JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV- II Sem.	**Th**	**Tu**	**C**
	3	**1**	**3**

(13A02801) POWER QUALITY

Course Objective:
This course mainly focuses on the various power quality issues, monitoring and the enhancement of the power quality.

UNIT I
INTRODUCTION
Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues- Magnitude Versus Duration Plot - Power Quality Standards - Responsibilities of The Suppliers and Users of Electric Power-CBEMA and ITIC Curves.

UNIT II
TRANSIENTS, SHORT DUARION AND LONG DURATION VARIATIONS
Categories and Characteristics of Electromagnetic Phenomena in Power Systems-Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption - Under Voltage – Over Voltage– Outage. Sources of Different Power Quality Disturbances- Principles of Regulating the Voltage- Conventional Devices for Voltage Regulation.

UNIT III
FUNDAMENTALS OF HARMONICS & APPLIED HARMONICS
Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Qualities Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources From Commercial Loads, Harmonic Sources From Industrial Loads. Applied Harmonics**:** Effects Of Harmonics, Harmonic Distortion Evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion.

UNIT IV
POWER QUALITY MONITORING
Power Quality Benchmarking-Monitoring Considerations- Choosing Monitoring Locations- Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments- Power Quality Measurement Equipment-Types of Instruments- Assessment of Power Quality Measurement Data- Power Quality Monitoring Standards.

UNIT V
POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES
Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL) -Solid State Breaker (SSB) -Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner(UPQC)-Principle of Operation Only.

Text Books:

1. *Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd., 2008.*
2. *Power quality by C. Sankaran, CRC Press, 2002.*

Reference Books:

1. *Understanding Power quality problems by Math H. J. Bollen IEEE Press, 2007.*
2. *Power quality enhancement using custom power devices by Arindam Ghosh,Gerard Ledwich,Kluwer academic publishers, 2002.*

B.Tech. IV-II Sem.	Th	Tu	C
	3	1	3

(13A02802) UTILIZATION OF ELECTRICAL ENERGY

Course Objective:

This course deals with the various utilization aspects like illumination, Electrical heating, Welding, Electrolytic Process and Electric Traction.

UNIT I

ILLUMINATION

Definition –Laws of Illumination–Polar Curves – Calculation of MHCP and MSCP. Lamps: Incandescent Lamp, Sodium Vapour Lamp, Fluorescent Lamp. Requirement of Good Lighting Scheme – Types, Design and Calculation of Illumination. Street Lighting and Factory Lighting – Numerical Problems.

UNIT II

ELECTRIC HEATING & WELDING

Electrical Heating: Advantages. Methods of Electric Heating – Resistance, Arc, Induction and Dielectric Heating.

Electric Welding: Types – Resistance, Electric Arc, Gas Welding. Ultrasonic, Welding Electrodes of Various Metals, Defects in Welding.

Electrolysis - Faraday's Laws, Applications of Electrolysis, Power Supply for Electrolysis.

UNIT III

ELECTRIC TRACTION – I

Introduction – Systems of Electric Traction. Comparison Between A. C And D. C Traction – Special Features of Traction Motors - The Locomotive – Wheel arrangement and Riding Qualities – Transmission of Drive – Characteristics and Control of Locomotives and Motor Coaches for Track Electrification – DC Equipment – AC Equipment – Electric Breaking with DC Motors and with AC Motors – Control Gear – Auxiliary Equipment – Track Equipment and Collector Gear – Conductor-Rail Equipment – Overhead Equipment – Calculation of Sags and Tensions – Collector Gear for Overhead Equipment.

UNIT IV

ELECTRIC TRACTION - II

Mechanics of Train Movement. Speed-Time Curves of Different Services – Trapezoidal and Quadrilateral, Speed-Time Curves – Numerical Problems. Calculations of Tractive Effort, Power, Specific Energy Consumption - Effect of Varying Acceleration and Braking Retardation, Adhesive Weight and Coefficient of Adhesion – Problems.

UNIT V

ECONOMIC ASPECTS OF UTILISING ELECTRICAL ENERGY

Power Factor Improvement, Improvement of Load Factor, Off Peak Loads- Use of Exhaust Steam, Waste Heat Stations, Pit Head Generation, Diesel Plant, General Comparison of Private Plant and Public Supply- Initial Cost and Efficiency, Capitalization of Losses, Choice of Voltage, Cost of Renewals.

Text Books:

1. *Utilization of Electric Energy – by E. Openshaw Taylor and V. V. L. Rao, Universities Press., 2009.*
2. *Art & Science of Utilization of electrical Energy – by Partab, Dhanpat Rai & Co., 2004.*

Reference Books:

1. *Generation, distribution and utilization of electrical energy by C.L Wadhwa, Wiley Eastern Limited,1993*
2. *"Electrical Power", by S. L. Uppal, Khanna pulishers,1988.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.	**Th**	**Tu**	**C**
	3	**1**	**3**

(13A02803) MODERN CONTROL THEORY
(ELECTIVE – III)

Course Objective:
This subject deals with state space, describing function, phase plane and stability analysis including controllability and observability. It also deals with modern control and optimal control systems.

UNIT I
CONTROLLABILITY AND OBSERVABILITY
Review of State Space Analysis, Tests for Controllability and Observability for Continuous Time Systems – Principle of Duality, Controllability and Observability of State Models in Jordan Canonical Form and Other Canonical Forms. Effect of State Feedback on Controllability and Observability.

UNIT II
ANALYSIS OF NONLINEAR SYSTEMS
Introduction to Nonlinear Systems, Types of Nonlinearities, Concepts of Describing Functions, Derivation of Describing Functions for Dead Zone, Saturation, Backlash, Relay With Dead Zone and Hysteresis - Jump Resonance. Introduction to Phase-Plane Analysis, Method of Isoclines for Constructing Trajectories, Singular Points, Phase-Plane Analysis of Nonlinear Control Systems.

UNIT III
STABILITY ANALYSIS
Stability in the Sense of Lyapunov. Lyapunov's Stability and Lypanov's Instability Theorems. Direct Method of Lypanov for the Linear and Nonlinear Continuous Time Autonomous Systems.

UNIT IV
CONTROLLERS AND OBSERVERS DESIGN
Design of State Feedback Control Through Pole Placement. Full Order Observer and Reduced Order Observer. State Estimation Through Kalman Filters.

UNIT V
OPTIMAL CONTROL
Introduction to Optimal Control, Formulation of Optimal Control Problems, Calculus of Variations, Minimization of Functionals of Single Function, Euler Lagrange Equation, Constrained Minimization, Minimum Principle, Control Variable Inequality Constraints, Control and State Variable Inequality Constraints.

Text Books:

1. *Modern Control System Theory – by M. Gopal, New Age International Publishers, 2nd edition, 1996.*
2. *Systems and Control by Stainslaw H. Zak , Oxford Press, 2003.*

Reference Books:

1. *Modern Control Engineering – by K. Ogata, Prentice Hall of India, 3rd edition, 1998.*
2. *Control Systems Engineering by I.J. Nagrath and M.Gopal, New Age International (P) Ltd. 2007.*
3. *Digital Control and State Variable Methods – by M. Gopal, Tata Mc Graw-Hill Companies, 1997.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.	**Th**	**Tu**	**C**
	3	**1**	**3**

(13A02804) SPECIAL ELECTRO MECHANICAL SYSTEMS
(Elective –III)

Course Objective:
This subject gives an extension of electrical machines which are already learned in the previous courses. It mainly concentrate on constructional details and principle of operation of special machines for various domestic and industrial applications which are widely used in the present days.

UNIT I
SPECIAL TYPES OF D. C. MACHINES
Series Booster – Shunt Booster – Non – Reversible Booster – Reversible Booster- Armature Excited Machines – Rosenberg Generator – The Amplidyne and Metadyne - Rototrol and Regulex– Third Brush Generator – Three – Wire Generator - Dynamometer.

UNIT II
STEPPER MOTORS
Constructional Features – Principle of Operation – Variable Reluctance Motor – Hybrid Motor – Single And Multi Stack Configurations – Torque Equations – Very Slow-Speed Synchronous Motor for Servo Control – Modes of Excitations – Characteristics – Drive Circuits – Microprocessor Control of Stepping Motors – An Open Loop And Closed – Loop Control of Step Motor - Application of Stepping Motors-5– Phase Hybrid Stepping Motor – Single – Phase Stepping Motor, The Construction, Operating

UNIT III
SWITCHED RELUCTANCE MOTORS
Constructional Features – Rotary And Linear SRMs - Principle of Operation – Torque Production – Differences Between SR and Conventional Reluctance Motors - Steady State Performance Prediction-Analytical Method - Design of Stator and Rotor and Pole Arcs in SR Motor, Determination Of L(Θ) – Θ Profile – Power Converters and Their Controllers – Methods of Rotor Position Sensing – Sensor Less Operation – Closed Loop Control of SRM - Characteristics

UNIT IV
BRUSHLESS DC MOTOR
Types of Construction – Principle of Operation of BLDM – Sensing and Switching Logic Scheme, Sensing, Logic Controller, Lockout Pulses – Power Converter Circuit – Theoretical Analysis and Performance Prediction, Modeling and Magnet Circuit, D-Q Analysis of BLDM – Transient Analysis – Formulation in Terms of Flux Linkages As State Variables – Approximate Solutions for Current and Torque Under Steady State – Theory of BLDM As Variable Speed Synchronous Motor (Assuming Sinusoidal Flux Distribution) – Methods of Reducing Torque Pulsations, 180^0 Pole Arc and 120^0 Current Sheet.

UNIT V
PERMANENT MAGNET MATERIALS & LINEAR INDUCTION MOTOR
Introduction, Hysteresis Loops and Recoil Line – Stator Frames (Pole – And Yoke – Part) of Conventional PM DC Motors, Equivalent Circuit of a PM – Development of Electronically Commutated DC Motor From Conventional DC Motor . Development of a Double Sided LIM From Rotary Type IM – A Schematic of LIM Drive for Electric Traction – Development of One Sided LIM With Back Iron – Field Analysis of a DSLIM: Fundamental Assumptions.

Text Books:

1. *K. Venkataratnam, Special Electrical Machines, University Press, 2009.*

Reference Books:

1. *R. K. Rajput, Electrical machines, 4th Edition, Laxmi Publications, 2010. [For Chapters I and II refer Chapter VIII of this book]*
2. *V. V. Athani, Stepper Motors: Fundamentals, Applications and Design, New Age International Pub., 1997.*
3. *N. Mohan, Undeland & Robbins, Power Electronics - Converters, Applications & Design, Wiley India, Student Edition., 2002.*
4. *Johan E. Gibson and F. B. Teuter, Control System Components, Mc Graw Hill Edition.*
5. *M. G. Say & E. O. Taylor, D. C. Machines, 2nd Edition, ELBS., 1986.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.	**Th**	**Tu**	**C**
	3	**1**	**3**

(13A02805) POWER SYSTEM DEREGULATION
(Elective – III)

UNIT I
DEREGULATION OF ELECTRIC UTILITIES
Introduction – Traditional central utility model, reform motivations, separation of ownership and operation, competition and direct access in the electricity market, independent system operator (ISO), retail electric providers, different experiences.

UNIT II
COMPETITIVE WHOLESALE ELECTRICITY MARKETS & TRANSMISSION OPEN ACCESS
Introduction, ISO, wholesale electricity market characteristics, market model, challenges, trading arrangements, the pool and bilateral trades, multi lateral trades.

UNIT III
TRANSMISSION COST ALLOCATION METHODS
Introduction - Postage Stamp Rate Method - Contract Path Method - MW-Mile Method – Unused Transmission Capacity Method - MVA-Mile method – Comparison of cost allocation methods.

UNIT IV
MARKET POWER & ANCILLARY SERVICES MANAGEMENT
Introduction - Different types of market Power – Mitigation of Market Power – Examples - Introduction – Reactive Power as an Ancillary Service – a Review – Synchronous Generators as Ancillary Service Providers.

UNIT V
AVAILABLE TRANSFER CAPABILITY (ATC)
Transfer Capability Issues – ATC – TTC – TRM – CBM Calculations – Calculation of ATC based on power flow - Introduction – Electricity Price Volatility Electricity Price Indexes – Challenges to Electricity Pricing – Construction of Forward Price Curves – Short-time Price Forecasting.

Text Books:

1. *Power System Restructuring and Deregulation, Loi Lei Lai, John Wiley & Sons Ltd., England, 2001.*

Reference Books:

1. Operation of Restructured Power System, Kankar Bhattacharya, Math H.J. Boller and Jaap E.Daalder Kulwer Academic Publishers, 2001.
2. Restructured Electrical Power Systems, Mohammad Shahidehpour and Muwaffaq alomoush, Marcel Dekker, Inc., 2001.

B.Tech. IV-II Sem.	Th	Tu	C
	3	1	3

(13A02806) SWITCH MODE POWER CONVERTERS
(Elective-III)

UNIT I
NON-ISOLATED DC-DC CONVERTERS
Basic Types of Switching Power Supplies – Volt-Sec balance – Non-Isolated Switched-Mode DC-to-DC Converters – Buck Converter – Boost Converter – Buck-Boost Converter – Cuk Converter – SEPIC and Zeta Converters – Comparison of Non-Isolated Switched mode DC-to-DC Converters.

UNIT II
ISOLATED DC-DC CONVERTERS
Need of Transformer Isolations in high frequency Power conversion - Isolated Switched Mode DC-to-DC Converters – Single Switch Isolated DC-to-DC Converters – Forward, Flyback, Push-Pull, Flux Walking Phenomena, Half and Full Bridge Converters – Multi Switch Isolated DC-to-DC Converters – Comparison of Isolated and Non-Isolated Switched Mode DC-to-DC Converters.

UNIT III
RESONANT CONVERTERS
Classification of Resonant converters-Basic resonant circuits- Series resonant circuit-parallel resonant circuits- Resonant switches, Concept of Zero voltage switching, principle of operation, analysis of M-type and L-type Resonant Buck and boost Converters.

UNIT IV
DYNAMIC ANALYSIS OF DC-DC CONVERTERS
Formulation of dynamic equations of buck and boost converters, State-Space Models, Averaged Models, linearization technique, small-signal model and converter transfer functions, Significance of Small Signal Models, Dynamical Characterization.

UNIT V
CONTROLLER DESIGN
Review of frequency-domain analysis of linear time-invariant systems, controller specifications, Proportional (P), Proportional plus Integral (PI), Proportional, Integral plus Derivative controller (PID), selection of controller parameters for Isolated and Non-Isolated DC -DC Converters.

Text Books:
1. *Andrzej M. Trzynadlowski,* ***Introduction to Modern Power Electronics****, 2nd Edition, WILEY-INDIA Edition, 2012.*
2. *Robert Erickson and Dragon Maksimovic,* ***Fundamentals of Power Electronics****, Springer Publications., 2nd Edition, 2001.*
3. *Issa Batarseh****, Fundamentals of Power Electronics,*** *John Wiley Publications, 2009.*

Reference Books:
1. *Philip T.Krein* ***Elements of Power Electronics*** *- Oxford University Press, 1997.*
2. *L. Umanand* ***Power Electronics,*** *Tata Mc-Graw Hill, 2004.*

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

B.Tech. IV-II Sem.	**Th**	**Tu**	**C**
	3	**1**	**3**

(13A02807) RELIABILITY ENGINEERING AND APPLICATIONS TO POWER SYSTEMS (ELECTIVE-IV)

Course Objective:

This course mainly focus the reliability concepts like markov modeling, frequency and duration techniques and its applications to power systems which includes generation, transmission and distribution system reliability analysis.

UNIT I

BASICS OF PROBABILITY THEORY, DISTRIBUTION & NETWORK MODELLING

Basic Probability Theory – Rules for Combining Probabilities of Events – Bernoulli's Trials – Probability Density and Distribution Functions – Binomial Distribution – Expected Value and Standard Deviation of Binomial Distribution. Analysis of Series, Parallel, Series-Parallel Networks – Complex Networks – Decomposition Method.

UNIT II

RELIABILITY FUNCTIONS

Reliability Functions F(T), F(T), R(T), H(T) and Their Relationships – Exponential Distribution – Expected Value and Standard Deviation of Exponential Distribution – Bath Tub Curve – Reliability Analysis of Series Parallel Networks Using Exponential Distribution – Reliability Measures MTTF, MTTR, MTBF.

UNIT III

MARKOV MODELLING AND FREQUENCY & DURATION TECHNIQUES

Markov Chains – Concept of Stochastic Transitional Probability Matrix (STPM), Evaluation of Limiting State Probabilities – Markov Processes One Component Repairable System – Time Dependent Probability Evaluation Using Laplace Transform Approach – Evaluation of Limiting State Probabilities Using STPM – Two Component Repairable Models. Frequency and Duration Concept – Evaluation of Frequency of Encountering State, Mean Cycletime, for One , Two Component Repairable Models – Evaluation of Cumulative Probability and Cumulative Frequency of Encountering of Merged States.

UNIT IV

APPLICATIONS TO POWER SYSTEMS -I

Generation System Reliability Analysis: Reliability Model of a Generation System– Recursive Relation for Unit Addition and Removal – Load Modeling - Merging of Generation Load Model – Evaluation of Transition Rates for Merged State Model – Cumulative Probability, Cumulative Frequency of Failure Evaluation – LOLP, LOLE, LOEE.

UNIT V

APPLICATIONS TO POWER SYSTEMS - II

Transmission & Distribution System Reliability Analysis: System and Load Point Reliability Indices – Weather Effects on Transmission Lines, Weighted Average Rate and Markov Model. Basic Techniques - Radial Networks – Evaluation of Basic Reliability Indices, Performance Indices – Load Point and System Reliability Indices – Customer Oriented, Loss and Energy Oriented Indices -Examples.

Text Books:

1. *Reliability Evaluation of Engg. System – R. Billinton, R.N.Allan, Plenum Press, New York, reprinted in India by B.S.Publications, 2007.*
2. *Reliability Evaluation of Power systems – R. Billinton, R.N.Allan, Pitman Advance Publishing Program, New York, reprinted in India by B.S.Publications, 2007.*

B.Tech. IV- II Sem.	T	Tu	C
	3	1	3

(13A02808) HIGH VOLTAGE ENGINEERING (ELECTIVE-IV)

Course Objective:

This subject deals with the detailed analysis of Breakdown occur in gaseous, liquids and solid dielectrics. Information about generation and measurement of High voltage and current. In addition the High voltage testing methods are also discussed.

UNIT I

BREAK DOWN IN GASEOUS, LIQUID & SOLID DIELECTRICS

Introduction to HV Technology, Need for Generating High Voltages in Laboratory. Industrial Applications of High Voltage, Electrostatic Precipitation, Separation.

Gases As Insulating Media, Collision Process, Ionization Process, Townsend's Criteria Of Breakdown in Gases, Paschen's Law, Liquid As Insulator, Pure and Commercial Liquids, Breakdown in Pure and Commercial Liquids.

Intrinsic Breakdown, Electromechanical Breakdown, Thermal Breakdown, Breakdown of Solid Dielectrics in Practice, Breakdown in Composite Dielectrics, Solid Dielectrics Used in Practice.

UNIT II

GENERATION OF HV AC AND DC VOLTAGES

HV AC-HV Transformer: Need for Cascade Connection and Working of Transformers Units Connected in Cascade. Series Resonant Circuit- Principle of Operation and Advantages - Tesla Coil - HV DC-Voltage Doubler Circuit, Cockroft- Walton Type High Voltage DC Set - Calculation of High Voltage Regulation, Ripple and Optimum Number of Stages for Minimum Voltage Drop.

UNIT III

GENERATION OF IMPULSE VOLTAGES

Introduction to Standard Lightning and Switching Impulse Voltages - Analysis of Single Stage Impulse Generator-Expression for Output Impulse Voltage - Multistage Impulse Generator Working of Marx Impulse Generator, Rating of Impulse Generator - Components of Multistage Impulse Generator - Triggering of Impulse Generator By Three Electrode Gap Arrangement - Trigatron Gap and Oscillograph Time Sweep Circuits, Generation of Switching Impulse Voltage - Generation of High Impulse Current.

UNIT IV

MEASUREMENT OF HIGH VOLTAGES:

Electrostatic Voltmeter-Principle, Construction and Limitation - Chubb and Fortescue Method for HV AC Measurement - Generating Voltmeter- Principle, Construction - Series Resistance Micro Ammeter for HV DC Measurements - Standard Sphere Gap Measurements of HVAC, HVDC And Impulse Voltages - Factors Affecting The Measurements - Potential Dividers-Resistance Dividers Capacitance Dividers Mixed RC Potential Dividers. Measurement of High Impulse Currents-Rogowsky Coil.

UNIT V

HIGH VOLTAGE TESTING TECHNIQUES

Dielectric Loss and Loss Angle Measurements Using Schering Bridge - Transformer Ratio Arms Bridge. Need for Discharge Detection and PD Measurements Aspects - Factors Affecting The Discharge Detection, Discharge Detection Methods-Straight and Balanced Methods. Tests on Isolators, Circuit Breakers, Cables, Insulators and Transformers.

Text Books:

1. *High Voltage Engineering by M.S.Naidu and V. Kamaraju – TMH Publications, 4th Edition, 2004.*
2. *High Voltage Engineering by C.L.Wadhwa, New Age Internationals (P) Limited, 1997.*

Reference Books:

1. *High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition, 2000.*
2. *High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.*
3. *High Voltage Technology by L. L. Alston, OXFORD University Press, Second Edition, 2009.*
4. *High Voltage Engineering Problems & S*olutions, R. D. Begamudre, New Age *International Publishers, First Edt., 2010*

B.Tech. IV-II Sem.	T	Tu	C
	3	1	3

(13A02809) SMART GRID
(ELECTIVE- IV)

UNIT I

THE SMART GRID

Introduction, Ageing Assets and Lack of Circuit Capacity, Thermal Constraints, Operational Constraints, Security of Supply, National Initiatives,

Early Smart Grid Initiatives, Active Distribution Networks, Virtual Power Plant, Other Initiatives and Demonstrations, Overview of The Technologies Required for The Smart Grid.

UNIT II

COMMUNICATION TECHNOLOGIES

Data Communications: Introduction, Dedicated and Shared Communication Channels, Switching Techniques, Circuit Switching, Message Switching, Packet Switching, Communication Channels, Wired Communication, Optical Fibre, Radio Communication, Cellular Mobile Communication, Layered Architecture and Protocols, The ISO/OSI Model, TCP/IP

Communication Technologies: IEEE 802 Series, Mobile Communications, Multi Protocol Label Switching, Power line Communication, Standards for Information Exchange, Standards For Smart Metering, Modbus, DNP3, IEC61850

UNIT III

INFORMATION SECURITY FOR THE SMART GRID

Introduction, Encryption and Decryption, Symmetric Key Encryption, Public Key Encryption, Authentication, Authentication Based on Shared Secret Key, Authentication Based on Key Distribution Center, Digital Signatures, Secret Key Signature, Public Key Signature, Message Digest, Cyber Security Standards, IEEE 1686: IEEE Standard for Substation Intelligent Electronic Devices(IEDs) Cyber Security Capabilities, IEC 62351: Power Systems Management And Association Information Exchange – Data and Communication Security.

UNIT IV

SMART METERING AND DEMAND SIDE INTEGRATION

Introduction, smart metering – evolution of electricity metering, key components of smart metering, smart meters: an overview of the hardware used – signal acquisition, signal conditioning, analogue to digital conversion, computation, input/output, communication.

Communication infrastructure and protocols for smart metering- Home area network, Neighbourhood Area Network, Data Concentrator, meter data management system, Protocols for communication. Demand Side Integration- Services Provided by DSI, Implementation of DSI, Hardware Support, Flexibility Delivered by Prosumers from the Demand Side, System Support from DSI.

UNIT V

TRANSMISSION AND DISTRIBUTION MANAGEMENT SYSTEMS

Data Sources, Energy Management System, Wide Area Applications, Visualization Techniques, Data Sources and Associated External Systems, SCADA, Customer Information System, Modelling and Analysis Tools, Distribution System Modelling, Topology Analysis, Load Forecasting, Power Flow Analysis, Fault Calculations, State Estimation, Applications, System Monitoring, Operation, Management, Outage Management System, Energy Storage Technologies, Batteries, Flow Battery, Fuel Cell and Hydrogen Electrolyser, Flywheels, Superconducting Magnetic Energy Storage Systems, Supercapacitors.

Text Books:

1. *Smart Grid, Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Wiley Publications, 2012.*
2. *Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley, IEEE Press., 2012.*

B.Tech. IV-II Sem.	Th	Tu	C
	3	1	3

(13A02810) ENERGY AUDITING & DEMAND SIDE MANAGEMENT
(Elective – IV)

Course Objective:

This course mainly focuses on the auditing and the management of the energy which includes energy efficient motors, power factor improvement and energy economic analysis.

UNIT I

ENERGY AUDITING

Energy Situation – World and India, Energy Consumption, Conservation, Codes, Standards and Legislation. Energy Audit- Definitions, Concept, Types of Audit, Energy Index, Cost Index, Pie Charts, Sankey Diagrams, Load Profiles, Energy Conservation Schemes. Measurements in Energy Audits, Presentation of Energy Audit Results.

UNIT II

ENERGY EFFICIENT MOTORS

Energy Efficient Motors , Factors Affecting Efficiency, Loss Distribution , Constructional Details , Characteristics - Variable Speed , Variable Duty Cycle Systems, RMS Hp- Voltage Variation-Voltage Unbalance- Over Motoring- Motor Energy Audit.

UNIT III

POWER FACTOR IMPROVEMENT

Power Factor – Methods of Improvement, Location of Capacitors, Pf With Non Linear Loads, Effect of Harmonics on P.F. ,P.F Motor Controllers.

UNIT IV

LIGHTING AND ENERGY INSTRUMENTS

Good Lighting System Design and Practice, Lighting Control ,Lighting Energy Audit - Energy Instruments- Watt Meter, Data Loggers, Thermocouples, Pyrometers, Lux Meters, Tongue Testers ,Application of PLC's

UNIT V

ENERGY ECONOMIC ANALYSIS & DEMAND SIDE MANAGEMENT

The Time Value of Money Concept, Developing Cash Flow Models, Payback Analysis, Depreciation, Taxes and Tax Credit – Numerical Problems. Introduction to DSM, Concept of DSM, Benefits of DSM, Different Techniques of DSM – Time of Day Pricing, Multi-Utility Power Exchange Model, Time of Day Models for Planning. Load Management, Load Priority Technique, Peak Clipping, Peak Shifting, Valley Filling, Strategic Conservation, Energy Efficient Equipment. Management and Organization of Energy Conservation Awareness Programs.

Text Books:

1. *Industrial Energy Management Systems, Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing Corporation, New York, 1994.*
2. *Fundamentals of Energy Engineering - Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey, 1984.*
3. *Electrical Power distribution, A S. Pabla, TMH, 5th edition, 2004*
4. *Demand Side Management, Jyothi Prakash, TMH Publishers, 2004.*

Reference Books:

1. *Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications, 2007.*
2. *Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998*
3. *Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995.*
4. *Energy management hand book by W.C.Turner, John wiley and sons, 1986.*
5. *Energy management and good lighting practice : fuel efficiency- booklet12-EEO, 1993.*
6. *Recent Advances in Control and Management of Energy Systems, D.P.Sen, K.R.Padiyar, Indrane Sen, M.A.Pai, Interline Publisher, Bangalore, 1993.*
7. *Energy Demand – Analysis, Management and Conservation, Ashok V. Desai, Wiley Eastern, 2005.*
8. *Hand book on energy auditing - TERI (Tata Energy Research Institute), 1999.*