JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR
ANANTHAPURAMU (A.P.)
COURSE STRUCTURE AND SYLLABUS
(For Affiliated Engineering Colleges w.e.f. 2017-18 Admitted Batch)
M.TECH - POWER ELECTRONICS, POWER & INDUSTRIAL DRIVES, POWER ELECTRONICS & ELECTRICAL DRIVES and POWER ELECTRONICS AND DRIVES

M.Tech I Semester

S.No	Subject Code	Subject	L	T	P	C
1.	17D54101	Advanced Power Semiconductor Devices	4	-	-	4
2.	17D49102	Machine Modeling and Analysis	4	-	-	4
3.	17D54102	Solid-State DC Drives	4	-	-	4
4.	17D54103	Applications of Power Electronics to Power Systems	4	-		4
5.	17D49105 17D49103 17D54104	**Elective-I** 1. Modern Control Engineering & Principles of Optimal Control 2. Optimization & Heuristic search Techniques 3. Advanced Digital Signal Processing	4	-	-	4
6.	17D54105 17D54106 17D54107	**Elective-II** 1. FPGA based Digital System Design 2. Solid-state Lighting and Control 3. Hybrid Electric Vehicle Systems	4	-	-	4
7.	17D54108	Power Electronics and Simulation Lab	-	-	4	2
		TOTAL	**24**	**-**	**04**	**26**

M.Tech II Semester

S.No	Subject Code	Subject	L	T	P	C
1.	17D54201	Advanced Power Converters	4	-	-	4
2.	17D49202	Power Quality	4	-	-	4
3.	17D54202	Advanced Drives & Control	4	-	-	4
4.	17D54203	Renewable Energy Conversion Systems	4	-		4
5.	17D49205 17D54204 17D49207	**Elective-III** 1. Reactive Power Compensation and Management 2. Adaptive Control 3. HVDC & EHVAC Transmission Systems	4	-	-	4
6.	17D49208 17D54205 17D49210	**Elective-IV** 1. Distributed Generation & Micro Grid Control 2. Energy Efficient Electrical Systems 3. Intelligent Control Techniques	4	-	-	4
7.	17D54206	Electrical Drives and Simulation Lab	-	-	4	2
		TOTAL	**22**	**-**	**04**	**26**

M.Tech III Semester

S.No	Subject Code	Subject	L	T	P	C
1.	17D20301 17D20302 17D20303	**Elective – V** 1. Research Methodology 2. Human Values and Professional Ethics 3. Intellectual Property Rights	4	-	-	4
2.	17D54301	**Elective - VI (MOOCS)**	-	-	-	-
3.	17D54302	Comprehensive Viva-Voce	-	-	-	2
4.	17D54303	Seminar	-	-		2
5.	17D54304	Teaching Assignment	-	-	-	2
6.	17D54305	Project Work Part – I	-	-	-	4
		TOTAL	**04**	**-**	**-**	**14**

M.Tech IV Semester

S.No	Subject Code	Subject	L	T	P	C
1.	17D54401	. Project Work Part - II	-	-	-	12

Project Viva Voce Grades:

A: Satisfactory

B: Not Satisfactory

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D54101) ADVANCED POWER SEMICONDUCTOR DEVICES

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-I: Introduction: Power switching devices, overview – Attributes of an ideal switch, application requirements, Device selection strategy – On-state and switching losses – Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

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, optocopler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

UNIT-V: Thermal Protection: Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for hear sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design.

Text books:

1. Rashid M. H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi.
2. B.W. Williams 'Power Electronics: Devices, Drivers, Applications and Passive Components, Tata McGraw Hill.

Reference books:

1. Advanced power electronics converters by Euzeli dos santos, Edison R. da silva.
2. Fundamentals of Power Semiconductor Devices by B. Jayanth Baliga, Springer Press, 2008.

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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D49102) MACHINE MODELING AND ANALYSIS

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, inter connection 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 III: Modeling of Three Phase Induction Machines: Voltage and torque equations in machine variables, Voltage and torque equations in arbitrary reference frame, Steady-state analysis and its operation. Free acceleration characteristics viewed from various reference frames, dynamic performance during sudden changes in load torque, dynamic performance during a three-phase fault at the machine terminals.

Unit IV: Modeling of Synchronous Machine: Voltage and torque equations in machine variables, Voltage equations in arbitrary and rotor reference frame, torque equations in in substitute variable, Steady-state analysis and its operation - Dynamic performance of synchronous machine, three-phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria.

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:

1. **Analysis of Electric Machinery and Drive Systems**, Paul C.Krause , Oleg wasynezuk, Scott D.Sudhoff, 3rd Edition, WILEY-IEEE Press, 2013.
2. **Electrical Motor Drives: Modelling, Analysis and Control** by R. Krishnan, Prentice-Hall, 2001.
3. **Thyristor control of Electric Drives** by Vedam Subramanyam, TMH, 18th Re-print, 2008.

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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D54102) SOLID STATE DC DRIVES

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 horse power 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

1. Gopal K Dubey, “Power Semiconductor controlled Drives”, Prentice Hall Inc., New Yersy, 1989.
2. R.Krishnan, “Electric Motor Drives – Modeling, Analysis and Control”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2003.

REFERENCES

1.Gobal K.Dubey, “Fundamentals of Electrical Drives”, Narosal Publishing House, New Delhi, 2001.
2.Bimal K.Bose “Modern Power Electronics and AC Drives”, Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
3.Vedam Subramanyam, “Electric Drives – Concepts and Applications”, Tata McGraw-Hill publishing company Ltd., New Delhi, 2002.
4.P.C Sen “Thyristor DC Drives”, John wiely and sons, New York, 1981

5. Power Electronics By M. D. Singh

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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D54103) APPLICATIONS OF POWER ELECTRONICS TO POWER SYSTEMS

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 I: General System considerations and FACTS: Transmission Interconnections, Flow of Power in an AC System, Power Flow and Dynamic Stability Considerations of a Transmission Interconnection, principles of series and shunt compensation, Basic Types of FACTS Controllers, Benefits from FACTS, Application of FACTS.

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
2. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, Electrical Power Systems Quality, McGraw Hill,2003

Suggested Reading:

1. Y.H.Song, A.T.Johns, Flexible A.C.Transmission System, IEE, London, 1999

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D49105) MODERN CONTROL ENGINEERING & PRINCIPLES OF OPTIMAL CONTROL (Elective – I)

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

Review of State-space representation, Controllability - Pole assignment using State feedback – Ackerman's formula for feedback gain determination; Observability. Duality. Effect of state feedback on controllability and observability. Controllable subspace – decomposition of states into controllable and uncontrollable components.

Unit II

Design of full-order observer – Bass Gura algorithm. The separation principle - Combined observer – controller compensator. Design of reduced order observer. Unobservable subspace – decomposition of states into observable and unobservable components – Canonical decomposition theorem.

Unit III

Reducibility – realization of transfer function matrices. Model decomposition and decoupling by state feedback. Design of robust control system for asymptotic tracking and disturbance rejection using State variable equations. Transfer function interpretations – transfer function form of observer and state estimate feedback. State-space interpretation of internal model principle.

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:

1. Modern Control Engineering, Katsuhiko Ogata, 5th Edition, Prentice Hall India, 1997
2. Modern Control System Theory, M. Gopal, Revised 2nd Edition, New Age International Publishers, 2005.
3. D.S. Naidu, Optimal control systems, CRC Press, First edition, 2002.

References:

1. Linear Systems, Thomas Kailath, Perntice Hall, 1980.
2. Control System Design, Graham C. Goodwin, StefanF. Graebe and Mario E. Salgado, Pearson Education, 2000.
3. Linear System Theory and Design, Chi-Tsong Chen, OXFORD University Press.

4. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 11th Edition, Pearson Edu India, 2009.
5. Donald E.Kirk, Optimal Control Theory an Introduction, Prentice - Hall Network series - First edition, 1970.

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D49103) OPTIMIZATION & HEURISTIC SEARCH TECHNIQUES
(Elective – I)

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:
1. "Modern Heuristic Optimization Techniques" by Kwang Y. Lee, Mohamed A. El-Sharkawi
2."Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rdedition, 1998.
3. "Introductory Operations Research" by H.S. Kasene & K.D. Kumar, Springer(India), Pvt.LTd.

REFERENCES:

1. "Optimization Methods in Operations Research and systems Analysis" – by K.V. Mital and C. Mohan, New Age International (P) Limited, Publishers, 3 rd edition, 1996.
2. Operations Research – by Dr. S.D.Sharma.
3. "Operations Research: An Introduction" by H.A. Taha, PHI Pvt. Ltd., 6thedition
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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D54104) ADVANCED DIGITAL SIGNAL PROCESSING

(Elective – I)

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:

Introduction, Analog-to-digital and Digital-to-Analog conversion, sampled and hold circuit, Continuous-time Fourier Transforms. Discrete-time signals and systems, Discrete-time Fourier transform- its properties and applications, Fast-Fourier Transform (in time-domain and Frequency domain) , IDFT and its properties.

UNIT-II: z- Transforms

Definition and properties, Rational z-transforms, Region of convergence of a rational z-Transform, The inverse z- Transform, z-Transform properties, Computation of the convolution sum of finite-length sequences, The transfer function. Digital Filter Structures, Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

UNIT III: **IIR Digital Filter Design:**

Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.

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:

1. S.K. Mitra**, Digital Signal Processing**-, Tata McGraw-Hill, Third Edition, 2006.

2. B.P. Lathi, **Principle of Signal Processing and Linear Systems**, Oxford International Student Version, 2009

3. M. Mondal and A Asif, **Continuous and Discrete Time Signals and Systems**, Cambridge, 2007

References:

1. Li Tan, **Digital Signal Processing- Fundamentals and Applications**-, Indian reprint, Elsevier, 2008.

2. Alan V. Oppenheim, Ronald W. Schafer, and John R.Buck, **Discrete- Time Signal Processing**-, Pearson Edu, 2008.

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D54105) FPGA BASED DEGITAL SYSTEM DESIGN

(Elective – II)

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:

State diagram-state table —state assignment-choice of flip-flops — Timing diagram —One hot encoding- Mealy and Moore state machines — Design of serial adder using Mealy and Moore state machines - State minimization — Sequence detection- Design of vending machine using One Hot Controller

Unit V: FPGA and its Architecture:

Types of Programmable Logic Devices- PLA & PAL- FPGA Generic Architecture. ALTERA Cyclone II Architecture — Timing Analysis and Power analysis using Quartus-II- SOPC Builder- NIOS-II Soft-core Processor- System Design Examples using ALTERA FPGAs — Traffic light Controller, Real Time Clock - Interfacing using FPGA: VGA, Keyboard, LCD.

Text Books:

1. S.Ramachandran," Digital VLSI System Design: A Design Manual for Implementation of Projects on FPGAs and ASICs Using Verilog" Springer Publication,2007

2. Samir Palnitkar,"Verilog HDL: A Guide to Digital Design and Synthesis" Prentice Hall, Second Edition,2003 3. Roger Woods,John McAllister,Gaye Lightbody,Ying Yi " FPGA-based Implementation of Signal Processing Systems" John Wiley & Sons, Ltd,2008.

References:

1. Charles H Roth, Jr "Digital Systems design using VHDL", Thomson Books/Cole 2. Wayne Wolf, "FPGA Based System Design", Prentices Hall Modern Semiconductor Design Serie 3. Mark Balch, "Complete Digital design — A Comprehensive Guide to Digital Electronics and Computer system Architecture," Mc Graw Hill, 2007

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D54106) SOLID STATE LIGHTING AND CONTROL

(Elective – II)

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

Generation of radiation, CCT, CRI & CT,Review of Light sources, Solid State Lighting Photons emission in LEDs,Life cycle of photon, Overall, Internal, External & Extraction efficiency of photons in LEDs,Optical characteristics of LED,Light escape cone and its relevance in LED design & Numerical Lambertian Radiation pattern .

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:

1. Arturas Zukauskus, Michael S. Shur and Remis Gaska, "Introduction to solid state lighting", wiley interscience 2002.
2. Mohan Underland and Robbins, " Power Electronic converters, Applications and Design", John Wiley and sons, 1989

3. Patrick Mottier, “LEDs for Lighting Applications”, John Wiley & Sons, 2009

Reference Books

1. E Fred Schubert, “ Light emitting Diodes” (2nd Edition), Cambridge University press, 2006
2. Gilbert Held, “Introduction to Light Emitting Diode Technology and Applications”, CRC press, 2009
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.

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M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D54107) HYBRID ELECTRIC VEHICLE SYSTEMS

(Elective – II)

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.

UNIT-III: Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT-IV: Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT-V: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

TEXT BOOKS:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design,CRC Press, 2004.
3. Ali Emadi,Advanced Electric Drive Vehicles, ,CRC Press, 2017

REFERENCE BOOKS:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2013.
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

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M.Tech I year I Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D54108) POWER ELECTRONICS AND SIMULATION LAB

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 180^0 Conduction Mode with Star & Delta Connected loads.
9. Simulation of Choppers.
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)

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M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D54201) ADVANCED POWER CONVERTERS

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-I: PWM Inverters: Principle of Operation – Performance Parameters – Single Phase Bridge Inverter – Output Voltage and Current With R, R-L & R-L-C Loads – Voltage Control of Single Phase Inverters – Advanced Modulation Techniques for Improved Performance –Numerical Problems.
Three Phase Inverters –180 Degree Condition –120 Degree Conduction – Analysis – Output Voltage and Current With R, R-L & R-L-C Loads – Voltage Control of Three Phase Inverters – Comparison of PWM Techniques – Harmonic Reductions – Current Source Inverter – Variable DC Link Inverter – Buck and Boost Inverter – Inverter Circuit Design – Applications – Numerical Problems.

UNIT-II: Resonant Pulse Inverters: Series Resonant Inverters – Analysis with Unidirectional Switches & Bidirectional Switches – Evaluation of Currents and Voltages – Frequency Response of Series Resonant Inverters – Series Loaded Inverter –Parallel Loaded Inverter –Series and Parallel Loaded Inverters – Parallel Resonant Inverters – Voltage Control of Resonant Inverters – Class E Resonant Inverter & Class E Resonant Rectifier – Numerical Problems.
Resonant Converters – Zero Current Switching Resonant Converters – L Type– M Type – Zero Voltage Switching Resonant Converters – Comparison Between ZCS And ZVS – Resonant Converters – Two Quadrant ZVS Resonant Converters – Resonant DC-Link Inverters – Numerical Problems.

UNIT-III: Multilevel Inverters
Multilevel Concept – Types of Multilevel Inverters – Diode Clamped Multilevel Inverter – Improved Diode Clamped Inverter – Flying Capacitors Multilevel Inverter – Cascaded Multilevel Inverter– Principle Of Operation – Main Features– Applications – Reactive Power Compensation, Back to Back Intertie System, Adjustable Drives– Switching Device Currents – DC Link Capacitor Voltage Balancing – Features of Multilevel Inverters –Comparisons of Multilevel Converters – Numerical Problems.

UNIT-IV: DC Power Supplies :DC Power Supplies – Types – Switched Mode DC Power Supplies – Fly Back Converter –Forward Converter – Push-Pull Converter – Half Bridge Converter – Full Bridge Converter –Resonant DC Power Supplies – Bidirectional Power Supplies – Applications – Numerical Problems.

UNIT-V: AC Power Supplies: AC Power Supplies – Types – Switched Mode Ac Power Supplies – Resonant AC Power Supplies – Bidirectional Ac Power Supplies – Multistage Conversions – Control Circuits – Power Line Disturbances – Power Conditioners – Uninterruptible Power Supplies – Applications – Numerical Problems.

TEXT BOOKS:
1. **Power Electronics** by Mohammed H. Rashid, Pearson Education, Third Edition.
2. **Fundamentals of Power Electronics** by Robert Warren Erickson and Dragan Maksimovic, Springer US, 2nd Edition, 2001.

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.

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M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D49202) POWER QUALITY

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

Introduction to Power Quality - Power Quality Issues - Susceptibility Criteria - Role of Power Suppliers and Users - Power Quality Standards. Introduction to Power Frequency Disturbances - Common Power Frequency Disturbances - Cures for Low Frequency Disturbances - Voltage Tolerance Criteria.

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

Definition of Harmonics - Odd and Even Order Harmonics - Harmonic Phase Rotation and Phase Angle – Causes of Voltage and Current Harmonics – Individual and Total Harmonic Distortion - Harmonic Signatures - Effect of Harmonics on Power System Devices - Guidelines for Harmonic Voltage and Current Limitation - Harmonic Current Mitigation.

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

Introduction to Power Quality Measurements - Power Quality Measurement Devices - Power Quality Measurements - Test Locations - Test Duration - Instrument Setup - Instrument Guidelines

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Understanding Power quality problems by Math H. J. Bollen IEEE Press
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.

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M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D54202) ADVANCED DRIVES & CONTROL

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

Review of Steady-State Operation of Induction Motor, Equivalent Circuit Analysis, Torque-Speed Characteristics. Phase Controlled Induction Motor Drive, Stator Voltage Control of Induction Motor, Phase-Controlled Converter Fed Induction Motor, Power Circuit and Gating, Reversible Phase-Controlled Induction Motor Drive, Torque-Speed Characteristics.

UNIT-II: Voltage Source Inverter Fed Induction Motor Drive

Stator Voltage and Frequency Control of Induction Motor, Torque-Speed Characteristic Static Frequency Changers, PWM Inverter Fed Induction Motor Drive, Variable-Voltage Variable-Frequency Operation of Induction Motor, Constant E/f And V/f Control Schemes, Slip Regulation. Current Source Inverter Fed Induction Motor Drive, Stator Current and Frequency Control of Induction Motor, Auto Sequentially Commutated Inverter (ASCI), Power Circuit, Commutation, Phase Sequence Reversal, Regeneration, Steady-State Performance.

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

Slip-Power Recovery Schemes, Steady-State Analysis- Range of Slip, Equivalent Circuit, Performance Characteristics; Rating of Converters. Vector Control of Induction Motor, Principles of Vector Control, Direct Vector Control, Derivation of Indirect Vector Control, Implementation – Block Diagram, Estimation of Flux, Flux Weakening Operation.

UNIT-IV: Control of Synchronous Motor Drives

Synchronous Motor and Its Characteristics- Control Strategies-Constant Torque Angle Control-Power Factor Control, Constant Flux Control, Flux Weakening Operation, Load Commutated Inverter Fed Synchronous Motor Drive, Motoring and Regeneration, Phasor Diagrams.

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:

1.R. Krishnan, **Electric Motor Drives Modeling, Analysis & control**, Pearson Education, 2001.

REFERENCE BOOKS:

1. B. K. Bose **Modern Power Electronics and AC Drives**, Pearson Publications-2001.
2. MD Murphy & FG Turn Bull, Pergaman press, **Power Electronics control of AC motors** 1stedition-1998.
3. G.K. Dubey **Fundamentals of Electrical Drives,** Narosa Publications -1995.

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.

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M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D54203) RENEWABLE ENERGY CONVERSION SYSTEMS

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:

1. **" Wind and solar Power Systems Design, analysis & Operation"** Mukund R. Patel CRC Taylor & Fracis- 2nd edition
2."**Wind Electrical Systems"** S.N.Bhadra, D. Kastha, S. Banerjee Oxford University press.
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

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M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D49205) REACTIVE POWER COMPENSATION & MANAGEMENT

(Elective – III)

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

Uncompensated line – Types of compensation – Passive shunt and series and dynamic shunt compensation – Characteristic time periods – Passive shunt compensation – Static compensation - Series capacitor compensation – Compensation using synchronous condensers –Examples.

UNIT-III: REACTIVE POWER COORDINATION & DEMAND SIDE MANAGEMENT

Objective – Mathematical modeling – Operation planning – Transmission benefits – Basic concepts of quality of power supply – Disturbances - Steady – state variations – Effects of under Voltages – Frequency – Harmonics, radio frequency and electromagnetic interferences. Load patterns – Basic methods - load shaping – Power tariffs - KVAR based tariffs - penalties for voltage flickers and Harmonic voltage levels.

UNIT-IV: DISTRIBUTION & USER SIDE REACTIVE POWER MANAGEMENT

System losses – Loss reduction methods – Examples – Reactive power planning – Objectives – Economics - Planning capacitor placement – Retrofitting of capacitor banks - KVAR requirements for domestic appliances – Purpose of using capacitors – Selection of capacitors – Deciding factors – Types of capacitors, characteristics and Limitations.

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

Typical layout of traction systems – Reactive power control requirements – Distribution transformers - Electric arc furnaces – Furnaces transformer – Filter requirements – Remedial measures – Power factor of an arc furnace.

TEXT BOOKS:

1. J.E.Miller, Reactive Power Control in Electric Power Systems, John Wiley and Sons, 1982 (Units I to IV).
2. D.M.Tagare, Reactive power Management, Tata McGraw Hill, 2004 (Units V toVIII).

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

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M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D54204) ADAPTIVE CONTROL
(Elective – III)

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

Introduction, Block Diagram of an Adaptive System, Effects of Process Variations on System Performance, Types of Adaptive Schemes, Formulation of the Adaptive Control Problem, Least Squares Method and Regression Models for Parameter Estimation, Estimating Parameters in Models of Dynamic Systems, the Finite Impulse Response Model, The Transfer Function and Stochastic Model.

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

Model Reference Adaptive System (MRAS), The MIT Rule, Block Diagram of an MRAS for adjustment of Feed Forward Gain based on MIT Rule. Adaptation Gain – Methods for determination. Design of MRAS using Lyapunov Theory – Block Diagram of an MRAS based on Lyapunov Theory for a First Order System. Proof of The Kalman – Yakubovich Lemma, Adjustment Rules for Adaptive Systems, Relation between MRAS and STR.

Unit – V

Gain Scheduling – Principle, Block Diagram, Design of Gain Scheduling Controllers, Nonlinear Transformations, Block Schematic of a Controller based on Nonlinear Transformations. Application of Gain Scheduling for Ship Steering, Flight Control. Self Oscillating Adaptive System (SOAS) – Principle, Block Diagram, Properties of The Basic SOAS, Procedure for Design of SOAS. Industrial Adaptive Controllers and applications.

Text books:

1. K.J.Astrom and Bjorn Wittenmark, Adaptive control, Pearson Edu., 2nd Edn.
2. Sankar Sastry, Adaptive control.

References

1. V.V.Chalam, Adaptive Control System - Techniques & Applications, Marcel Dekker Inc.
2. Miskhin and Braun, Adaptive control systems, MC Graw Hill
3. Karl Johan Åström, Graham Clifford Goodwin, P. R. Kumar, Adaptive Control, Filtering and Signal Processing.
4. G.C. Goodwin, Adaptive control.
5. Narendra and Anna Swamy, Stable Adaptive Systems.

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

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M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D49207) HVDC & EHVAC TRANSMISSION SYSTEMS
(Elective – III)

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 SUPRESSION 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

Introduction to EHVAC, Line inductance and capacitances – Sequence inductances and capacitances – Modes of propagation – Ground return – Examples. Electrostatics – Field of sphere gap – Field of line changes and properties – Charge – potential relations for multi-conductors – Surface voltage gradient on conductors – Distribution of voltage gradient on sub-conductors of bundle – Examples.

UNIT – IV: ELECTRO STATIC FIELD & TRAVELING WAVE THEORY

Electrostatic field: calculation of electrostatic field of EHV/AC lines – Effect on humans, animals and plants – Electrostatic induction in unenergised double circuit line - Electromagnetic interference - Examples. Traveling wave expression and solution - Source of excitation - Terminal conditions - Open circuited and short circuited end - Reflection and refraction coefficients - Lumped parameters of distributed lines - Generalized constants - No load voltage conditions and charging current.

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.
3. HVDC power Transmission systems by K.R.Padiyar 2nd edition, Wiley Eastern limited.

REFERENCE BOOKS:

1. High voltage direct current transmission by J.Arrilaga, IEE power engineering series.
2. Direct current transmission by E.W.Kimbark, Vol-1, Wiley inter science-New york.

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.

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M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D49208) DISTRIBUTED GENERATION & MICROGRID CONTROL (Elective – IV)

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

Introduction to distributed generation - Active distribution network - Concept of Microgrid - Microgrid configuration - Interconnection of Microgrids - Technical and economical advantages of Microgrid - Challenges and limitations of Microgrid development - Management and operational issues of a Microgrid - Dynamic interactions of Microgrid with main grid – low voltage DC grid.

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

Introduction - Impact on heat utilisation - Impact on process optimisation - Impact on market - Impact on environment - Impact on distribution system - Impact on communication standards and protocols - Network management needs of Microgrid - Microsource controller - Central controller.

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

Introduction - Power quality disturbances - Power quality sensitive customers - Power quality improvement technologies - Impact of DG integration - Issues of premium power in DG integration.

TEXT BOOK:

1. S. Chowdhury, S.P. Chowdhury and P. Crossley, "Microgrids and Active Distribution Networks", The Institution of Engineering and Technology, 2009.

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.

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M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
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(17D54205) ENERGY EFFICIENT ELECTRICAL SYSTEMS

(Elective – IV)

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 maximumdemand 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:

1. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,.Logman Scientific & Technical, ISBN-0-582-03184, 1990.

REFERENCE:

1. Power System Engineering 2nd Ed. D P Kothari, I J Nagrath, Tata McGraw-Hill Co 2008
2. Bureau of Energy Efficiency (BEE) : www.bee-india.nic.in
3. The Energy and Resource Institute (TERI): http://www.teriin.org/

4. Energy Efficiency for Engineers and Technologists, First Edition, 1990, by TD Eastop and DR Croft,Longman Group UK Ltd.
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.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	4	**0**	**0**	**4**

(17D49210) INTELLIGENT CONTROL TECHNIQUES
(Elective – IV)

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 I: Introduction to control techniques, need of intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule - based systems, the AI approach. Knowledge representation. Expert systems. Data Pre - Processing: Scaling, Fourier transformation, principal - component analysis and wavelet transformations.

UNIT II

Concept of Artificial Neural Networks and its basic mathematical model, McCulloch - Pitts neuron model, simple perceptron, Adaline and Madaline, Feed - forward Multilayer Perceptron. Learning and Training the neural network. Networks: Hopfield network, Self - organizing network and Recurrent network. Neural Network based controller, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab / Neural Network toolbox.

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

Fuzzy modeling and control schemes for nonlinear systems. Self - organizing fuzzy logic control. Implementation of fuzzy logic controller using Matlab fuzzy - logic toolbox. Stability analysis of fuzzy control systems. Intelligent Control for SISO/MIMO Nonlinear Systems. Model Based Multivariable Fuzzy Controller.

Text Books:

1. Simon Haykins, Neural Networks: A comprehensive Foundation, Pearson Edition, 2003.
2. T.J.Ross, Fuzzy logic with Fuzzy Applications, Mc Graw Hill Inc, 1997.
3. David E Goldberg, Genetic Algorithms.

References:

1. M.T.Hagan, H. B. Demuth and M. Beale, Neural Network Design, Indian reprint, 2008.
2. Fredric M.Ham and Ivica Kostanic, Principles of Neurocomputing for science and Engineering, McGraw Hill, 2001.

3. N.K. Bose and P.Liang, Neural Network Fundamentals with Graphs, Algorithms and Applications, Mc - Graw Hill, Inc. 1996.
4. Yung C. Shin and Chengying Xu, Intelligent System - Modeling, Optimization and Control, CRC Press, 2009.
5. N.K.Sinha and Madan M Gupta, Soft computing & Intelligent Systems - Theory & Applications, Indian Edition, Elsevier, 2007.
6. John Yen and Reza Langari, Fuzzy logic Intelligence, Control, and Information, Pearson Education, Indian Edition, 2003.
7. Witold Pedrycz, Fuzzy Control and Fuzzy Systms, Overseas Press, Indian Edition, 2008.

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech I year II Semester (PE, PID, PEED and PED)	**L**	**T**	**P**	**C**
	0	**0**	**4**	**2**

(17D54206) ELECTRICAL DRIVES AND SIMULATION LAB

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.
9. Simulation of speed control of separately excited DC 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)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech III semester (PE, PID, PEED and PED)

L	T	P	C
4	0	0	4

(17D20301) RESEARCH METHODOLOGY

(Elective V-OPEN ELECTIVE)

UNIT I

Meaning of Research – Objectives of Research – Types of Research – Research Approaches – Guidelines for Selecting and Defining a Research Problem – research Design – Concepts related to Research Design – Basic Principles of Experimental Design.

UNIT II

Sampling Design – steps in Sampling Design –Characteristics of a Good Sample Design – Random Sampling Design.

Measurement and Scaling Techniques-Errors in Measurement – Tests of Sound Measurement – Scaling and Scale Construction Techniques – Time Series Analysis – Interpolation and Extrapolation.

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

Statistical Inference: Tests of Hypothesis – Parametric vs Non-parametric Tests – Hypothesis Testing Procedure – Sampling Theory – Sampling Distribution – Chi-square Test – Analysis of variance and Co-variance – Multi-variate Analysis.

UNIT V

Report Writing and Professional Ethics: Interpretation of Data – Report Writing – Layout of a Research Paper – Techniques of Interpretation- Making Scientific Presentations in Conferences and Seminars – Professional Ethics in Research.

Text Books:

1. Research Methodology:Methods And Techniques – C.R.Kothari, 2nd Edition,New Age International Publishers.
2. Research Methodology: A Step By Step Guide For Beginners- Ranjit Kumar, Sage Publications (Available As Pdf On Internet)
3. Research Methodology And Statistical Tools – P.Narayana Reddy And G.V.R.K.Acharyulu, 1st Edition,Excel Books,New Delhi.

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)

M.Tech III semester (PE, PID, PEED and PED)

L	T	P	C
4	0	0	4

(17D20302) HUMAN VALUES AND PROFESSIONAL ETHICS

(Elective V-OPEN ELECTIVE)

Unit I:

HUMAN VALUES:Morals, Values and Ethics-Integrity-Work Ethic-Service learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty - Courage- Co Operation – Commitment – Empathy –Self Confidence Character – Spirituality.

Unit II:

ENGINEERING ETHICS: Senses of Engineering Ethics- Variety of moral issues – Types of inquiry – Moral dilemmas – Moral autonomy –Kohlberg‟s theory- Gilligan‟s theory- Consensus and controversy – Models of professional roles- Theories about right action- Self interest - Customs and religion –Uses of Ethical theories – Valuing time –Co operation – Commitment.

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:

ENGINEERS RESPONSIBILITY FOR SAFETY AND RISK: Safety and risk – Assessment of safety and risk – Risk benefit analysis and reducing riskSafety and the Engineer- Designing for the safety- Intellectual Property rights(IPR).

UINIT V:

GLOBAL ISSUES: Globalization – Cross culture issues- Environmental Ethics – Computer Ethics – Computers as the instrument of Unethical behavior – Computers as the object of Unethical acts – Autonomous Computers- Computer codes of Ethics – Weapons Development - Ethics .

Text Books :

1. “Engineering Ethics includes Human Values” by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd-2009.

2. “Engineering Ethics” by Harris, Pritchard and Rabins, CENGAGE Learning, India Edition, 2009.

3. “Ethics in Engineering” by Mike W. Martin and Roland Schinzinger – Tata McGrawHill– 2003.

4. “Professional Ethics and Morals” by Prof.A.R.Aryasri, Dharanikota Suyodhana-Maruthi Publications.

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY ANANTAPUR

M.Tech III semester (PE, PID, PEED and PED)

L	T	P	C
4	0	0	4

(17D20303) INTELLECTUAL PROPERTY RIGHTS

(Elective V-OPEN ELECTIVE)

UNIT – I

Introduction To Intellectual Property: Introduction, Types Of Intellectual Property, International Organizations, Agencies And Treaties, Importance Of Intellectual Property Rights.

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

Law Of Copy Rights : Fundamental Of Copy Right Law, Originality Of Material, Rights Of Reproduction, Rights To Perform The Work Publicly, Copy Right Ownership Issues, Copy Right Registration, Notice Of Copy Right, International Copy Right Law.

Law Of Patents : Foundation Of Patent Law, Patent Searching Process, Ownership Rights And Transfer

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

New Development Of Intellectual Property: New Developments In Trade Mark Law ; Copy Right Law, Patent Law, Intellectual Property Audits.

International Overview On Intellectual Property, International – Trade Mark Law, Copy Right Law, International Patent Law, International Development In Trade Secrets Law.

TEXT BOOKS & REFERENCES:

1. Intellectual Property Right, Deborah. E. Bouchoux, Cengage Learing.

2. Intellectual Property Right – Nleashmy The Knowledge Economy, Prabuddha Ganguli, Tate Mc Graw Hill Publishing Company Ltd.,