc.; Location, construction

and erection of pole mounted sub stations; Selection, fixing of switches, fuses etc.; Operation & Maintenance of Distribution Lines.

10. **O & M of Distribution Substations and Distribution Metering**
    Distribution Substation - types, layouts, bus bar arrangements; Selection of Distribution sub station equipment, Distribution sub station relay schemes, O&M of Relay schemes, Substation Operation overview, Code of practice in Sub Station Operations, Work permits, line clear procedure, Maintenance of log books, Records etc., Distribution Substation Operation - Case studies; Types, design and construction of distribution meters, Failure analysis of Distribution Meters.
11. **Power Cables and Jointing Techniques**
    Power Cable - Design, Construction, Testing, Operation & Maintenance; Trouble shooting of Power Cables; LT and HT Cable jointing, Termination and Accessories; Cable fault detection and repair; Demo on LT & HT Power cable jointing - End joint & Straight through joint.
12. **Communication in Power Systems**
    Communication systems: PLCC, Microwave, Leased lines, OPF, Satellite, Power Line Carrier Communication, Optical fibre communication, Satellite communication, Planning and selection of communication systems, Trends in communication, Telemetry, Tele control and Tele protection
13. **Power system Operation - Active and Reactive Power Despatch, SCADA, AGC & ED**
    Functions of Load Despatch Centres, Supervisor control & Data requisition, Load forecasting, generation scheduling, load management & load shedding, Energy management system functions, Voltage and frequency control, Grid Disturbances-Case Studies, State estimation, Security and contingency analysis, Voltage and frequency control, Automatic Generation Control and economic dispatch, Application of SCADA in power systems, Application of EMS in power systems.
14. **Power Market Regulations**
    Introduction to commercial aspects of transmission and distribution, Tariff structure, types, method of working out, revenue realization, Regional energy accounting, Inter-utility tariff, commercial disputes and solutions. Availability based tariff and open access. TTC, ATC, Reliability Margin, Tariff Regulations, Open Access, RES Integration, Point of Connection Charges, Congestion Charge Regulations, Regional Energy account, Power exchanges
15. **Electrical Safety and Statutory Regulations**
    Safety Requirement, Hazards, Electrical Accidents and prevention, First Aid, Fire fighting-Types of fire, fire fighting/system, fire extinguishers
16. **Labs:** Despatcher Training Simulator, Relay Testing, Power System Studies, HV Testing, Instrumentation, Switchgear Labs
17. **Technical Visits:** Sub-stations, Transmission Lines, Power Plants, Manufacturing units, Testing Centres, etc.

Who may attend
Fresh graduates or sponsored engineers of Electrical / Electrical & Electronics / Power engineering.
Methodology
Lectures, Lab Sessions, Appraisal, Communication skills & Project work
Program Date: From18.01.16 to 16.07.16

52 week PGDC IN SUB-TRANSMISSION AND DISTRIBUTION SYSTEMS

Objective

The main objective of the course is to create a technically trained manpower readily available for recruitment by the power companies and electrical service divisions of large industries in the area of Sub-Transmission & Distribution of Electrical Power.

This is a **Post Graduate Diploma Course** for those who desire to make a career in the power sector. On successfully undergoing this course the Electrical Graduate Engineers will find immense opportunities and preference in employment with various power companies. The course covers the Syllabus as per Central Electricity Authority (Measures relating to Safety and Electric Supply) Regulations, 2010

Outline

1.0 General Introduction, Power Sector scenario:

Overview of Sub T&D Course, Power scenario and growth of power industry in India, Power Sector set up in India, Transmission and Distribution of Electricity in India, Role of private participants

2.0 Fundamentals of Electricity, Power Quality, Harmonics & Mitigation:

Power Terms in single phase system, Introduction to sinusoidal voltage source supplying Non-linear load current and non-sinusoidal voltage source supplying non-linear loads, Familiarization with the terms: Active power, reactive power, apparent power, distortion power, power factor; Introduction to balanced three phase circuits; instantaneous active and reactive power of a balanced and unbalanced three phase circuit, Three phase non sinusoidal balanced system and three phase non sinusoidal unbalanced system, Fundamentals of load compensation, practical aspects of compensator used as voltage regulator, Phase balancing and power factor correction of unbalanced loads, Generalized approach for load compensation using symmetrical components; Control theories for load compensation; compensating star connecting load, compensating delta connected load, Conventional methods to regulate voltage, dynamic voltage restorer: principle of operation, mathematical description, Transient operation of DVR, realization of DVR voltage using voltage source inverter, maximum compensation capacity of the DVR, Power Quality; Harmonics – Sources, Measurement and Mitigation, Active and Passive filters of harmonics

3.0 Generation Systems – Thermal, Hydro, Nuclear, CCGT, Diesel Power Plant:

Hydro Station- Layout, Operation and Maintenance, Thermal Power Plant – Coal to Electricity, Boiler, Turbine, Boiler auxiliaries, Turbine types, working principle and construction, Synchronous Generator and its auxiliaries, Gas Power Plant – Layout and operation, Diesel Power Plant Operation, Nuclear Power Plant- Layout, Basics and working principles, Combined Cycle Gas Turbine Power Plant.

4.0 **RES - Site selection, RE System Sizing, Feasibility reports:**

Selection of site for wind power plant, Wind speed studies, Wind Electric Generators– Types, configurations, sizing, technologies, Selection of wind electric generators- Induction, doubly-fed induction, synchronous generators – merits and demerits; Small Hydro, Biomass Power Plants, Co-Gen Power Plants, Geothermal and Tidal Power Sources; Feasibility Study, Site Survey, Design considerations, Example of a RE feasibility study report,

5.0 Power Electronics Controls, Rectifier, Inverter, Power Control Unit:

Introduction to self-commutated switches , MOSFET and IGBT - Principle of operation of half and full bridge inverters – Performance parameters, Voltage control

of single phase inverters using various PWM techniques, Various harmonic elimination techniques – forced commutated Thyristor inverters, Three Phase Voltage Source Inverters**-** 180 degree and 120 degree conduction mode inverters with star and delta connected loads, Voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques, Application to drive system, Current Source Inverters **-** Operation of six-step thyristor inverter – inverter operation modes – load – commutated inverters, Auto sequential current source inverter (ASCI) – current pulsations – comparison of current source inverter and voltage source inverters, PWM techniques for current source inverters, Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters, Comparison of multilevel inverters - application of multilevel inverters, PWM techniques for MLI – Single phase &Three phase Impedance source inverters, Series and parallel resonant inverters **-** voltage control of resonant inverters – Class E resonant inverter – resonant DC – link inverters, Grid-connected electronics, grid-tie inverters commercial products, Evolution of PV inverters, string inverters, micro-inverters, multi-string inverters, inverter topology, multilevel inverters and comparison, multilevel inverter motivation and operation, panel mismatch ,the n-phase micro inverter, DC/DC converters, various types of inverters and their advantages and disadvantages, Design and testing of inverters, Efficiency calculation and performance analysis of Inverters

6.0 Solar Photo Voltaic (SPV) Systems:

Preliminary SPV cell manufacturing process, Sun light to electricity, Thin film SPV modules, Poly-crystalline SPV Cells; Concentrator SPV systems, Solar Power Plant, Meteorological Data, Structural Design Considerations, Project Preliminary Cost Estimate, Energy Cost Factors, Environment Impact Assessment (EIA), Preparing the detailed project report of SPV – Case Study

7.0 Sub T & D Planning, Optimisation, Design & Engineering:

Load flow studies, Steady state fault analysis, Transient Stability studies, Relay coordination, Load forecasting, Philosophy of distribution planning, Acquaintance with software for distribution planning and optimization. Spatial analysis, Distribution substation types, layouts, bus bar arrangements, Civil engineering requirements, Bay design, Selection of Distribution substation Transformers, circuit breakers, etc., General rules for Electrical Installation design: Rules and statutory regulations, Installed power loads – Characteristics, Power loading of an installation, Procedure for the establishment of a new substation- Preliminary investigation, Project studies, Implementation and Commissioning,

8.0 Engineering of Sub-transmission and Distribution Sub-stations:

Single feed, dual feed and dual transformer substations, Choosing MV equipment, Choice of MV switchgear panel for a transformer circuit, Choice of MV & LV transformer, Instructions for use of MV equipment, selection of Transformers, CT, PT, Isolators and lightning arresters, Sizing of Cable trays Cable loading, Cable routing, design of Cable trenches in Sub stations, Design of lighting for Sub Stations, Switchyard, Control room & Switchgear Rooms, Design and Engineering of Gas Insulated Substation, Overview of Geographical information systems and Remote Sensing, Global positioning system & applications and Surveying techniques, Data profiles – Analysis, processing and modeling, Time synchronization.

Erection of DP Structures and Distribution Transformers, Distribution control panel, meters, indicators, recorders, relays; Erection, Testing and commissioning of Sub Transmission and Distribution substation equipment, Management of Electrical Contracts, Capacitors – Selection, sizing, optimal location and protection.

9.0 HT & LT Switchgears, Battery, Battery Chargers & DCDB, UPS & UPS Batteries:

Switching devices used in the Substation and switching procedures, Types of

switchgears and Selection of switchgear, Features of circuit breaker, types of quenching medium used in circuit breakers, Air Circuit Breaker, Vacuum C B, SF6 CB, Vacuum Contactors, Metal clad switch gear and arrangement, Maintenance of Switchgear, Sizing and performance of circuit breakers, Testing of circuit breakers, Fuse, Isolator / Disconnectors, MCB, MCCB, ACDB, PDB Soft Starters, DOL Starters , VFD & VVFD drives, starters etc., Types of Batteries, Selection and sizing of Battery Chargers for Sub Stations, UPS system, sizing of UPS Batteries, Selection, Sizing of Dg Set , AMF Panel, Switchgear, etc.

10.0 Metering:

Design and construction of distribution meters, Indian electricity rules of metering; Electro mechanical meter, electronic meters, Static Energy Meters, Smart Meters, Regulations on installation of meters and Technical standards, Metering system in controlling commercial losses, Trouble shooting and Failure analysis of Distribution Meters, Checking accuracy and troubleshooting: Types of metering, viz. DT metering, feeder metering and consumer metering: setting, operation, testing and sealing, detection of theft/ tempering, unauthorized loads, investigation, legal aspects, anti theft measures and case studies, Familiarity with hardware (CMRI) and software for meter data download, Smart Meter & its applications, Role of advanced metering system in controlling commercial losses.

11.0 Power Cables, LT Cables:

Power Cable Design, Construction, Testing, Operation & Maintenance, Trouble shooting of Power Cables, LT and HT Cable jointing, Termination and Accessories, Cable fault detection and repair, Demo on LT & HT Power cable jointing - End joint & Straight through joint

12.0 Engineering of Sub-transmission and Distribution Lines:

Statutory Clearances for Sub Transmission & Distribution, Forest and PTCC clearances, Surveying, Route alignment and profiling of Towers, Modern technology in surveying of Transmission lines, GPS application, Line Components, Bill of Quantities, Types of Poles, foundation, Design and selection aspects of tower / pole structures, Tower types, Classification and selection of towers, Transmission line conductors, insulators and other hardware, Digging holes and pole erection, Fixing of different fittings on poles such as cross arms, insulators, stay wires etc., Erection of Distribution structures, Line Stringing, Sagging, Line construction, Line Reconfiguration, Compact Lines, Aerial Bunched Cable systems, Stringing and sagging overhead line conductors. Jointing overhead line conductors.

13.0 Inspection of Electrical Installations and IE Safety Regulations:

IE Rules and Electrical safety Regulations, Basic principles of safety, importance of safety rules and their observance, List of safety equipment, their use and maintenance, Electrical clearances, Check points in Electrical Inspection and Case studies, Earth Resistance measurement, Soil Resistivity – treatment, Design of Earth Mat, Soil Resistivity Tests, Earthing connections, Definition of standardized earthing schemes, Characteristics of TT, TN and IT systems, Selection criteria for the TT, TN and IT systems, Electric Shocks and First aid, Choice of earthing, method of implementation, Installation, Demo on earthing, Fire Safety & Fire fighting of Electric fires, Emulsifier system, Fire Hydrant system and sizing, Demo on Fire fighting

14.0 Protective Relays:

Relays – Types, construction and characteristics, Location of Protection relays in Substation, Fault interrupting devices and non fault interrupting devices, Instantaneous over current relays, Over current and Earth Fault Protection of distribution equipment, Differential Relays – case studies, Distance Relays,

Buchholtz Relay, Breaker failure Relays, Fuse failure relays, Digital relays – Functional Characteristics & Design Principles, Testing of protective relays, Primary and secondary injection tests on CT's and Relays.

15.0 Sub Transmission and Distribution System Protection:

Overview of Power system Protection, Generator Protection, Transformer Protection, Bus Bar Protection, Transmission Line protection, Distribution Protection, Motor and Pump Protection, Over current Relay Coordination for Radial Distribution system, Over voltage Protection – Over voltage characteristics of atmospheric origin: Over voltage definitions, Over voltage Effects on electrical installations, Characterization of the lightning wave, Principle of lightning protection: General rules of Building protection system, Electrical installation protection system, The Surge Protection Device (SPD), Propagation of a lightning wave, Example of lightning current in TT system, Practical method for determining the smallest allowable cross-sectional area of circuit conductors: General method for cables, Recommended simplified approach for cables, Busbar trunking systems, Short-circuit current supplied by an alternator or an inverter, Radial distribution system fault analysis, Protective earthing conductor, Conductor sizing, Protective conductor between MV/LV transformer and the main general distribution board (MGDB), Equipotential conductor, The neutral conductor, Sizing the neutral conductor, Protection of the neutral conductor, Breaking of the neutral conductor, Isolation of the neutral conductor, Calculation of voltage at different locations under fault conditions, significance of power source impedance on fault current magnitude and terminal voltage, Applications and disadvantages of fuses, application of circuit breaker, Relay Coordination calculations and settings.

16.0 Power System Operation:

Electricity Act 2003, Legal Framework, Policies and Regulations, Indian Electricity Grid Code, Frequency Control – Primary, Secondary, Tertiary Control and RGMO, Reactive Power Management – Basics, Sources and Sinks, Reactive Power Management in Transmission and Distribution, Open access Regulations- Long term access, Medium Term OA and Short Term Open Access, Power exchange Operations.

17.0 Flexible AC Transmission Systems:

Introduction on FACTS, Thyristor Controlled FACTS devices - Static Var Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Reactor (TCR), Phase Shifting Transformer, Voltage Source Converter based FACTS controllers- STATCOM, Static Synchronous Series Compensator(SSSC), Unified Power Flow Controller (UPFC), Interline Power Flow Controller (IPFC), HVDC – Planning, design and construction, HVDC – Operation and maintenance, FACTs and Power Transmission control.

18.0 Grid Integration of Distributed Generation:

Distributed Generation (DG) - Cost of energy and net present value calculations and implications on power converter design, Import/export metering, net metering, generation based incentives, accelerated depreciation, RES Policy Initiatives – AD, FIT, Generation Incentives, Capital subsidy, Distributed Generation-Grid Integration issues, Grid connected wind power plant, power conditioning unit, charge controller, Power quality implication, acceptable ranges of voltage and frequency, flicker, reactive power compensation, active filtering and low voltage ride through, Low frequency ride through requirements & Islanding.

19.0 Energy Storage, Scheduling and Despatch:

Energy Storage technologies- Batteries, Flywheel, Super capacitors, Fuel cells, Compressed air Energy storage, Hybrid Storage – Applications, Scheduling and despatch, Black start of Renewable energy sources, Options for smart grid including solar energy, wind energy, fuel cell, biomass etc., Penetration and variability; Demand Response, Electric vehicles and plug-in hybrid vehicles.

20.0 Distribution Automation, SCADA, EMS, PMU, Wide Area Monitoring:
Customer Site Automation functions: Load control, Remote meter reading, Time-of-use rates, connect/disconnect System level functions: Fault location, isolation, and service restoration; Feeder reconfiguration & Transformer balancing, Distribution system monitoring, Digital protection of substations and feeders, Equipment for Feeder Automation & Customer Automation, Implementing a SCADA Project, Basic principles of RE power plant communications, Nano-grid, Micro-grid, Smart grid, Automatic control systems, Intelligent sensors, Phasor Measurement Units (PMU), Wide Area Monitoring System (WAMS), Static security assessment; State estimation and stability assessment; Reliability assessment, Decision support tools; Advanced optimization and control

21.0 Smart Grids:
Smart Grid – Basic overview – Evaluation of Smart Grid road map in India, on-going Smart Grid activities in India, Smart Grid Distribution network, Policy and Regulation – Requirement of Smart Grid, Smart Grid Benefits - Improved Reliability, Improved Economics, Improved Efficiency, Environmental Improvements, Improvements in Security and Safety.

22.0 Project Management of Sub T&D Systems:
Interface management, programme scheduling, Introduction to Project Management, Supply chain management, cost management, Contractor warranties and guarantees, Quality management, Identifying various construction and execution issues, Installation, Testing and Commissioning of Sub T&D Systems,

23.0 Reliability issues:
Reliability and quality of power supply and reliability indices, Creating customer awareness, Causes and cures for breakdowns, tripping and voltage & frequency fluctuation, Prompt attendance to faults, Overview of the Electricity supply regulations.

24.0 O&M of Sub T&D Systems:
O&M of Power Transformers, O&M of Instrument Transformers: O&M of Circuit Breakers, O&M of HT and LT Switchgear, O&M of Capacitor Banks, O&M of Distribution Transformers, O&M of Sub-station, Transformer oil- Properties, Sampling procedures, Testing and Dissolved Gas Analysis.

25.0 O&M of REPS, Converters, Battery and Control Panel:
Preparation of operation and maintenance manuals, Maintenance and Check list preparation, Identifying the schedule / preventive maintenance, Unscheduled maintenance, performance loss analysis for unscheduled shutdown, Identifying the spares, Performance monitoring, evaluation and optimization, O&M of Batteries, O&M of Control Panels, Failure modes effect criticality analysis (FEMCA): Performance analysis and trouble shooting of RE system, Monitoring of generation per string; Incoming & outgoing power at junction box & Inverter level.

26.0 Service Connections, H R Aspects & CRM:
Service Connections – Bill of quantities, Estimate preparation for service connections, Team Management, Overview of Enterprise Resource Planning, Material Management – Purchase and inventory management, Human Resource Management, Budgeting and Cost Control, Customer Relationship Management,

Customer Mapping, Customer Fault detection and restoration.

27.0 Energy Efficiency and Energy Audit:

Energy Conservation Act-2001- Features, Designated Agencies**,** Role of Regulatory Commissions. Designated Consumers; **Electricity Act 2003,** Schemes of Bureau of Energy Efficiency (BEE)- ECBC, S&L, DSM, BLY, SME's, Integrated Energy Policy, National Action Plan on Climate Change, Energy Management and Audit: Energy audit- Need, Types of energy audit. Energy management, Understanding energy costs, Benchmarking energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments and metering, Manner and intervals of EA regulation, Material And Energy Balance: Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams, Financial Management: Investment - Need, Appraisal and Criteria, Financial analysis techniques - Simple payback period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis, Financing options, Energy performance contracts and role of ESCOs, Tutorials on Financial Management, Electrical System: Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefit, Automatic power factor controllers, Selection and location of capacitors, Performance assessment of PF capacitors – Energy efficiency in electrical equipment, Distribution and transformer losses, Energy efficient transformers, Standards & Labeling (S&L) program of distribution transformers, Loss reduction due to harmonics and voltage unbalance in distribution transformers, Tutorials on Transformers, Electric Motors Types - Squirrel cage and Slip-ring and their characteristics; Losses in induction motors, motor efficiency; Factors affecting motor performance, Rewinding versus replacement of motor, Energy saving opportunities, Motor history sheet, Star operation of motors, Energy efficient motors, Variable speed drives, Soft starters with energy saver, Electrical characteristics. S & L program on energy efficient motors; Tutorials on Electric motors, Energy Efficient Buildings, Energy efficiency in Lighting; Annual Revenue Recovery of a DISCOM

28.0 Demand Side Management:

Demand Side Management – DSM Measures – Demand Response – Financial incentives, DSM- Load Management, Economic response, Peak management, Load reduction, Load shifting, Contractual tools – Ripple control, Call options, Demand exchanges, Spot markets, Smart metering, Regulation, Educating the customer, Financial incentives – Subsidies, Taxes, Renewable Purchase Obligations and Renewable Energy Certificates, Lighting System**:** Light source, T5, T8, T12 Definitions, CFL, LEDs, Metal Halides, Choice of lighting, Luminance requirements, Tutorial on lighting systems, Energy conservation avenues, Electronic ballast, Energy efficient lighting controls, Occupancy sensors, High efficiency street lighting, Labeling scheme, Energy Conversation in Buildings and ECBC: Building envelope, Fenestrations, Insulation, HVAC, Lighting, Water pumping, Inverters and energy storage / captive generation, Elevators and escalators, Star labeling for existing buildings.

29.0 Best Practices in Sub Transmission & Distribution Loss Reduction:

Concept of AT&C Losses, Segregation of losses, Best Practices in Tech loss reduction, High Voltage Distribution System, Best Practices in commercial loss reduction, Detection of thefts, tampering, unauthorized loads, Anti-theft measures and case studies, Commercial loss reduction measures and Penalties under the act

for theft and misuse of power, Case studies.

30.0 General Principles of Live Line Maintenance Techniques (LLMT):

Introduction to Hot Line Operations, Theory on Hot Line Maintenance/ Tools History, Theory on wooden Tools / Epoxy glass tools, Theory on Transmission line / Earthing system, Theory on Ropes & knots, Practice on Knot making & knot Practice, Theory on Insulator & Conductor Binding, Demo/ practice on Binding, Theory on Electrical Hot Line Safety, Theory on Insulators, Theory on Maintenance of Hot Line Tools, Theory on Tower Structures, Practice of Pole saddle fitting / Conductor Guard Fitting, Theory on Mechanical Maintenance, Practice of Grip all Stick Operation, Theory on Repair, Restoring of Hot Line tools, Practical Demo on Maintenance of Hot Line Tools,

31.0 Demo of LLMT on 11 kV and 33 kV systems:

Demonstration on 11 kV Operation, Pole climbing Practice, Demonstration and practice on 11 KV Lever Lift Method, 11 KV Wire Tong method, 11 KV Side Arm method, 11 kV Dead End Operation.

Demonstration and practice on 33 kV Straight Lift method, 33 kV Dead End Operation.

Punctured Insulator detection- Live Line Insulator Testing on 66 kV line using Islo Meter, 220 kV Line Insulator Testing using PID Kit, Down Loading of result/ Analysis of Data.

Who may attend
Fresh graduates or sponsored engineers of Electrical / Electrical & Electronics / Power engineering.
Methodology
Lectures, Demonstrations, Lab sessions, Field visits
Program Dates
From 05/10/15 to 01/10/2016

Short Term Courses:

Smart Grids
Objective
To Provide comprehensive view of Distribution metering
Outline
• Smart Grid: goals, history, scale and scope, Functions of smart grid, • Features of Smart Grid, • Demand response support, • Net metering and grid connectivity for renewables, • Role of smart grid in integration of renewable energy and DSM • Protection issues and relay coordination problems, • Micro – grid / protection strategies for micro grid, • Low voltage ride through (LVRT) implementation issues, • Grid operation and balancing of renewable energy power sector, • Interconnection standards of distributed generation, • Power quality (PQ) issues and remedial measure, • Case studies & Field visits
Who may attend
Engineers from State Electricity Boards/ Power utilities/Distribution Systems, R & D organisations, Academic institutions, manufacturers, contractors, consultants etc.
Methodology
Lectures, field visits, lab sessions
Dates
4-7/4/16

Substation Planning & Engineering

Objective

To familiarize participants with the planning, layout, design & engineering of Substation and selection of Substation equipment.

Outline

- Planning of Substation & Preparation of Project Report
- Layout of Substation, Choice of Switching Schemes and Bus Bar /Bay Design
- Selection of Substation Main Equipment
- Design considerations of Substation equipment and Earthing
- Cost estimates of Sub-Station and case studies
- Electrical Clearances and pre-commissioning inspection
- Over Voltages & Selection of Surge Arrestors
- Engineering of Protection System for Substation
- Measurement of Soil Resistivity
- Metering in Substation
- Substation Automation
- Field visits
- Case studies.

Who may attend

Engineers from State Electricity Boards, Power Utilities/Corporations, R & D organisations, Academic institutions

Methodology

Lectures, Demonstrations, Video sessions, Technical visits, Group discussions

Dates

11-15/4/16, 2-6/1/17

Power System Communications, SCADA & EMS
Objective
To familiarise power engineers with the architecture, functions and advantages of SCADA & EMS
Outline
• Data Acquisition System • Supervisory Control • Communications – VSAT, Microwave, Optical fibre • Communication networks & Protocols • SCADA in Transmission and Distribution • EMS Hardware: SCADA, control centre. • EMS Software: SCADA & Database • EMS Software: Generation applications • EMS Software: Network applications • Field Visits
Who may attend
Engineers from State Electricity Boards, Power Utilities/Corporations, R & D organisations and Academic institutions
Methodology
Lectures, DTS Lab Sessions, Field visits
Dates
25-29/4/16

Power System Operation

Objective

To familiarise the Load Despatch engineers to sector set up, system control, market operations, logistics and new technologies. To develop the system operators for secure operation of Power System in India in the scenario of continuous load growth, system expansion and multiplying number of organisations.

Outline

- **Power Sector Overview, Policy, Legal framework**
  Power sector overview in India, Hydro station layout, startup, shutdown and emergency response, Electricity Act 2003, Legal Framework, policies & regulations and organizational set up in India, EHV AC Substations: Layout, Equipment & Bus arrangements, Gas Insulated Sub-Station, Ring Fencing of System Operation & Independent functioning of Load Despatch Centers, Thermal station Layout, startup, shut down and emergency response. New technologies, Smart Grid Operations- Prevailing practices and future roadmap, CEA Grid connectivity standards, Grid Standards, Regulations, Metering Standards.
- **Power System Operation and Control,**
  Frequency control-Primary, Secondary and Tertiary Control and RGMO; Reactive power management, Indian Electricity Grid Code, Protection of Generators and transformers, Protection of Bus Bars and Distribution Systems, Impedance protection-fault loops, impedance relay characteristics, reactance, impedance, admittance (MHO), quadrilateral, special characteristics, faults affecting impedance relay performance, Fault resistance, load encroachment, remote in feed, mutual induction; System protection schemes, Protection for abnormal frequency and voltages.
- **Power Market Operation,**
  Power system reliability, TTC / ATC Computations and Ancillary Services in Indian Electricity Market, POC Tariff Philosophy and Transmission Losses, Open Access Regulations and Long Term & Medium Term Access and connectivity with Regional and States Perspectives, Metering and settlement principles, Power Exchange Operations, Regional energy, UI and reactive energy account, Terms and condition of Tariff Regulations, Renewable energy in Power Sector, Integration of Renewables, REC Mechanism & RRF,
- **Power System Logistics-SCADA, Communications & IT, Energy Management System**
  State estimation techniques**,** Energy Management Systems: Load Forecasting and Network Study, UI and Congestion Charge Regulations, SCADA/ EMS- Overview, Architecture, Main Components; Communication Systems- Overview, VSAT, Microwave, Optical Fibre etc., Hardware Protocols, Configuration, Communication network, System software – Displays, Database; Disturbance data collection modules / HDR retrieval & playback, HIM, Trends, Alarms, Health check, trouble shooting;
- **Labs & Assessments-** DTS Lab, Relay Testing Lab,
- **Technical Visits-** Visit to SRLDC

Who may attend

System operation Engineers from State Electricity utilities / Distribution Systems, R & D organisations, Academic institutions, etc.

Methodology

Lectures, demo sessions, field visits

Dates

2-14/5/16, 1-13/8/16, 21/11-3/12/16, 13-25/2/17

Electrical Safety and Inspection of Electrical Installations under IE Rules
Objective
To familiarise about the mandatory procedures before energising any electrical equipment from LV to EHV level by consumers / suppliers and the role of electrical inspectors in enforcing IE Rules 1956.
Outline
• Overview & Safety Requirements of IE Rules • Design of Electrical Installations • Earthing System Design • Circuit Breakers and Protective Relays • Basic Protection schemes of power equipment • Inspection procedures for statutory inspection by Electrical Inspectors • Check points in Electrical Inspection • Pre-commissioning tests of Transformers, Switchgears and Power Cables • First Aid and Fire Fighting Practices in Industrial Installations / Substations • Field Visits
Who may attend
Industrial / other consumers of electricity, electrical inspectors/assisting officers, utility representatives, manufacturers/dealers of electrical equipment/power cables/LT/HT switchgear
Methodology
Lectures, field visits, lab sessions
Dates
9-13/5/16, 27/2-3/3/17

Power Quality and Harmonics Mitigation and Reactive Power Management

Objectives

To familiarise the power engineer regarding the power quality and causes, consequences and cures to harmonics in electrical systems/industry.

Outline

- Introduction to power quality
- Power Quality – impacts, manifestations
- Consequences of power quality
- Power quality measurement
- Harmonics – sources, measurements and mitigation
- Filters – Active and passive filters, selection of filters
- Statcoms, custom power devices, Static Var Compensators
- Reactive Power Control Equipment
- Performance of Reactive Power Equipment under different Operating Conditions
- Comparative Study of AVRs, OLTCs, Power Capacitors, Shunt Reactors, SVCs, TCRs, Statcoms etc, in reactive power management.
- Automatic Power factor controllers
- Harmonics – causes, measurement and mitigation
- Thyristor based and voltage source converter based FACTS Controllers
- Case Studies
- Technical Visits

Who may attend

The practicing engineers/supervisors of industry, utilities and faculty of educational institutions involved in maintenance of power quality and mitigation of harmonics

Methodology

Lectures, tutorials, video sessions , lab sessions, case studies, Field Visits

Dates

16-20/5/16, 6-10/3/17

Distribution Metering, Smart meters and Demand Side Management
Objective
To Provide comprehensive view of Distribution metering
Outline
• National and International specifications on smart meters and energy meters • Smart meters issues & concerns • Standardization of smart meters, interoperability, testing methods and special purpose energy metering. • Reliability analysis of smart electronic meters • New technology platform- Zig bee in smart metering • Advanced metering infrastructure • Role of smart meters in the power sector-development ,Technology challenges and Way forward • Role of new generation energy meters technology in arresting Theft/Tampering • Smart meters in Demand side management • Field visits
Who may attend
Engineers from State Electricity Boards/ Power utilities/Distribution Systems, R & D organisations, Academic institutions, manufacturers, contractors, consultants etc.
Methodology
Lectures, field visits, lab sessions
Dates
23-27/5/16

Power Cables and jointing techniques
Context & Objectives
To familiarize the power engineers on the mechanical considerations in the design of cables, applications, current carrying capacity, insulation strength and electrical properties of cables.
Outline
• Design & construction of Power Cables • Testing of cables • Testing of cable accessories • Demo on Cable Jointing • Failure of cables and case studies • Condition monitoring of power cables • Power cable jointing techniques • Field Visits
Who may attend
Engineers from State Electricity Boards, Power Utilities/Corporations, R & D organisations, Academic institutions, power consumers, consultants/contractors etc.
Methodology
Lectures, demonstrations, field visits
Dates
1-3/6/16, 14-16/12/16

O & M of Transformers and Circuit Breakers

Objective

To give insight into various aspects on operation, maintenance, testing and condition monitoring of Transformers and Circuit Breakers

Outline

- Transformers-Construction, connections,
- Tap Changing Mechanism & Parallel Operation,
- Selection and sizing of Transformer, Transformer Neutral Earthing and Substation
- Earthing Practices,
- Testing of Transformers,
- Condition Monitoring of Transformers,
- Protection of Transformers,
- Maintenance of Transformers,
- Application and Design of Air and Gas Insulated Circuit Breakers,
- Selection, Sizing, Performance Analysis of Circuit Breakers,
- O&M of Circuit Breakers,
- Testing and Condition Monitoring of Circuit Breakers,
- Testing of Circuit Breakers
- Field visits

Who may attend

Engineers from State Electricity Boards, Power Utilities/Corporations, R & D organisations, Academic institutions

Methodology

Lecture, Video Sessions, Lab Sessions, Demonstrations, Field visits, Group Discussions

Dates

6-10/6/16, 6-10/2/17

Power System Protection

Objective

To familiarise the power engineers with protection in power systems

Outline

- Fault analysis
- Relay input sources
- Protection of Generators & motors
- Protection of bus bars
- Protection of Transformers
- Protection of EHV lines
- Protection of Distribution systems
- Protection against over voltages
- Insulation co-ordination
- Testing of Surge Arrestors
- Testing & commissioning of relays
- Integrated Protection, Control & Monitoring
- Intelligent Electronic Devices in system protection
- Software Architecture and performance characteristics of numerical relays
- Wide Area Protection
- Present trends in protection
- Case studies
- Laboratory sessions
- Tutorials
- Field visits

Who may attend

Engineers from State Electricity Boards, Power Utilities/Corporations, R & D organisations, Academic institutions

Methodology

Lecture, Demonstrations, Tutorials, Laboratory work, Field visits, Video sessions, Group Discussions

Dates

13-24/6/16, 13-24/3/17

Advanced Power System Protection
Objective
To familiarise the power engineers on the advanced aspects of protection in power systems
Outline
• Overview of System Protection • Numerical Relays • Protection of Transformers, Transmission lines, Bus bars, Feeders. • Integrated Protection, Control & Monitoring • Intelligent Electronic Devices in system protection • Software Architecture and performance characteristics of numerical relays • Wide Area Protection • Video Sessions • Field Visits
Who may attend
Engineers from State Electricity Boards, Power Utilities/Corporations, R & D organisations, Academic institutions
Methodology
Lectures, Video sessions, Lab sessions, technical visits
Dates
20-24/6/16, 20-24/3/17

Renewable Energy Sources & Grid Integration
Objective
To investigate the impact of Renewable Energy Sources & their integration with the grid.
Outline
• **Overview of power scenario and importance of renewable energy,** • **solar energy,** • **wind energy,** • **bio-mass energy,** • **Net metering and grid connectivity for renewables** • **Role of smart grid in integration of renewable energy and DSM** • **Renewable purchase obligations** • **Renewable Energy Certificates** • **Tariff regulations related to Renewable Energy** • **Renewable Energy power evacuation issues** • **Grid operation and balancing of renewable energy power** • **Interconnection standards of distributed generation** • **field visits**
Who may attend
Engineers from State Electricity Boards, Power Utilities/Corporations, R & D organisations, involved in implementation of renewable energy sources and their integration
Methodology
Lectures, Tutorials and Technical visits
Dates
27/6-2/7/16, 3-7/10/16, 13-18/3/17

Power System Reliability

Objective

Ensuring reliable and secure power system is the primary responsibility of every system operator. Recent grid incidents of July 2012 have underlined the importance of grid security. As the grid grows in size and complexity, grid security has to be enhanced because the consequences of failure of a large grid are severe.

Therefore Capacity Building in Reliability is essential for all personnel in the Power Sector. This is recognized as the next step forward in the continued Capability Enhancement of System Operators and an area of specific specialization. Hence, a Specialist Learning and Development Programme and Certification Exam has been planned on "Power System Reliability". This is a specialist level system operator course on "Power System Reliability" for basic level certified system operators having a minimum of 10 years experience in power sector.

Outline

- Module 1: Basics of Power System
  - Basic Concepts
  - EHV AC Transmission and HVDC Transmission
  - Power System Planning

- Module 2: Power System Operation and Control
  - System Operation Concepts
  - Load Frequency Control
  - Voltage Control
  - Power System Restoration
  - FACTS and Power Transmission Comtrol

- Module 3: Power System Analysis
  - Steady State Power Flow Analysis
  - Fault Analysis
  - Power System Stability
  - Power System Protection

Who may attend

Middle level engineers from State Electricity Boards, Power Utilities/Corporations, R&D Organisations, Academic Institutions etc.

Methodology

Lectures, Video sessions, laboratory/simulation studies, DTS Lab Sessions, Field visits

Dates

11-16/7/16

Dispatcher Training Simulator

Objectives

To practise the Normal and Emergency Operation and Power Systems, Active and Reactive Power Control and Advanced Applications using Dispatcher Training Simulator (DTS)

Outline

- Dispatcher Training Simulator overview
- Active and Reactive Power Control
- Indian National Network including HVDC lines
- Prime mover dynamics (Hydro, Steam, Gas and Pumped storage units)
- Load shedding schemes
- Islanding Schemes
- SCADA Operation
- Automatic Generation Control
- Islanding and Integrated Operation
- System Occurrence and Restoration
- System Stability
- Voltage control & Voltage Collapse Simulation
- Prevention of Grid Disturbance

Who may attend

Persons involved in System Operation and Control, i.e. Generating Station, Transmission, Load Dispatch Centre, Substation and Distribution Personnel.

Methodology

Lectures, Video session, Hands on and demo sessions on simulator and case studies

Dates

18-29/7/16, 21/11-2/12/16, 9-20/1/17

Flexible AC Transmission Systems (FACTS)
Objective
To familiarize power engineers about the Flexible AC Transmission devices and their applications in power systems with respect to active/reactive power control.
Outline
• Introduction • Thyristor Controlled FACTS devices - Static Var Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Reactor (TCR) • Phase Shifting Transformer • Voltage Source Converter based FACTS controllers- STATCOM, Static Synchronous Series Compensator(SSSC), Unified Power Flow Controller (UPFC) • HVDC • Applications of FACTS • Tutorials • Technical Visits
Who may attend
Practicing engineers involved in planning, design and implementation of FACTS devices.
Methodology
Lectures, Lab sessions and Technical visits
Dates
25-29/7/16

Distribution Automation
Objectives
Familiarize participants with the Customer and System level functions that are associated with distribution automation. Describe the equipment and software used to implement these functions.
Outline
• Customer Site Automation functions: Load control, • Remote meter reading, Time-of-use rates, • Remote connect/disconnect, • System level functions; Fault location, isolation, and service restoration; • Design of LT Distribution Systems, • Feeder reconfiguration & Transformer balancing; • Voltage/Var control using: Capacitors, Regulators, and LTC; Distribution system monitoring, • Digital protection of substations and feeders, • Equipment for Feeder Automation & Customer Automation, • Implementing a DA Project, • Labs & Field Visits
Who may attend
Engineers and Managers responsible for planning, cost-justifying, designing, implementing and working with Distribution Automation systems
Methodology
Lectures, Lab Sessions, Group discussions and Field Visits
Dates
8-12/8/16

Low Voltage Power Distribution System Design
Objective
To familiarise the participants from the low voltage power distribution system design including selection and sizing of cables, switchgear, control panels and safety requirements
Outline
• **General Rules of Electrical Installation and Design,** • **LV Distribution and Earthing schemes,** • **Protection against electric shocks,** • **Cables, Bus ways & Switchboards,** • **LV Switchgear: functions & selection, Understanding the wiring system and Cable sizing,** • **Understanding MV/LV installation design by ID Spec Large software & Understanding the LV installation calculation by My Ecodial L Software,** • **Distribution System Earthing, Electrical safety and accident prevention techniques,** • **LV Distribution system protection & Technical Visits.**
Who may attend
The medium voltage and low voltage distribution engineers working in utilities and industries and responsible for design installation testing and maintenance of distribution systems
Methodology
Lectures, Lab sessions and Technical visits
Dates
22-26/8/16

Regulatory Framework in Power Sector
Objective
To familiarise the participants from the low voltage power distribution system design including selection and sizing of cables, switchgear, control panels and safety requirements
Outline
• **CEA Regulations-connectivity, metering, construction of electrical plant and electrical lines, Implementation of case I & case II bid route projects for generation capacity addition, drafting petitions and case studies** • **Electricity Act 2003** • **Legal framework, electricity policy and tariff policy** • **Indian Electricity Grid Code Regulations & Grid Standards Regulations – 2010** • **Energy conservation act – 2001** • **Sharing of Inter State Transmission Charges and Losses Regulations – 2010(Technical & Commercial Aspects)** • **Grant of Regulatory Approval for execution of Inter State Transmission Scheme to Central Transmission Utility Regulations 2010** • **Procedure, Terms and Conditions for grant of Transmission License and other related matters** • **Deviation settlement mechanism – Regulations 2014** • **Measures to relieve congestion in real time operation – Regulations 2014** • **Regulations of power supply** • **Terms and conditions of tariff regulations for 2014-19** • **Connectivity, LTA & MTOA – Regulations** • **Short term open access – Regulations** • **Terms and conditions for recognition and issuance of REC for Renewable Energy Generation Regulations – 2015** • **Renewable energy scheduling, despatch & deviation settlement – Regulations 2015**
Who may attend
The medium voltage and low voltage distribution engineers working in utilities and industries and responsible for design installation testing and maintenance of distribution systems
Methodology
Lectures, Lab sessions and Technical visits
Dates
19-23/12/16

Power System Studies
Objective
To familiarise the power system engineers with modelling of power system components and the power system studies software for power flow studies, short circuit studies, stability studies and relay coordination
Outline
• **Load flow: Modelling and case studies** • **Short circuit studies; Z bus matrix and symmetrical components** • **Balanced and unbalanced faults and case studies** • **Over current relay coordination- case studies** • **Distant relay coordination - case studies** • **Stability studies – modelling, case studies** • **Laboratory: use of MiPower / Neplan software** • **Field visits**
Who may attend
Transmission and distribution engineers involved in system design, planning, protection and control, and engineers from R & D organisations, Academic institutions
Methodology
Lectures, Video sessions, laboratory/simulation studies, field visits
Dates
6-9/9/16

Management of Electrical Contracts
Context and Objective
To familiarize the young engineers with the nuances of the electrical industry and the contracts involved
Outline
• **Types of Contracts.** • **General & Special Conditions of Contract** • **Erection Conditions of Contracts.** • **Project Management & Execution.** • **Measurement of work completion, Invoicing & Billing.** • **Market survey of electrical equipments.** • **Estimation & bidding for electrical works.** • **Electricity: Generation, transmission & distribution.** • **Principle of operation of electrical equipment.** • **Codes & practices in electrical system.** • **Indian Electricity act, IEEE codes & ISO standards.** • **Design of electrical lay outs.** • **Installation of electrical equipments.** • **Procedure for Availing electrical supply from Electric Supply Company.** • **Statuary requirements from Electrical Inspectorate to carryout business.** • **Labour act, Workmen compensation acts, Insurance & Provident Fund.** • **Fire Fighting & Requirement of Fire Extinguishers.** • **First aid & Artificial Respiration.**
Who may attend
Electrical graduates fresh as well as practising who require exposure regarding electrical industry and contracts, in particular in distribution system
Methodology
Lectures, Video sessions, Technical visits, Group discussions
Dates
13-16/9/16

Power System Logistics
Context and Objective
To familiarize the young engineers with the nuances of the electrical industry and the contracts involved
Outline
▪ Communication – VSAT, Microwave**,** ▪ **Net work communication protocols,** ▪ **Data Acquisition systems,** ▪ **Supervisory controls in power systems** ▪ **Sub – station Automation** ▪ **Distribution SCADA** ▪ **DISTRIBUTION AUTOMATION** ▪ **Automation in distribution management** ▪ Control centre hard ware ▪ SCADA/ EMS- software ▪ Control centre data base management ▪ EMS Software – Generation applications, ▪ Visit to LDC/ Subsation ▪ EMS Software – Net working applications ▪ Test
Who may attend
Electrical graduates fresh as well as practising who require exposure regarding electrical industry and contracts, in particular in distribution system
Methodology
Lectures, Video sessions, Technical visits, Group discussions
Dates
19-24/9/16

High Voltage Testing of Power System Equipment
Objective
To give insight into all aspects of High Voltage Testing of Power system equipment
Outline
• **High voltage technology** • **Solid insulating media, liquid insulation media** • **Gas & Vacuum Insulation** • **Generation of high voltages for testing** • **High voltage measurements** • **High voltage testing of transformers** • **Testing of Circuit Breakers** • **Testing of Surge Arrestors** • **Testing of Insulators, Cables, Capacitors** • **High Power Testing of switchgear** • **Partial Discharges** • **Field visits**
Who may attend
Engineers involved in procurement, installation and testing of power system equipment.
Methodology
Lecture, Demonstrations, Lab Sessions, Field visits, Group Discussion
Dates
26-30/9/16, 20-24/2/17

HVDC Transmission Systems
Objective
To familiarize the engineers with the HVDC technology and its importance in system operation
Outline
• **Introduction to HVDC** • **Principles of HVDC Conversion** • **HVDC Lines** • **HVDC Sub Stations** • **Reactive Power Management in HVDC Stations** • **AC & DC harmonics and filtering** • **HVDC System operation, control and maintenance** • **HVDC Protection, Insulation Co-ordination, Emergencies and case studies** • **Field visits**
Who may attend
Practising Engineers from Generation, Transmission, Distribution Systems, Industrial and other consumers of electricity, Electrical Inspectors and Electrical Consultants.
Methodology
Lectures, Video Sessions, Lab sessions and Technical Visit to HVDC Station
Dates
24-28/10/16

Energy Efficiency in Electrical Utilities
Objective
To familiarize the engineers with the energy efficiency opportunities available in the various electrical equipments and to help them to prepare better for the BEE certified Energy Manager Exam
Outline
• **General Introduction – Electrical systems,** • **Power quality, Harmonics – Manifestation measurement, mitigation** • **Electric Motor,** • **Compressed Air System,** • **HVAC & Refrigeration System,** • **Fans & Blowers,** • **Pumps & Pumping System,** • **Cooling Tower, Lighting System, Diesel Generating System,** • **Energy Efficient Technologies in Electrical Systems,** • **Tutorials, case studies, labs and Technical Visits –** **This complies with the syllabus of BEE's Energy manager – Paper III**
Who may attend
Engineers from SEBs, power utilities/corporations, PSUs, R&D Organisations, Academic Institutions, entrepreneurs and consultants involved in energy audit and energy conservation projects.
Methodology
Lectures, Tutorials, Lab sessions and Technical visits
Dates
7-11/11/16

O&M of Power & Distribution Transformers
Objectives
To discuss maintenance aspects of Power and Distribution Transformers
Outline
• **State of the art of Transformer** • **Tests to check the adequacy of Transformers** • **Insulation Co-ordination of Transformers** • **Earthing, Loading, Maintenance & Protection of Transformers** • **Failure, Failure Analysis & Condition Monitoring of Transformers** • **Condition Monitoring of Transformer Oil** • **Diagnostic Monitoring by DGA with case histories** • **RLA of Paper Insulation by Furan Analysis** • **Field Visits**
Who may attend
Engineers involved in the operation, Maintenance and Testing of Transformer from State Electricity Boards, Power Utilities, R&D Organisations, Academic Institutions, Transformer manufacturers, Transformer Oil Processors and Servicing Organisations.
Methodology
Lectures, Field Visits, Lab sessions, Tutorials
Dates
26-30/12/16

Reactive Power Management
Objectives
To familiarize the engineers with the design and performance aspects of power system elements so as to have an understanding of reactive power management and control.
Outline
• **Reactive Power Control Equipment** • **Performance of Reactive Power Equipment under different Operating Conditions** • **Comparative Study of AVRs, OLTCs, Power Capacitors, Shunt Reactors, SVCs, TCRs, Statcoms etc, in reactive power management.** • **Automatic Power factor controllers** • **Harmonics – causes, measurement and mitigation** • **Thyristor based and voltage source converter based FACTS Controllers**
Who may attend
Transmission and Distribution Operating Personnel, Engineers involved in Planning, Design and Testing of Power Control Equipment and Engineers in-charge of electrical maintenance.
Methodology
Lectures, DTS Lab session, Video sessions, Technical visits
Dates
23-25/1/17

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