



JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

Course Structure for Electrical and Electronics Engineering

B. Tech Course

IV B. Tech – I Sem

S.No.	Course Code	Subject	Theory	Tu	Lab	Credits
1	13A02701	Electrical Distribution Systems	3	1	-	3
2	13A04602	Digital Signal Processing	3	1	-	3
3	13A52702	Management Science	3	1	-	3
4	13A02702	Utilization of Electrical Energy	3	1	-	3
5	13A02703 13A02704 13A02705	CBCC-2 (Department) 1. Modern Control Theory 2. Switched Mode Power Converters 3. Energy Auditing & Demand Side Management	3	1	-	3
6	13A02706 13A02707 13A02708	CBCC -3 (Department) 1. Smart Grid 2. Flexible AC Transmission Systems 3. Power Quality	3	1	-	3
7	13A02709	Microprocessors and Microcontrollers Laboratory	-	-	4	2
8	13A02710	Power Electronics and Simulation Laboratory	-	-	4	2
Total			18	06	08	22

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(13A02701) ELECTRICAL DISTRIBUTION SYSTEMS

OBJECTIVES: The student has to acquire knowledge about:

- The classification of distribution systems
- The technical aspects and design considerations in DC and AC distribution systems and their comparison
- Technical issues of substations such as location, ratings and bus bar arrangements
- The causes of low power factor and methods to improve power factor
- The principles in Distribution automation

UNIT – I LOAD MODELING AND CHARACTERISTICS

Introduction to Distribution Systems, Load Modelling and Characteristics. Coincidence Factor, Contribution Factor Loss Factor - Relationship between the Load Factor and Loss Factor. Classification of Loads (Residential, Commercial, Agricultural and Industrial) and Their Characteristics.

UNIT – II CLASSIFICATION OF DISTRIBUTION SYSTEMS

Classification of Distribution Systems - Comparison of DC vs AC and Under-Ground vs Over - Head Distribution Systems- Requirements and Design Features of Distribution Systems. Design Considerations of Distribution Feeders: Radial and Loop Types of Primary Feeders, Voltage Levels, Feeder Loading, Basic Design Practice of the Secondary Distribution System. Voltage Drop Calculations (Numerical Problems) In A.C. Distributors for The Following Cases: Power Factors Referred to Receiving End Voltage and With Respect to Respective Load Voltages.

UNIT – III SUBSTATIONS

Location of Substations: Rating of Distribution Substation, Service Area within Primary Feeders. Benefits Derived Through Optimal Location of Substations.

Classification of Substations: Air Insulated Substations - Indoor & Outdoor Substations: Substation Layout showing the Location of all the Substation Equipment.

Bus Bar Arrangements in the Sub-Stations: Simple Arrangements Like Single Bus Bar, Sectionalized Single Bus Bar, Main and Transfer Bus Bar Double Breaker – One and Half Breaker System With Relevant Diagrams.

UNIT – IV POWER FACTOR IMPROVEMENT

Voltage Drop and Power-Loss Calculations: Derivation for Voltage Drop and Power Loss in Lines, Manual Methods of Solution for Radial Networks, Three Phase Balanced Primary Lines.

Causes of Low P.F -Methods of Improving P.F -Phase Advancing and Generation of Reactive KVAR Using Static Capacitors-Most Economical P.F. for Constant KW Load and Constant KVA Type Loads, Numerical Problems.

Capacitive Compensation for Power-Factor Control - Effect of Shunt Capacitors (Fixed and Switched), Power Factor Correction- Economic Justification - Procedure to Determine the Best Capacitor Location.

UNIT – V DISTRIBUTION AUTOMATION

Distribution Automation (DA) – Project Planning – Definitions – Communication – Sensors- Supervisory Control and Data Acquisition (SCADA) – Consumer Information Service (CIS) – Geographical Information System (GIS) – Automatic Meter Reading (AMR) – Automation Systems.

OUTCOMES: Student should be able to:

- Compute the various factors associated with power distribution
- Make voltage drop calculations in given distribution networks
- Learn principles of substation maintenance
- Compute power factor improvement for a given system and load
- Understand implementation of SCADA for distribution automation

TEXT BOOKS:

1. Electric Power Distribution Engineering, Turan Gonen, CRC Press, 3rd Edition, 2014.
2. Electric Power Distribution, A.S. Pabla, Tata Mc Graw Hill (India) Pvt. Ltd., 6th Edition, 2011.

REFERENCE BOOKS:

1. Electric Power Distribution Automation, Dr. M. K. Khedkar and Dr. G. M. Dhole, University Science Press, 2010.
2. Electrical Power Distribution Systems, V. Kamaraju, Jain Book Depot. 2012.
3. Electrical Power Systems for Industrial Plants, Kamallesh Das, JAICO Publishing House, 2008.

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(13A04602) DIGITAL SIGNAL PROCESSING

Course Objectives:

- To use Z transforms and discrete time Fourier transforms to analyze a digital system.
- To design and understand simple finite impulse response filters
- To understand stability of FIR filters
- To know various structures used in the implementation of FIR and IIR filters
- Window method design structure for implementation.

Learning Outcomes:

At the end of the course, the student should be able to:

- Describe the Sampling Theorem and how this relates to Aliasing and Folding.
- Determine if a system is a Linear Time-Invariant (LTI) System and Take the Z-transform of a LTI system.
- Find the frequency response of FIR and IIR filters through analysis.
- Understand the relationship between poles, zeros, and stability and determine the spectrum of a signal using the DFT, FFT, and spectrogram.
- Design, analyze, and implement various digital filters.

UNIT-I

Introduction: Review of discrete-time signals and systems – Time domain analysis of discrete-time signals & systems, Frequency domain analysis of discrete-time signals and systems. Discrete Fourier Transform: Frequency-domain sampling and reconstruction of discrete-time signals, Discrete Fourier Transform (DFT), The DFT as a linear transformation, Relationship of the DFT to other transforms, Properties of DFT, Linear filtering methods based on DFT, Frequency analysis of signals using the DFT.

UNIT-II

Fast Fourier Transform Algorithms (FFTA): Efficient computation of the DFT – Direct computation of DFT, Divide and conquer approach to computation of DFT, Radix-2, Radix-4, and Split radix FFT algorithms, Implementation of FFT algorithms, Applications of FFT algorithms – Efficient computation of the DFT of two real sequences, $2N$ point real sequences, Use of the FFT algorithm in linear filtering and correlation, A linear filtering approach to computation of the DFT- the Goertzel, and the Chirp-z transform algorithms, Quantization errors in the computation of DFT.

UNIT-III

Implementation of Discrete-Time Systems: Structures for the realization of discrete-time systems, Structures for FIR systems - Direct form, Cascade form, Frequency sampling, and Lattice structures, Structures for IIR systems – Direct form, Signal flow graphs & Transposed, Cascade form, Parallel form and Lattice structures, Conversion from Lattice structure to direct form, lattice –Ladder structure.

UNIT-IV

Design of Digital Filters: General considerations – Causality and its implications, Characteristics of practical Frequency Selective Filters, Design of Finite Impulse Response (FIR) filters – Symmetric and asymmetric FIR filters, Design of linear phase FIR filters using windows, Design of linear phase FIR filters by the frequency sampling method, Design of optimum equi-ripple linear phase FIR filters, Comparison of design methods for linear phase FIR filters, Design of Impulse Invariance Response (IIR) filters from analog filters – IIR filter design by approximation of derivatives, by Impulse invariance, and by bilinear transformation methods, Characteristics of commonly used analog filters, Design examples of both FIR and IIR filters, Frequency transformation in the analog and digital domains, Illustrative problems.

UNIT-V

Multirate Digital Signal Processing: Introduction, Decimation, and interpolation, Sampling rate conversion by a rational factor, Implementation of sampling rate conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion of bandpass signals, Sampling rate conversion by arbitrary factor, Applications of multirate signal processing.

TEXT BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, "Digital signal processing, principles, Algorithms and applications," Pearson Education/PHI, 4th ed., 2007.
2. Sanjit K Mitra, "Digital signal processing, A computer base approach," Tata McGraw Hill, 3rd edition, 2009.

REFERENCES:

1. A.V.Oppenheim and R.W. Schaffer, & J R Buck, "Discrete Time Signal Processing," 2nd ed., Pearson Education, 2012.
2. B. P. Lathi, "Principles of Signal Processing and Linear Systems," Oxford Univ. Press, 2011.
3. Li Tan, Jean Jiang, "Digital Signal Processing, Fundamentals and Applications," Academic Press, Second Edition, 2013.
4. Andreas Antoniou, "Digital Signal Processing," TATA McGraw Hill, 2006.
5. Schaum's outlines M H Hayes, "Digital Signal Processing," TATA Mc-Graw Hill, 2007.
6. A. Anand Kumar, "Digital Signal Processing," PHI Learning, 2011.

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(13A52702) MANAGEMENT SCIENCE

Course Objective:

The objectives of this course are to equip the student the fundamental knowledge of Management Science and its application to effective management of human resources, materials and operations of an organization. It also aims to expose the students about the latest and contemporary developments in the field of management.

Learning outcome:

This course enables the student to know the principles and applications of management knowledge and exposure to the latest developments in the field. This helps to take effective and efficient managerial decisions on physical and human resources of an organization. Besides, the knowledge of Management Science facilitates for his/her personal and professional development.

UNIT I

INTRODUCTION TO MANAGEMENT

Definition of Management- Function of Management- Management as a Science and Art-Management as a Profession- Universality of Management- Henri Faylo's Administrative Theory –Elton Mayo's Human Relations Movement- Systems theory – Contingency theory- Monetary and non-monetary incentives to motivate work teams- Leadership –Definition- Qualities of successful leaders- Different leadership styles.

UNIT II

ORGANIZATION DESIGN AND STRUCTURE

Organization design and structure- Principles—Types of organization structure-Mechanic and Organic Structures- Line organization- Line & Staff organization- Functional Organization – Matrix organization structures- merits and demerits- Departmentation and Decentralization-Power and Authority- Delegation of authority-Principles for effective delegation of authority.

UNIT III

HUMAN RESOURCE AND MATERIALS MANAGEMENT

Concept of HRM-functions – Human Resource Planning-Job Analysis-Recruitment and Selection- Training and Development- Performance appraisal –methods- Wage and Salary Administration-Grievances handling Procedure-Material Management- Need for Inventory control- Economic order quantity- ABC analysis- Management of purchase, stores and stores records.-Marketing Management – Concept- Channels of distribution- Marketing mix and product mix.

UNIT IV

MANAGEMENT OF OPERATIONS & PROJECT MANAGEMENT

Nature of organizational control- Marketing control- HR control- effective control systems- Operations Management- Essentials of operations management- Trends in operational management- Designing operation system for effective management of an organization-Project Management –Network Analysis-PERT and CPM-Project crashing (Simple problems)

UNIT V

CONTEMPORARY MANAGEMENT ISSUES

Strategic Management-Concept- Mission-Vision-Core values-Setting objectives-Corporate planning – Environmental scanning-SWOT analysis- Steps in strategy formulation & implementation- Management

Information System (MIS)- Enterprise Resource Planning (ERP)-Just-in-Time (JIT)- Total Quality Management (TQM) – Supply Chain Management-Six Sigma-Business Process Outsourcing (BPO).

Text Books:

1. Stoner, Freeman, Gilbert, Management, Pearson, Six Edition 2008
2. Aryasri: Management Science, Fourth Edition TMH, 2012.

Reference Books:

1. Vijay Kumar & Apparo, Introduction to Management Science, Cengage, 2011.
2. Kotler Philip & Keller Kevin Lane: Marketing Management, 14th Edition, Pearson, 2012.
3. Aswathappa, Human Resource Management, Himalaya, 2012.
4. Kanishka Bedi, Production and Operations Management, Oxford University Press, 2011.
5. Schermerhorn, Capling, Poole & Wiesner: Management, Wiley, 2012.
6. Joseph M Putti, Management Principles, Mc Millan Publishers, 2012.

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(13A02702) UTILIZATION OF ELECTRICAL ENERGY

OBJECTIVES: The objectives of the course are to make the students learn about:

- The laws of illumination and their application for various lighting schemes
- Principles and methods for electric heating and welding.
- Systems of electric traction, study of traction equipment, mechanics of train movement and associated calculations.

UNIT-I ILLUMINATION

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

UNIT-II ELECTRIC HEATING & WELDING

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

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

OUTCOMES: Student should be able to:

- Develop a lighting scheme for a given practical case.
- Analyze the performance of Heating and Welding methods
- Make all numerical calculations associated with electric traction.
- Assess the economic aspects in utilisation of electrical energy

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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**(13A02703) MODERN CONTROL THEORY
(CBCC-II)**

OBJECTIVE : The objectives of the course are to make the students learn about:

- Concepts of state vector, State transition matrix and solution of state equations.
- Importance of controllability and observability concepts.
- Pole placement, state estimation using observers
- Lyapunov criterion for stability analysis
- Types of nonlinearities, their effect on system performance

UNIT – I STATE VARIABLE DESCRIPTION AND SOLUTION OF STATE EQUATION

Concept of State – Derivation of State Space models for Linear Continuous time Systems from Schematic Models, Differential equations, Transfer functions and block diagrams – Non uniqueness of state model – State diagrams for continuous time state models – Solution of state equations – State transition matrix. Complete response of continuous time systems.

UNIT – II : CONTROLLABILITY, OBSERVABILITY,

Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, 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 – III: STATE FEEDBACK CONTROLLERS AND OBSERVERS

Design of State Feedback Controllers through Pole placement. Full-order observer and reduced-order observer. State estimation through Kalman Filters.

UNIT – IV ANALYSIS OF NONLINEAR SYSTEMS

Introduction to nonlinear systems, Types of nonlinearities, Concept 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- V STABILITY ANALYSIS

Stability in the sense of Lyapunov. Lyapunov's stability and Lyapunov's instability theorems. Direct method of Lyapunov for Linear and Nonlinear continuous time autonomous systems.

TEXT BOOKS:

1. Modern Control Engineering, Katsuhiko Ogata, Prentice Hall, 5th Edition, 2010.
2. Modern Control System Theory, M. Gopal, New Age International Publishers, Revised 2nd edition, 2005.

REFERENCE BOOKS:

1. Control Systems Engineering, I.J. Nagarath and M.Gopal, New Age International Publishers, 5th Edition, 2007, Reprint 2012.
2. Modern Control Engineering, D. Roy Choudhury, PHI Learning Private Limited, 9th Printing, January 2015.

OUTCOMES: At the end of studying the course, the student should be able to:

- Model a given dynamic system in state space and obtain the solution for the state equation
- Test whether a given system is controllable and/or observable
- Design a state feedback controller for pole placement
- Design an observer for state estimation
- Apply Lyapunov criterion and determine stability of a given system
- Analyze nonlinear systems

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(13A02704) SWITCHED MODE POWER CONVERTERS

(CBCC-II)

OBJECTIVES: The objectives of the course are to make the students learn about:

- The concepts of modern power electronic converters and their applications in electric power utility.
- Analyzing and control of various power converter circuits

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 Weakening 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.

OUTCOMES: Upon completion of this course,

- The student learns the fundamental concepts of DC - DC Converters
- Student can explain the operation of different topologies of DC to DC converters and their differences
- Student will be able to model various converters as per state space, time average etc.
- Student can analyse in frequency domain with different P, PI and PID converters

TEXT BOOKS:

1. Issa Batarseh, Fundamentals of Power Electronics, John Wiley Publications, 2009.
2. Robert Erickson and Dragomir Maksimovic, Fundamentals of Power Electronics, Springer Publications., 2nd Edition, 2001.

REFERENCE BOOKS:

1. Switched Mode Power Supplies design and construction 2nd Edition, H W Whittington, B W Flynn and D E Macpherson, Universities Press, 2009.
2. Philip T. Krein Elements of Power Electronics - Oxford University Press, 1997.
3. L. Umanand Power Electronics, Tata Mc-Graw Hill, 2004.

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(13A02705) ENERGY AUDITING & DEMAND SIDE MANAGEMENT

(CBCC-II)

OBJECTIVES: The objectives of this course include

- To learn about energy consumption and situation in India
- To learn about Energy Auditing.
- To learn about Energy Measuring Instruments.
- To understand the Demand Side Management.

UNI -I INTRODUCTION TO 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 AND POWER FACTOR IMPROVEMENT

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.Power Factor – Methods of Improvement, Power factor With Non Linear Loads

UNIT –III LIGHTING AND ENERGY INSTRUMENTS FOR AUDIT

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

UNIT –IV INTRODUCTION TO DEMAND SIDE MANAGEMENT

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.

UNIT –V ECONOMICS AND COST EFFECTIVENESS TESTS OF DSM PROGRAMS

Basic payback calculations, Depreciation, Net present value calculations. Taxes and Tax Credit – Numerical Problems. Importance of evaluation, measurement and verification of demand side management programs. Cost effectiveness test for demand side management programs - Ratepayer Impact Measure Test, Total Resource Cost, Participant Cost Test, Program Administrator Cost Test

Numerical problems: Participant cost test, Total Resource Cost test and Ratepayer impact measure test.

OUTCOMES: After completion of the course the student should be able to:

- Conduct energy auditing and evaluate energy audit results
- Carry out motor energy audit
- Analyze demand side management concepts through case study

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.

REFERENCES:

1. Economic Analysis of Demand Side Programs and Projects - California Standard Practice Manual, June 2002 – Free download available online
http://www.calmac.org/events/spm_9_20_02.pdf
2. Energy management by W.R. Murphy & G. McKay Butter worth, Heinemann publications, 2007.
3. Energy management by Paul o' Callaghan, Mc-graw Hill Book company-1st edition, 1998
4. Energy efficient electric motors by John .C. Andreas, Marcel Dekker Inc Ltd-2nd edition, 1995.

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**(13A02706) SMART GRID
(CBCC-III)**

OBJECTIVES: The objectives of the course are to make the students learn about:

- Overview of the technologies required for the smart grid
- Switching techniques and different means for data communication
- Standards for information exchange and smart metering
- Methods used for information security on smart grid
- Smart metering, and protocols for smart metering
- Management systems for Transmission and distribution

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.

OUTCOMES: The student should have learnt about:

- How to meet the standards for information exchange and for smart metering
- How to preserve data and Communication security by adopting encryption and decryption procedures.
- Monitoring, operating, and managing the transmission and distribution tasks under smart grid environment

TEXT BOOKS:

1. Smart Grid, Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Wiley Publications, 2012, Reprint 2015.
2. Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley, IEEE Press., 2012, Reprint 2016.

REFERENCES:

1. The Smart Grid – Enabling Energy efficiency and demand response, Clark W. Gellings, P.E., CRC Press, Taylor & Francis group, First Indian Reprint. 2015.
2. Smart Grid – Applications, Communications, and Security Edited by Lars Torsten Berger, Krzysztof Iniewski, WILEY, 2012, Reprint 2015.
3. Practical Electrical Network Automation and Communication Systems, Cobus Strauss, ELSVIER, 2003.

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(13A02707) FLEXIBLE AC TRANSMISSION SYSTEMS

(CBCC-III)

OBJECTIVES: The objectives of the course are to make the students learn about:

- The basic concepts, different types, and applications of FACTS controllers in power transmission.
- The basic concepts of static shunt and series converters
- The working principle, structure and control of UPFC.

UNIT-I: CONCEPTS OF FLEXIBLE AC TRANSMISSION SYSTEMS

Transmission line Interconnections, Power flow in parallel lines, Mesh systems, Stability considerations, Relative importance of controllable parameters, Basic types of FACTS controllers, Shunt controllers, Series controllers, Combined shunt and series controllers, Benefits of FACTS.

UNIT-II: VOLTAGE AND CURRENT SOURCED CONVERTERS

Concept of Voltage Sourced Converters, Single Phase Full Wave Bridge Converter, Three Phase Full Wave Bridge Converter, Transformer Connections for 12-Pulse Operation, 24 and 48-Pulse Operation, Three Level Voltage Sourced Converter, Pulse Width Modulation (PWM) Converter, Converter Rating, Concept of Current Sourced Converters, Thyristor based converters, Current Sourced Converter with Turn off Devices, Current Sourced –vs- Voltage Sourced Converters.

UNIT-III: STATIC SHUNT COMPENSATORS

Objectives of Shunt Compensation, Midpoint Voltage Regulation for Line Segmentation, End of Line Voltage Support to Prevent Voltage Instability, Improvement of Transient Stability, Power Oscillation Damping, Methods of Controllable VAR Generation, Variable Impedance Type Static VAR Generators, Switching Converter Type VAR Generators, Hybrid VAR Generators, SVC and STATCOM, Transient Stability Enhancement and Power Oscillation Damping, Comparison Between STATCOM and SVC, V-I, V-Q Characteristics, Response Time.

UNIT-IV: STATIC SERIES COMPENSATORS

Objectives of Series Compensation, Voltage Stability, Improvement of Transient Stability, Power Oscillation Damping, Subsynchronous Oscillation Damping, Variable Impedance Type Series Compensators, GTO Thyristor Controlled Type Series Capacitor (GCSC), Thyristor Switched Series Capacitor (TSSC), Thyristor-Controlled Series Capacitor(TCSC), Basic Operating Control Schemes for GCSC, TSSC, and TCSC, Switching Converter Type Series Compensators, The Static Synchronous Series Capacitor(SSSC), Transmitted Power Versus Transmission Angle Characteristic, Control Range and VA Rating, Capability to Provide Real Power Compensation.

UNIT-V: POWER FLOW CONTROLLERS

The Unified Power Flow Controller-Basic Operating Principles, Conventional Transmission Control Capabilities, Independent Real and Reactive Power Flow Control. Control Structure, Basic Control System for P and Q Control, Dynamic Performance, The Interline Power Flow Controller (IPFC), Basic Operating Principles and Characteristics, Generalized and Multifunctional FACTS Controllers.

OUTCOMES: After completing this course the student will be able to:

- Understand various control issues, for the purpose of identifying the scope and for selection of specific FACTS controllers.
- Apply the concepts in solving problems of simple power systems with FACTS controllers.
- Design simple FACTS controllers and converters for better transmission of electric power.

TEXT BOOKS:

1. Understanding FACTS – Concepts and technology of Flexible AC Transmission systems, Narain G. Hingorani, Laszlo Gyugyi, IEEE Press, WILEY, 1st Edition, 2000, Reprint 2015.
2. FACTS Controllers in Power Transmission and Distribution, Padiyar K.R., New Age International Publishers, 1st Edition, 2007.

REFERENCE BOOKS:

1. Flexible AC Transmission Systems: Modelling and Control, Xiao – Ping Zhang, Christian Rehtanz, Bikash Pal, Springer, 2012, First Indian Reprint, 2015.
2. FACTS – Modelling and Simulation in Power Networks, Enrigue Acha, Claudio R. Fuerte – Esquivel, Hugué Ambriz – perez, Cesar Angeles – Camacho, WILEY India Private Ltd., 2004, Reprint 2012.

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B.Tech IV-I Sem. (E.E.E)

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(13A02708) POWER QUALITY

(CBCC-III)

OBJECTIVES: The objectives of the course are to make the students learn about:

- Power quality issues and standards.
- The sources of power quality disturbances and power transients that occur in power systems.
- The sources of harmonics, harmonic indices, Devices for controlling harmonic distortion.
- The principle of operation of DVR and UPQC.

UNIT I INTRODUCTION

Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues-Magnitude Versus Duration Plot - Power Quality Standards - Responsibilities of Suppliers and Users of Electric Power-CBEMA and ITI Curves.

UNIT II TRANSIENTS, SHORT DURATION 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 Quality 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.

UNITV 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.

OUTCOMES: After completion of the course the student should be able to:

- Address power quality issues to ensure meeting of standards
- Apply the concepts of compensation for sags and swells using voltage regulating devices
- Assess harmonic distortion and its mitigation.
- Explain the power measurement data according to standards

TEXT BOOKS:

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2012.
2. Power quality, C. Sankaran, CRC Press, 2001.

REFERENCE BOOKS:

1. Understanding Power quality problems – Voltage Sags and Interruptions, Math H. J. Bollen IEEE Press Series on Power Engineering, WILEY, 2007.
2. Power quality – VAR Compensation in Power Systems, R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2009, First Indian Reprint 2013.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2012.

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B.Tech IV-I Sem. (E.E.E)

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(13A02709) MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

OBJECTIVES: The student has to perform:

- Assembly language programming on 8086 Microprocessors
- Interfacing of various devices with 8086
- MASM Programming
- Interfacing 8051 Microcontroller with its peripheral devices

I. Microprocessor 8086

Introduction to MASM/TASM.

Arithmetic Operation – Multi Byte Addition and Subtraction, Multiplication and Division – Signed and Unsigned Arithmetic Operation, ASCII – Arithmetic Operation.

Logic Operations – Shift and Rotate – Converting Packed BCD to Unpacked BCD, BCD to ASCII Conversion.

By Using String Operation and Instruction Prefix: Move Block, Reverse String, Sorting, Inserting, Deleting, Length of The String, String Comparison.

Modular Program: Procedure, Near and Far Implementation, Recursion.

DOS/BIOS Programming: Reading Keyboard (Buffered With And Without Echo) – Display Characters, Strings.

II. Interfacing

8259 – Interrupt Controller.

8279 – Keyboard Display.

8255 – PPI.

8251 – USART.

III. Microcontroller 8051

1. Reading and Writing on a Parallel Port.
2. Timer in Different Modes.
3. Serial Communication Implementation.

4. Using External Interrupts
5. Programs Using Special Instructions like Swap, Bit/Byte, Set/Reset Etc.
6. Programs Based on Short, Page, Absolute Addressing.

OUTCOMES: The student should be able to perform:

- Assembly language programming on 8086 Microprocessors
- Interfacing of various devices with 8086
- MASM Programming
- Interfacing 8051 Microcontroller with its peripheral devices

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B.Tech IV-I Sem. (E.E.E)

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(13A02710) POWER ELECTRONICS AND SIMULATION LABORATORY

OBJECTIVES: The student will understand:

- The characteristics of power electronic devices with gate firing circuits
- Various forced commutation techniques
- The operation of single-phase voltage controller, converters and Inverters circuits with R and RL loads
- Simulation of power electronic circuits using PSPICE/PSIM/SEQUEL/MATLAB/SIMULINK

Any Eight of the Experiments in Power Electronics Lab

1. Gate Firing Circuits for SCRs
2. Single Phase AC Voltage Controller with R and RL Loads
3. DC Jones Chopper with R and RL Loads
4. Forced Commutation Circuits (Class A, Class B, Class C, Class D and Class E)
5. Three phase fully controlled Bridge converter with R- load
6. Single Phase Parallel Inverter with R and RL Loads
7. Single phase Cycloconverter with R and RL loads
8. Single Phase Series Inverter with R and RL Loads
9. Single Phase Dual Converter with RL Loads
10. Illumination control / Fan control using TRIAC

Any Two Simulation Experiments with PSPICE / PSIM /SEQUEL / MATLAB / SIMULINK

1. Simulation of 3-Phase Full Converter Using RLE Loads and Single-Phase AC Voltage Controller Using RLE Loads
2. Simulation of Single Phase Inverter with PWM Control
3. Simulation of 3-phase Bridge Inverter

OUTCOMES: Student should be able to:

- Test the turn on –turn off characteristics of various power electronic devices.
- Test and analyze firing circuits for SCRs
- Test different types of voltage controllers, converters and Inverters with R and RL loads
- Simulate a simple power electronic circuit using PSPICE / SEQUEL / PSIM / MATLAB / SIMULINK

REFERENCE BOOKS:

1. Simulation of Electrical and Electronic circuits using PSPICE – by M.H.Rashid, PHI.
2. PSPICE reference guide – Microsim, USA.
3. Simulation of Power Electronics Circuit, M B Patil, V Ramanarayan and V T Ranganat, Alpha Science International Ltd., 2009.
4. Web Address for SEQUEL [http:// www.ee.iitb.ac.in/~sequel](http://www.ee.iitb.ac.in/~sequel)
5. Modelling and Simulation using MATLAB – Simulink, Dr. Shailendra Jain