## M.Tech I Semester

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<tr>
<th>S.No</th>
<th>Subject Code</th>
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<td>1.</td>
<td>17D54101</td>
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<td>Solid-State DC Drives</td>
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<td>17D54103</td>
<td>Applications of Power Electronics to Power Systems</td>
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<td>17D49103</td>
<td>1. Modern Control Engineering &amp; Principles of Optimal Control</td>
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<td>3. Hybrid Electric Vehicle Systems</td>
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**TOTAL** 24 - 04 26

## M.Tech II Semester

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**TOTAL** 22 - 04 26
M.Tech III Semester

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M.Tech IV Semester

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<td>Project Work Part - II</td>
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Project Viva Voce Grades:

A: Satisfactory
B: Not Satisfactory
COURSE OBJECTIVES:
The student will be able:
- To understand the static and dynamic characteristics of current controlled power semiconductor devices.
- To understand the static and dynamic characteristics of voltage controlled power semiconductor devices.
- To enable the students for the selection of devices for different power electronics applications.
- To understand the control and firing circuit for different devices.

SYLLABUS:


UNIT-II: Current Controlled Devices: BJT’s – Construction, static characteristics, switching characteristics; Negative temperature co-efficient and secondary breakdown; Power darlington – Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation.

UNIT-III: Voltage Controlled Devices: Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady-state and dynamic models of MOSFET and IGBTs - Basics of GTO, MCT(Mos Controlled Thyristor ), FCT(Field Controlled Thyristor), RCT(Reverse Conducting Thyristor) .

UNIT-IV: Firing and Protecting Circuits: Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.


Text books:

Reference books:
1. Advanced power electronics converters by Euzeli dos santos, Edison R. da silva.
COURSE OUTCOMES:

After completion of the course, student will be able to:

- Understand the static and dynamic characteristics of current controlled power semiconductor devices.
- Understand the static and dynamic characteristics of voltage controlled power semiconductor devices.
- Select the devices for different power electronics applications.
- Understand the control and firing circuit for different devices.
COURSE OBJECTIVES:
The student will be able:

• To Identifying the methods and assumptions in modeling of machines.
• To recognize the different frames for modeling of AC machines.
• To write voltage and torque equations in state space form for different machines.

SYLLABUS:

Unit I: Modeling and Analysis of DC Machine
Magnetically coupled circuits, Machine windings and air-gap MMF, winding inductances and voltage equations - Separately excited dc generators, Separately excited dc motors, interconnection of machines, transfer functions of dc machines, dc series motor, dc shunt machines, dc compound machines, linearization techniques for small perturbations, cross field machines, transfer functions of cross field machines, Electric braking of dc motors.

Unit II: Reference Frame Theory: Introduction to transformations, equations of transformations, change of variables, transformation to an arbitrary reference frame, commonly used reference frames, transformation between reference frames, Steady-state phasor relationships and voltage equations.


Unit V: Modeling of Brushless DC Machines: Voltage and torque equations in machine variables, Voltage and torque equations in rotor reference frame variables, Analysis of steady state operation, dynamic performance.

References:

COURSE OUTCOMES:
After completion of the course, student will be able to:

• Develop the mathematical models of various machines like, induction motor and Synchronous machines using modeling equations.
• Analyze the developed models in various reference frames.
COURSE OBJECTIVES:
The student will be able:
- To understand steady state operation and transient dynamics of a motor load system
- To study and analyze the operation of the converter/chopper fed DC drive, both qualitatively and quantitatively.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drive.
- To understand the implementation of control algorithms using microcontrollers and phase locked loop.

UNIT-I: DC MOTORS AND DRIVE SYSTEMS: DC motor - Types, induced emf, speed-torque relations; Speed control – Armature and field speed control; Ward Leonard control – Constant torque and constant horsepower operation - Introduction to high speed drives and modern drives.
Characteristics of mechanical system – dynamic equations, components of torque, types of load; Requirements of drives characteristics – multi-quadrant operation; Drive elements, types of motor duty and selection of motor rating.

UNIT-II: CONVERTER FED DC MOTORS CONTROL: Principle of phase control – Fundamental relations; Analysis of series and separately excited DC motor with single-phase and three-phase converters – waveforms, performance parameters, performance characteristics. Continuous and discontinuous armature current operations; Current ripple and its effect on performance; Operation with freewheeling diode; Implementation of braking schemes; Drive employing dual converter.

UNIT-III: CHOPPER FED DC MOTORS AND THEIR CONTROL: Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control – Chopper based implementation of braking schemes; Multi-phase chopper; Related problems.

UNIT-IV: CLOSED LOOP CONTROL OF DC DRIVES: Modeling of drive elements – Equivalent circuit, transfer function of self, separately excited DC motors; Linear Transfer function model of power converters; Sensing and feeds back elements - Closed loop speed control – current and speed loops, P, PI and PID controllers – response comparison. Simulation of converter and chopper fed d.c drive.

UNIT-V: DIGITAL CONTROL OF D.C DRIVE: Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant horse power and load disturbed operations; Speed detection and gate firing.

TEXT BOOKS

REFERENCES
COURSE OUTCOMES:
After completion of the course, the student will be able to:

- Understand steady state operation and transient dynamics of a motor load system
- Analyze the operation of the converter / chopper fed DC drive, both qualitatively and quantitatively.
- Analyze and design the current and speed controllers for a closed loop solid state DC motor drive.
- Understand the implementation of control algorithms using microcontrollers and phase locked loop.
COURSE OBJECTIVES:
Student will be able:

- To develop the understanding of uncompensated lines and their behavior under heavy loading conditions.
- To understand the concept and importance controllable parameters of FACTS controllers.
- To emphasize the objectives of Shunt compensation, and basic operation of SVC and STATCOM.

SYLLABUS:


UNIT II: 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, Static Var Compensators, SVC and STATCOM, The Regulation Slope, Transfer Function and dynamic Performance, Transient Stability, Enhancement and Power Oscillation Damping

UNIT III: Series Compensators: Objectives of Series Compensation, concept of series capacitive compensation, voltage stability, improvement of transient stability, power oscillation damping, GTO thyristor controlled series capacitor, Thyristor controlled series capacitor, SSSC.

UNIT IV: Combined Compensators: Introduction, Unified power flow controller, basic operating principles, independent real and reactive power flow control, and control structure, basic control system for P and Q control.

UNIT V: Mitigation of Harmonics: Power quality problems, harmonics, harmonic creating loads, harmonic power flow, and mitigation of harmonics, filters, passive filters, active filters, shunt, series and hybrid filters.

Text books:
1. Narain G. Hingorani, Laszlo Gyugyi, Understanding FACTS, IEEE press

Suggested Reading:
COURSE OUTCOMES:

After completion of the course, student will be able to:

• Choose proper controller for the specific application based on system requirements
• Understand various systems thoroughly and their requirements
• Interpret the control circuits of Shunt Controllers SVC & STATCOM for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping
COURSE OBJECTIVES:

The student will be able to:

- Learn about concepts of controllability, observability and Pole placement design
- Understand concepts of full order and reduced order observer designs
- Learn about model decomposition and robust control
- Understand optimal control problem and various functional
- Learn about state regulator and Riccati equation

Unit I


Unit II


Unit III


Unit IV

Introduction to optimal control, Calculus of variations: Fundamental concepts, functionals of single function, functional involving several independent functions, fixed end point problem, necessary and sufficient conditions for optimal control.

Unit V

Discrete-time linear state regulator – Algorithm for the solution, Use of observer in implementing the control law. Continuous-time linear state regulator – Matrix Riccati equation. Time invariant linear state regulator – the reduced matrix Riccati equation - An iterative method to solve the reduced matrix Riccati equation. Suboptimal linear regulator.

Text Books:

References:

COURSE OUTCOMES:

After completion of the course, student will be able to:

- Learn about concepts of controllability, observability and Pole placement design
- Understand concepts of full order and reduced order observer designs
- Learn about model decomposition and robust control
- Understand optimal control problem and various functional
- Learn about state regulator and Riccati equation
COURSE OBJECTIVES:
The student will be able to:
- Learn about optimization problem and basic optimization issues
- Understand the concept of linear programming
- Learn about transportation problem and solution
- Understand unconstrained optimization techniques
- Acquire knowledge about various heuristic optimization techniques

UNIT – I: INTRODUCTION AND CLASSICAL OPTIMIZATION TECHNIQUES:
Statement of an Optimization problem – design vector – design constraints – constraint surface –
objective function – objective function surfaces – classification of Optimization problems. Single
variable Optimization – multi variable Optimization without constraints – necessary and
sufficient conditions for minimum/maximum – multivariable Optimization with equality
constraints. Solution by method of Lagrange multipliers – multivariable Optimization with
inequality constraints – Kuhn – Tucker conditions.

UNIT – II: LINEAR PROGRAMMING
Standard form of a linear programming problem – geometry of linear programming problems –
definitions and theorems – solution of a system of linear simultaneous equations – pivotal
reduction of a general system of equations – motivation to the simplex method – simplex
algorithm.

UNIT – III: TRANSPORTATION PROBLEM
Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel’s
approximation method – testing for optimality of balanced transportation problems. One –
dimensional minimization methods: Classification, Fibonacci method and Quadratic
interpolation method. Dynamic programming multistage decision processes – types – concept of
sub optimization and the principle of optimality – computational procedure in dynamic
programming – examples illustrating the calculus method of solution - examples illustrating the
tabular method of solution.

UNIT – IV: UNCONSTRAINED OPTIMIZATION TECHNIQUES
Univariate method, Random Search methods, Grid Search method, Pattern Directions, Powell’s
method, Simplex method, Gradient of a function, Steepest Descent (Cauchy) method, Conjugate
Gradient (Fletcher-Reeves) method, Newton’s method.

UNIT – V: HEURISTIC OPTIMIZATION TECHNIQUES
Meta heuristic search methods: Genetic Algorithm based optimization, Simulated Annealing
Techniques, Swarm Intelligent Algorithms, PSO, etc.

TEXT BOOKS:
REFERENCES:
4. Linear Programming by G. Hadley

COURSE OUTCOMES:
After completion of the course, student will be able to:
- Learn about optimization problem and basic optimization issues
- Understand the concept of linear programming
- Learn about transportation problem and solution
- Understand unconstrained optimization techniques
- Acquire knowledge about various heuristic optimization techniques
COURSE OBJECTIVES:
The student will be able to:
- Understand the basic concepts of digital signals and systems
- Learn about transformation techniques and Filter realizations
- Learn about design concepts of IIR and FIR filters
- Understand the concept of quantization and error analysis
- Learn about poly phase decomposition and various applications

UNIT-I:

UNIT-II: Z- Transforms

UNIT III: IIR Digital Filter Design:

UNIT IV: FIR Digital Filter Design:
Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.

UNIT V: Analysis of Finite word length effects:
The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms. The basic sample rate alteration devices, Multi rate structures for sampling rate conversion, Multistage design of decimator and interpolator, The Polyphase decomposition, Arbitrary-rate sampling rate converter, Nyquist Filters and some applications of digital signal processing.

Text Books:

**References:**


**COURSE OUTCOMES:**

After completion of the course, student will be able to:

- Understand the basic concepts of digital signals and systems
- Learn about transformation techniques and Filter realizations
- Learn about design concepts of IIR and FIR filters
- Understand the concept of quantization and error analysis
- Learn about poly phase decomposition and various applications
COURSE OBJECTIVES:
The student will be able:
- To Design and optimize complex combinational and sequential digital circuits
- To Model combinational and sequential digital circuits by Verilog HDL
- To Design and model digital circuits with Verilog HDL at behavioral, structural, and RTL Levels
- To Develop test benches to simulate combinational and sequential circuits.
- To Understand the FPGA Architecture

SYLLABUS:
Unit I: Introduction to FPGAs
Introduction, Field-programmable Gate Arrays, Programmability and DSP, History of the Microchip, Technology Offerings, Influence of Programmability, Challenges of FPGAs.

Unit II: Verilog HDL Coding Style:
Lexical Conventions - Ports and Modules — Operators -Gate Level Modelling - System Tasks & Compiler Directives - Test Bench - Data Flow Modeling - Behavioral level Modeling -Tasks & Functions

Unit III: Verilog Modeling of Combinational & Sequential Circuits:
Behavioral, Data Flow and Structural Realization — Adders — Multipliers- Comparators - Flip Flops -Realization of Shift Register - Realization of a Counter- Synchronous and Asynchronous FIFO — Single port and Dual port RAM — Pseudo Random LFSR — Cyclic Redundancy Check

Unit IV: Synchronous sequential circuit:

Unit V: FPGA and its Architecture:

Text Books:

References:
2. Wayne Wolf, "FPGA Based System Design", Prentices Hall Modern Semiconductor Design Series

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

- Design and optimize complex combinational and sequential digital circuits
- Model combinational and sequential digital circuits by Verilog HDL
- Design and model digital circuits with Verilog HDL at behavioral, structural, and RTL Levels
- Develop test benches to simulate combinational and sequential circuits.
- Understand the FPGA Architecture
COURSE OBJECTIVES:
The student will be able:

- To introduce the concept of Solid State Lighting and to impart the skills necessary for implementing light emitting diode in various sectors of illumination.
- To Redesigning an existing office and educational facility with LED luminaire,

Unit-I: Fundamentals of lighting & terminologies

UNIT-II : LEDs & White light generation: Role of extraction efficiency & methods to increase it. Materials used for LEDs, Different types of LEDs, manufacturing technology White light generation, Challenges & Issues, RGB LED – CIE x-y chromaticity diagram, Advantages & disadvantages, Electrical Characteristics of LED & dependence of photometry Driver circuits – linear regulators, resistive circuits & current mirror.

UNIT-III : Driving Circuits for LEDs: Switching Regulators – Buck Converter
Boost Converter, Buck Boost Converter, SEPIC Converter, Numerical on Driver design for LEDs, Necessity of closed control loop & its considerations, closed loop control of LED, Dimming approaches.

UNIT-IV : Design of LED luminaires
Redesigning an existing office and educational facility with LED luminaire, Lighting quality and Energy conservation analysis of redesigned facility. OLEDs and its types, principle, advantages, disadvantages and application, AC LEDs and its challenges, Selecting components for drivers.

UNIT-V : Application of LEDs:
Traffic lights, Automotive signage, Displays- Alphanumeric displays, Full color video displays, Medical Applications- phototherapy of neonatal jaundice, Photo dynamic therapy, photo synthesis- plant growing, photo bioreactors.

Text Books:

Reference Books

3. Application Notes from Texas Instruments, National semiconductors, Hitachi

COURSE OUTCOMES:

After completion of the course, the student will be able to:

- Understand the concept of Solid State Lighting
- Implement light emitting diode in various sectors of illumination.
- Redesigning an existing office and educational facility with LED luminaire.
COURSE OBJECTIVES:
Objectives of this course are to:

• Introduce the fundamental concepts, principles, analysis and design of hybrid and electric vehicles
• Introduce the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used, energy storage devices, etc.

SYLLABUS:

UNIT-I: Introduction to Hybrid Electric Vehicles: Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT-II: Hybrid Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.


TEXT BOOKS:

REFERENCE BOOKS:
3. http://nptel.ac.in/syllabus/108103009
COURSE OUTCOMES:
After the completion of course, the student will be able to:

• Get knowledge on hybrid electric vehicles
• Compare the advantages and disadvantages of hybrid electric vehicles over conventional vehicles
• Compare the merits and demerits of hybrid electric trains over electrical trains
• Know the different energy storage techniques
• Discuss the electric population, motor drive technologies
• Analyze the different types of energy management strategies
COURSE OBJECTIVES:
The student will be able:

- To understand the operation of Power Electronic converters
- To enable the students gain a fair knowledge on the programming and simulation of Power Electronics.

List of Experiments:

1. Single Phase Full Controlled Converter With R And R-L Loads
2. Single Phase AC Voltage Controller With R And R-L Loads
3. Single Phase Cycloconverter
4. McMurray Full Bridge Inverter
5. Thyristorised Chopper
6. Simulation of Three Phase Fully Controlled Converter with R and R-L Loads using MATLAB/PSIM.
7. Simulation of Three Phase AC Voltage Controller with R and R-L Loads using MATLAB/PSIM.
8. Simulation of Three Phase Inverter in 180° Conduction Mode with Star & Delta Connected loads.
10. Simulation of Single Phase Cycloconverter

COURSE OUTCOMES:

After completion of the course, student will be able to:

- Understand the operation of Power Electronic converters
- Gain a fair knowledge on the programming and simulation of Power Electronics converters.

(Simulation software tools: Matlab/Simulink/PSPICE/PSIM)
COURSE OBJECTIVES:

The student will be able:

- To understand Principle of Operation Advanced Power Converters.
- To describe the operation of multi level inverters with switching strategies for high power applications.
- To comprehend the design of resonant converters and switched mode power supplies.

SYLLABUS:


UNIT-III: Multilevel Inverters


TEXT BOOKS:

COURSE OUTCOMES:
After taking this course, student will be able to:
• Understand Principle of Operation Advanced Power Converters.
• Develop and analyze various converter topologies.
• Describe the operation of multi level inverters with switching strategies for high power applications.
• Comprehend the design of resonant converters and switched mode power supplies.
COURSE OBJECTIVES:

To make the student learn about:

- Understand the different power quality and power frequency problems in the power system.
- Analyzing the types and causes of Electrical transients.
- Various types of Harmonics their causes and effects on Power System.
- The Concept of Electromagnetic Interference and its impacts Power Quality and Power System.

SYLLABUS:

UNIT I: INTRODUCTION TO POWER QUALITY AND POWER FREQUENCY DISTURBANCE


UNIT II: ELECTRICAL TRANSIENTS

Introduction to Transients - Transient System Model - Examples of Transient Models and Their Response - Types and Causes of Transients - Examples of Transient Waveforms – Three Phase unbalance – single phase faults – phase to phase faults – two phase to ground faults – seven tips of three phase unbalanced sag.

UNIT III: HARMONICS


UNIT IV: ELECTROMAGNETIC INTERFERENCE

Introduction to EMI - Frequency Classification - Electrical Fields - Magnetic Fields - EMI Terminology - Power Frequency Fields - High Frequency Interference - EMI Susceptibility - EMI Mitigation - Health Concerns of EMI.

UNIT V: POWER QUALITY PROBLEMS – EMI IMPACT


TEXT BOOKS:

1. Power quality by C. Sankaran, CRC Press
REFERENCE BOOKS:
2. Power quality enhancement using custom power devices by Arindam Ghosh, Gerard Ledwich, Kluwer academic publishers

COURSE OUTCOMES:

After completing the course, the student should be able to do the following:

- Understand the concepts of power quality and power frequency problems in the power system.
- Analyze different types of Electrical Transients and Harmonics along with their causes and effects.
- Understand the concept of Electromagnetic interference.
- Analyze the various effects of Electromagnetic Interference on Power Quality.
COURSE OBJECTIVES:

The student will be able:

- To understand principle operation of scalar control of ac motor and corresponding speed-torque characteristics
- To understand the vector control for ac motor drive (IM and SM)
- To explain the static resistance control and Slip power recovery drive
- To explain synchronous motor drive characteristics and its control strategies
- To understand the brushless dc motor principle of operation.

UNIT-I: Induction Motor - An Overview

UNIT-II: Voltage Source Inverter Fed Induction Motor Drive

UNIT-III: Rotor Side Control of Slip-Ring Induction Motor

UNIT-IV: Control of Synchronous Motor Drives

Unit-V: PMSM and BLDC Drives
Characteristics of Permanent Magnet, Synchronous Machines With Permanent Magnet, Vector Control of PMSM- Motor Model and Control Scheme, Constant Torque Angle Control, Constant Mutual Flux Linkages, Unity PF Control Modeling of PM Brushless Dc Motor, Drive Scheme, Commutation Torque Ripple, Phase Advancing.

TEXT BOOK:
REFERENCE BOOKS:

COURSE OUTCOMES:
After taking this course, student will be able to:

- Develop induction motor for variable speed operations using scalar and vector control techniques.
- Identify the difference between the rotor resistance control and static rotor resistance control method and significance of slip power recovery drives.
- Develop controllers for synchronous motor.
COURSE OBJECTIVES:
The student will be able:

• To create the awareness of energy conservation in students
• To identify renewable energy sources for electrical power generation
• To analyze different energy storage methods
• To have knowledge on environmental effects of energy conversion

SYLLABUS:
UNIT I:
SOLAR PHOTO VOLTAIC POWER AND THERMAL SYSTEMS: The PV cell, Module and array, equivalent electrical circuit, open circuit and short circuit current, i-v and p-v curves, array design. Energy collection, solar power plant, synchronous generator, commercial power plants

UNIT II:
FUNDAMENTAL OF WIND TURBINES: Historical back ground, power contained in wind, thermodynamics of wind energy, efficiency limit for wind energy conversion, maximum energy obtainable for a thrust-operated converter, types of wind energy conversion devices, some relevant definitions, aerodynamics, design of wind turbine rotor, power speed, torque-speed characteristics, wind turbine control systems, control strategy.

UNIT III:
GRID CONNECTED SYSTEMS: constant voltage, constant frequency generation, reactive power compensation, variable voltage, variable frequency generation, effect of wind generator on the network. Classification of schemes, operating area, induction generators, doubly fed induction generator, wound field synchronous generators, the permanent magnet generators.

UNIT IV:
INTEGRATION OF WIND FORMS IN TO THE POWER SYSTEM: Reactive power compensation-Static Var compensator- Static synchronous compensator-STATCOM and FSIG stability, HVAC connections, HVDC connections-LCC-HVDC, Vsc-HVDC, Multi terminal HVDC. HVDC Transmission-opportunities and challenges

UNIT V:
ENERGY STORAGE AND HYBRID ENRGY SYSTEMS: Battery, types of batteries, equivalent electrical circuit, performance characteristics, lead- acid battery, battery design, battery charging, charging regulators, battery management, flywheel. Diesel generator and photo-voltaic system, wind-diesel hybrid system, wind-Photo voltaic systems.

References:
3. “Wind energy generation modeling and control” , Anaya-Lara, Jenkins et al John Wiley & Sons Ltd
COURSE OUTCOMES:

After completion of the course, the student will be able to:

- Find different renewable energy sources to produce electrical power
- Estimate conventional energy sources to produce electrical energy
- Role-play the fact that the conventional energy resources are depleted
- Arrange Stored energy and to avoid the environmental pollution
COURSE OBJECTIVES:

The student will be able:

• To identify the necessity of reactive power compensation
• To describe load compensation
• To select various types of reactive power compensation in transmission systems
• To illustrate reactive power coordination system
• To characterize distribution side and utility side reactive power management.

SYLLABUS:

UNIT-I: LOAD COMPENSATION

Objectives and specifications – Reactive power characteristics – Inductive and capacitive approximate biasing – Load compensator as a voltage regulator – Phase balancing and power factor correction of unsymmetrical loads - Examples.

UNIT-II: STEADY – STATE & TRANSIENT STATE REACTIVE POWER COMPENSATION IN TRANSMISSION SYSTEM


UNIT-III: REACTIVE POWER COORDINATION & DEMAND SIDE MANAGEMENT


UNIT-IV: DISTRIBUTION & USER SIDE REACTIVE POWER MANAGEMENT

UNIT-V: REACTIVE POWER MANAGEMENT IN ELECTRIC TRACTION SYSTEMS AND ARC FURNACES


TEXT BOOKS:


COURSE OUTCOMES:

After completion of the course, the student will be able to:

• Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads
• Observe various compensation methods in transmission lines
• Construct model for reactive power coordination
• Distinguish demand side reactive power management & user side reactive power management
COURSE OBJECTIVES:

The student will be able to:

- Understand the concept of adaptive control problem, basic models of adaptive control
- Learn about Self Tuning Regulator
- Learn about STR control mechanisms and LQG control
- Understand the concept of MRAS
- Learn about SOAS and Gain scheduling

Unit – I

Unit – II
Block Diagram of Deterministic Self Tuning Regulator (STR), Pole Placement Design – Process Model, Causality Conditions. Indirect STRs – Estimation, Continuous - Time STRs, Direct STRs – Minimum Phase Systems, Adaptive Control Algorithm, Feed Forward Control, Non Minimum Phase Systems – Adaptive Control Algorithm, Algorithm For Hybrid STR.

Unit – III
Design of Minimum Variance and Moving - Average Controllers, Stochastic STR – Indirect STR, Algorithm for Basic STR, Theorems on Asymptotic Properties. Unification of Direct STRs, Generalized Direct Self Tuning Algorithm, Self Tuning Feed Forward Control. Linear Quadratic STR – Theorems on LQG Control, Algorithms for Indirect LQG – STRs Based on Spectral Factorization and Riccati Equation.

Unit – IV

Unit – V
Text books:
2. Sankar Sastry, Adaptive control.

References
1. V.V.Chalam, Adaptive Control System - Techniques & Applications, Marcel Dekker Inc.

COURSE OUTCOMES:

After completion of the course, student will be able to:

- Understand the concept of adaptive control problem, basic models of adaptive control
- Learn about Self Tuning Regulator
- Learn about STR control mechanisms and LQG control
- Understand the concept of MRAS
- Learn about SOAS and Gain scheduling
COURSE OBJECTIVES:

To make the student learn about:

- HVDC and EHVAC systems and their applications.
- Different Harmonics suppression filters and their role in power systems.
- Various theories like Electrostatic field and Travelling Wave Theory
- How to control the Voltage in various systems for effective and efficient system.

SYLLABUS:

UNIT - I: INTRODUCTION TO HVDC SYSTEMS

Introduction, Basic means of control-power reversal-constant current versus constant voltage control-Desired features of control- Actual control characteristics - Constant minimum ignition angle control - constant current control - Constant extinction angle control-stability of control - Tap changer control - Frequency control.

UNIT - II: HARMONICS SUPPRESSION FILTERS, INTERACTION BETWEEN AC AND DC SYSTEMS

Characteristic Harmonics-troubles caused by harmonics-definitions of wave distortion or ripples –means of reducing harmonics-design of AC filters –Dc side filters- Voltage interaction –DC power modulation – Power frequency control-Large signal modulation – active and reactive power coordination.

UNIT – III: EHVAC TRANSMISSION SYSTEM


UNIT – IV: ELECTRO STATIC FIELD & TRAVELING WAVE THEORY


UNIT – V: VOLTAGE CONTROL

Introduction to Voltage Control - Power circle diagram and its use – Voltage control using synchronous condensers – Cascade connection of shunt and series compensation – Sub synchronous resonance in series capacitor – Compensated lines – Static VAR compensating system.

TEXT BOOKS:

1. R. D. Begamudre, EHVAC Transmission Engineering, New Age International (p) Ltd.
2. S. Rao, HVAC and DC Transmission.
REFERENCE BOOKS:

1. High voltage direct current transmission by J. Arrilaga, IEE power engineering series.

COURSE OUTCOMES:

After completing the course, the student should be able to do the following:

- Understand the basics of HVDC and EHVAC systems and their characteristics.
- Analyze different types of Harmonic suppression Filters and also the interaction between AC and DC Systems due to the presence of harmonics.
- Analyze the impacts of electrostatic field and travelling wave on the system.
- Understand the different methods to Control the Voltage of the system at various points of power system.
COURSE OBJECTIVES:

The student able to learn about:

- Able to know about the concept of distributed generation, distribution network & the concept of Microgrid, its configuration, advantages & limitations.
- Able to understand the basic concepts in combined heat and power, Wind energy conversion systems, solar photovoltaic systems & other renewable energy sources.
- Able to analyze the impact of Microgrid & Active distribution network management system on various factors.
- Able to know the effect of SCADA & understand the concept of Power quality disturbances, improvement technologies & issues of premium power in DC integration.

SYLLABUS:

UNIT I: INTRODUCTION TO DISTRIBUTED GENERATION AND MICROGRID CONCEPT


UNIT II: DISTRIBUTED ENERGY RESOURCES

Introduction - Combined heat and power (CHP) systems: Micro-CHP systems - Wind energy conversion systems (WECS): Wind turbine operating systems - Solar photovoltaic (PV) systems: Classification of PV cell - Small-scale hydroelectric power generation - Other renewable energy sources - Storage devices.

UNIT III: MICROGRID AND ACTIVE DISTRIBUTION NETWORK MANAGEMENT SYSTEM


UNIT IV: SCADA AND ACTIVE DISTRIBUTION NETWORKS

Introduction - Existing DNO SCADA systems - Control of DNO SCADA systems - SCADA in Microgrids - Human–machine interface (HMI) - Hardware components - Communication trends in SCADA - Distributed control system (DCS) - Sub-station communication standardization - SCADA communication and control architectures - Communication devices.
UNIT V: IMPACT OF DG INTEGRATION ON POWER QUALITY AND RELIABILITY


TEXT BOOK:

COURSE OUTCOMES: Student acquire knowledge about:

- Understand the concept of distributed generation, distribution network & the concept of Microgrid, its configuration, advantages & limitations.
- Understand the basic concepts in combined heat and power, Wind energy conversion systems, Solar photovoltaic systems & other renewable energy sources.
- The impact of Microgrid & Active distribution network management system on various factors is known.
- Understand the effect of SCADA & understand the concept of Power quality disturbances, improvement technologies & issues of premium power in DC integration.
Course objectives: Student learnt about:

- To analyse the concepts of Electricity billing and electrical load management.
- To understand the types of electrical products and systems that can lose energy.
- Learn how to measure energy loss.
- Able to know how to select and size equipment for the application.

SYLLABUS:

UNIT-I:

**ELECTRICAL SYSTEM:** Electricity billing, Electrical load management and maximum demand control, Power factor improvement and its benefits, Selection and location of capacitors, Performance assessment of PF capacitors, Distribution and transformer losses.

UNIT-II:

**ELECTRIC MOTORS:** Types, Losses in electric motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving methods in electric motors.

UNIT-III:

**LIGHTING SYSTEM:** Light source, choice of lighting, illumination requirements, and energy conservation aspects. Energy efficient lighting controls, comparison of sodium vapor, halogen, CFL and LED lamps.

UNIT-IV:

**Electric Drives:** Maximum demand controllers, energy efficient drives, soft-starters with energy saver, variable speed drives, energy efficient techniques in drives.

UNIT-V:

**Power Electronic Systems:** Automatic power factor controllers, electronic ballast, occupancy sensors, energy saving in power electronic controlled systems. Calculation of energy frequency ratio in the performance of star ratings.

TEXT BOOKS:


REFERENCE:

2. Bureau of Energy Efficiency (BEE) : www.bee-india.nic.in
5. www.bee-india.nic.in (Guide on Energy Efficient room Air conditioners)

COURSE OUTCOMES:

- Analysed the concept of Electricity billing and electrical load management.
- Understand the types of electrical products and how the systems can lose energy.
- Measuring of energy loss is known.
- Understand how to select and size equipment for the application.
COURSE OBJECTIVES:

The student will be able to:

- Learn about basic concepts of AI
- Understand concepts of ANN and various learning algorithms
- Learn about Genetic Algorithm, ACO and Tabu search concepts
- Understand the concepts of Fuzzy
- Learn about Fuzzy logic controller and design using MATLAB


UNIT II

UNIT III
Genetic Algorithm: Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other than GA search techniques like tabu search and ant - colony search techniques for solving optimization problems.

UNIT IV
Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to Fuzzy logic modeling and control of a system. Fuzzification, inference and defuzzification. Fuzzy knowledge and rule bases.

UNIT V

Text Books:


References:


COURSE OUTCOMES:

After completion of the course, student will be able to:

- Learn about basic concepts of AI
- Understand concepts of ANN and various learning algorithms
- Learn about Genetic Algorithm, ACO and Tabu search concepts
- Understand the concepts of Fuzzy
- Learn about Fuzzy logic controller and design using MATLAB
COURSE OBJECTIVES:

The student will be able to:
- Understand the operation of Power Electronic Drives.
- Enable the students gain a fair knowledge on the simulation of Power Electronics Drives.

List of Experiments:
1. 1-Phase AC input Thyristorised DC Drive with Closed Loop Control.
2. 3-Phase AC input Thyristorised DC Drive with Closed Loop Control.
3. Four Quadrant Chopper fed PMDC Motor Drive with Speed Closed Loop Control.
4. 1-Phase AC Induction Motor Speed Control using Cyclo Converter.
5. 3-Phase AC Wound Rotor Induction Motor Speed Control from rotor side.
6. Simulation of VSI fed Induction motor (square wave and PWM inverters).
7. Simulation of induction motor with open loop constant V/F control.
8. Simulation of Closed loop speed control of BLDC motor.
10. Simulation of PMSM.

COURSE OUTCOMES:
After completion of the course, student will be able to:
- Understand the operation of Power Electronic Drives.
- Acquire skills of computer packages, MATLAB coding and SIMULINK in power electronics drives

(Simulation software tools: Matlab/Simulink/PSPICE/PSIM)
UNIT I


UNIT II


Data Collection Methods – Primary Data – Secondary data – Questionnaire Survey and Interviews.

UNIT III

Correlation and Regression Analysis – Method of Least Squares – Regression vs Correlation – Correlation vs Determination – Types of Correlations and Their Applications

UNIT IV

UNIT V


Text Books:

2. Research Methodology: A Step By Step Guide For Beginners- Ranjit Kumar, Sage Publications (Available As Pdf On Internet)

REFERENCES:

1. Scientists Must Write - Robert Barrass (Available As Pdf On Internet)
2. Crafting Your Research Future – Charles X. Ling And Quiang Yang (Available As Pdf On Internet)
(17D20302) HUMAN VALUES AND PROFESSIONAL ETHICS

(Elective V - OPEN ELECTIVE)

Unit I:


Unit II:


Unit III:

ENGINEERING AS SOCIAL EXPERIMENTATION: Engineering As Social Experimentation - Framing the problem - Determining the facts - Codes of Ethics - Clarifying Concepts - Application issues - Common Ground - General Principles - Utilitarian thinking respect for persons.

UNIT IV:


UNIT V:

Text Books:


5. “Professional Ethics and Human Values” by A.Alavudeen, R.Kalil Rahman and M.Jayakumaran, Laxmi Publications.
UNIT – I


UNIT – II

Trade Marks : Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.

UNIT – III


UNIT – IV

Trade Secrets : Trade Secrete Law, Determination Of Trade Secrete Status, Liability For Misappropriations Of Trade Secrets, Protection For Submission, Trade Secrete Litigation.

Unfair Competition : Misappropriation Right Of Publicity, False Advertising.

UNIT – V


TEXT BOOKS & REFERENCES:
