DEPARTMENT OF ELECTRICAL ENGINEERING &
ELECTRONICS ENGINEERING
MATS SCHOOL OF ENGG & IT
MATS UNIVERSITY, GULLU, ARANG, C.G.

School of Engineering & IT
MATS University
Raipur

Syllabus Scheme
(1st to 4th Semester)
For
Master of Technology
In
Power Electronics
(DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING)

This Course aims at training graduate engineers in the field of Power Electronics. This course deals with the state of the art techniques in system-level modeling, analysis, design and integration of motor drives. The course also covers advanced topics in microprocessors and micro controllers which are very much needed for today's Power Electronics engineer. Projects of practical relevance in these areas of carried out in the final year of the course.

Program Objectives and Outcomes

PROGRAMME EDUCATIONAL OBJECTIVES

The major objectives of the M.Tech. Programme in Power Electronics are to equip the students with adequate knowledge and skills in Power Electronics and to prepare them for the following career options:

1. research programmes in Power Electronics and related areas
2. employment in R & D organisations related to sustainable technologies
3. to work in power electronic circuit design and fabrication industries
4. faculty positions in reputed institutions

Programme Outcomes for Power Electronics

A student who has undergone M.Tech. programme in Power Electronics (PE) will

1. have an ability to evaluate and analyses problems related to Power Electronic Systems and incorporate the principles in the state of art systems for further improvement
2. be able to investigate critical PE problems and to arrive at possible solutions independently, by applying theoretical and practical considerations
3. be able to solve PE problems such as switching control, converter design, analysis and control of solid state drives and stability studies
4. be able to develop appropriate power converters for sustainable energy technologies
5. be able to identify optimal solutions for improvising power conversion and transfer capability, enhancing power quality and reliability through PE based solutions
6. be able to evolve new power electronic topologies and control schemes based on literature survey and propose solutions through appropriate research

methodologies, techniques and tools, and also by designing and conducting experiments

7. be able to work on small, well-defined projects with particular goals to provide real time solutions pertaining to power electronics
8. be able to develop, choose, learn and apply appropriate techniques, various resources including sophisticated digital controllers and IT tools for modern power electronic system simulation, including prediction and modelling with existing constraints
9. be able to develop dedicated software for analysing and evaluating specific power electronics and control problems
10. be able to participate in collaborative-multidisciplinary engineering / research tasks and work as a team member in such tasks related to PE domain, giving due consideration to ecological and economical intricacies, and lead the team in specific areas
11. be able to confidently interact with the industrial experts for providing consultancy
12. be able to pursue challenging professional endeavors based on acquired competence and knowledge
13. be a responsible professional with intellectual integrity, code of conduct and ethics of research, being aware of the research outcomes and serve towards the sustainable development of the society
14. be capable of examining critically the outcomes of research and development independently without any external drive.

Scheme of Teaching & Examination
M.Tech in Power Electronics
I- Semester

Semester - 1								
S. No.	Code	Subject	Periods per week			Scheme of marks		Total Credit
			L	T	P	ESE	IM	
1	MT100	Research Methodology and IPR	3		2	70	30	3
1	MT131	Power Converters	3	-	-	70	30	3
2	MT132	Microcontroller & Embedded System	3	-	-	70	30	4
3	MT133	Power Electronic Circuits	3	-	-	70	30	4
4	MT134	Industrial Control Electronics	3	-	-	70	30	3
6	MT135	Power Converters Laboratory	-	-	2	30	20	2
7	MT136	Power Electronic Circuits Laboratory	-	-	2	30	20	2
Total			15	-	4	410	190	21

L – Lecture, T – Tutorial, ESE – End Semester Examination,

P – Practical, IM – Internal Marks (Include Class Test & Teacher's Assessments)

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Semester :	1st M. Tech. Course	Branch	:	Power Electronics
Subject :	Research Methodology and IPR	Total Theory Periods :		40

Code : MT100

Unit I: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

Unit II: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit III: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit IV: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit V: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit VI: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007.
5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property
9. in New Technological Age”, 2016.
10. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

Course Outcomes:

At the end of this course, students will be able to

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.

5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

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Semester :	1st M.Tech. Course	Branch :	Power Electronics
Subject :	Power Converters	Total Theory Periods :	40
	Code : MT131		

UNIT : I

Analysis of switched circuits- thyristor controlled half wave rectifier – R, L, RL, RC load circuits, classification and analysis of commutation.

UNIT :II

Single-Phase and Three-Phase AC to DC converters- half controlled configurations operating domains of three phase full converters and semi-converters – Reactive power considerations.

UNIT :III

Analysis and design of DC to DC converters- Control of DC-DC converters, Buck converters, Boost converters, Buck-Boost converters, Cuk converters

UNIT :IV

Single phase and three phase inverters, Voltage source and Current source inverters, Voltage control and harmonic minimization in inverters.

UNIT :V

AC to AC power conversion using voltage regulators, choppers and cyclo-converters, consideration of harmonics.

TEXT BOOKS:

1. Ned Mohan, Undeland and Robbin, “Power Electronics: converters, Application and design”, John Wiley and sons. Inc, Newyork,3rd edition 2002.
2. Rashid M.H., „Power Electronics Circuits, Devices and Applications „, Prentice Hall India, New Delhi, 3rd edition 2004.
3. P.C Sen.,“ Modern Power Electronics „, Wheeler publishing Co, First Edition, New Delhi, 1998.

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Semester :	1st M.Tech. Course	Branch	:	Power Electronics
Subject :	Microcontroller & Embedded System	Total Theory Periods :		40

Code : MT132

UNIT – I

Architecture 16 bit microprocessors: Intel 8086 Architecture- Memory address space and data organization - Segment registers and memory segmentation - I/O address space - Addressing modes - Comparison of 8086 and 8088 - Basic 8086/8088 configuration - Minimum mode - Maximum mode - System timing. Bus interface. Interrupts and interrupt priority management. Intel 80286 Architecture- Comparison with 8086 processor. Architecture of 32 bit Microprocessors: Intel 80386 Architecture

UNIT – II

Introduction to Microcontroller, brief History of 8051, 8052, 8031, 8751, AT89651, Pin configuration of 8051, 89C52RD2, Instruction set of 8051, Assembly language programming , Internal structure of 8051 , Power resetting , Built up RAM & ROM, I/O programming and Addressing modes.

UNIT – III

Introduction to counter and timer, Counter and timer programming using 8051, interrupt programming, Types of interrupt.

UNIT – IV

Introduction to Asynchronous serial communication, Data programming, RS232 standard, RS422 Standard, 1488 & 1489 standard, GPIB, Max 232 Driver, Serial communication programming.

UNIT – V

Introduction to Embedded Systems, Definition of Embedded System, Embedded Systems v/s General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems, embedded design concept.

TEXT BOOKS:

1. Barry B. Brey , The Intel Microprocessors 8086 to Pentium 4 - Architecture Programming and Interfacing, 6/e Pearson Education ,2003.
2. James L. Antonacos , An Introduction to Intel Family of Microprocessors , 3/e Pearson Education, 2002.

REFERENCE BOOKS:

1. John Uffenbeck , The 80x86 Family Design Programming and Interfacing, 3/e Pearson Education, 2002.
2. YU-Cheng Liu & Glenn A Gibson, Microprocessor System, Architecture Programming & Design, Pentice Hall of India.
3. Douglas V Hall, Microprocessors & Interfacing, Tata McGrawhill, 1998.

4. The 8051 Microcontroller and Embedded Systems using Assembly and C, Mazidi, Mazidi & McKinlay, 2nd Ed.,PHI.

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Semester :	1st M.Tech. Course	Branch :	Power Electronics
Subject :	Power Electronic Circuits	Total Theory Periods :	40
		Code :	MT133

UNIT – I
Ideal and Real switches, static and dynamic performance, Power diodes, Power Transistors, Power MOSFETS, IGBTs, Thyristor, GTO, TRIAC- Static and Dynamic Performance, Driver circuits. Turn on, Turn off and over voltage Snubbers for switching devices.

UNIT – II
Uncontrolled rectifiers-Single phase and three phase- Analysis with R and RL loads, effect ofsource inductance-Effect of Single Phase Rectifiers on Neutral Currents in a Three Phase Four-Wire System.
Controlled Rectifiers-Single phase and Three phase-fully controlled and semi controlled- Analysis with RL, RLE loads-Performance, Inversion mode of operation- Effect of source inductance-Dual converters- Circulating and Non circulating type.

UNIT – III
Chopper - Principle of operation, two quadrant and four quadrant choppers, PWM control-Forced commutation- Voltage and Current commutated choppers, multiphase chopper.

UNIT – IV
Inverter - Half Bridge and Full Bridge- Six Step and Two Level PWM. Harmonics and Voltage control in inverters- Current source inverter-Single phase and three phase. Introduction to Multilevel Invertors-Different types

UNIT – V
AC Voltage Controllers- Single Phase and Three phase, Principle of operation-analysis with R and RL loads, Thyristor Controlled Inductor
Cyclo converters- types- Single Phase and Three phase- Circulating and Non circulating type, Analysis with R and RL loads.

TEXT BOOKS:

1. Ned Mohan, Undeland, Robbins, Power Electronics; Converters, Applications and Design-

3rd edn, John Wiley, 2003.

2. M H Rashid; Power Electronics Circuits, Devices and Applications, Pearson.

REFERENCE BOOKS:

1. William Shepherd, Li Zhang., Power Converter Circuits, Marcel Dekker, 200.4

2. Joseph Vithayathil, Power Electronics; Principles and Applications, McGrawHill-1994

3. Philip T Krein, Elements of Power Electronics- Oxford, 1998

4. IssaBatarseh, Power Electronics Circuits, John Wiley, 2004

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Semester :	1st M.Tech. Course	Branch	:	Power Electronics
Subject :	Industrial Control Electronics	Total Theory Periods :		40

Code : MT134

UNIT – I
Review of switching regulators and switch mode power supplies-Uninterrupted power supplies-solid state circuit breakers – programmable logic controllers

UNIT – II
Analog Controllers - Proportional controllers, Proportional – Integral controllers, PID controllers, Feed forward control

UNIT – III
Signal conditioners-Instrumentation amplifiers – voltage to current, current to voltage, voltage to frequency, frequency to voltage converters; Isolation circuits – cabling; magnetic and electro static shielding and grounding.

UNIT – IV
Opto-Electronic devices and control , Applications of opto isolation, interrupter modules and photo sensors – Fibre optics – Bar code equipment, application of barcode in industry.

UNIT – V
Stepper motors and servo motors- control and applications. Servo motors – servo motor controllers – servo amplifiers – selection of servo motor – applications of servo motors.

TEXT BOOKS:
1. Michael Jacob, „Industrial Control Electronics – Applications and Design‟, Prentice Hall, 1988.
2. Thomas, E. Kissel, „ Industrial Electronics‟PHI, 2003
3. James Maas, „Industrial Electronics‟, Prentice Hall, 1995

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Semester :	1st M.Tech. Course	Branch	: Power Electronics
Subject :	Power Converters Laboratory		

Code : MT135

Experiments and computer simulations on:

1. Single phase, three phase Semi converters and Full converters,

2. DC-DC Choppers using SCRs and Self communicating Devices.

3. Single phase and three phase inverters using IGBTs,

4. AC-AC voltage regulators.

5. DC and AC drives

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Semester : 1st M.Tech. Course Branch : Power Electronics
Subject : Power Electronic Circuits Laboratory

Code : MT136

List of Experiments: A) HARDWARE

1. Single Phase Semi-converter with R-L load for continuous & discontinuous conduction modes.

2. Single Phase Full-converter with R-L load for continuous & discontinuous conduction modes.

3. Three Phase Full-converter with R-L-E load.

4. Controlled and Uncontrolled rectifier with different types of filters - continuous & discontinuous modes of operation.

5. Transformer and Inductor design.

6. Current & voltage commutated thyristorized chopper.

7. MOSFET/ IGBT/Transistor based DC Choppers (Buck & Boost)

8. Half bridge square wave inverter

9. Single-phase Sine triangle PWM inverter

10. Single Phase AC Voltage Controller

B) SIMULATION

1. 3-phase full converter and semi-converter with R, RL and RLE loads

2. 3-phase ac voltage controller

3. Closed loop control of DC-DC converter

4. 3-phase sine PWM inverter

5. Measurement of THD of current & voltage waveforms of controlled & uncontrolled 3- phase rectifiers.

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Scheme of Teaching & Examination
M.Tech in Power Electronics
II– Semester

Semester - 2								
Code	Subject	Periods per week			Scheme of marks		Total Credit
		L	T	P	ESE	IM	
MT230	Switched mode Power Conversion	3	-	-	70	30	3
MT231	Power Electronics Drivers	3	-	-	70	30	3
MT232	PWM converters & Application	3	-	-	70	30	3
MT233	Advance Digital Signal Processing	3	-	-	70	30	3
MT234	Power Modules Laboratory	-	-	2	30	20	1
MT235	Power Electronics Drives Laboratory	-	-	2	30	20	1
MTP23XX	**Professional Elective - 1**	3			70	30	3
Total		15		4	410	190	17

L – Lecture, T – Tutorial, ESE – End Semester Examination,

P – Practical, IM – Internal Marks (Include Class Test & Teacher's Assessments)

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Semester : 2nd M.Tech Branch : Power Electronics
Subject : Switched mode Power Conversion
Code : MT230

UNIT :I

Reactive Elements in Power Electronic Systems, Design of inductor, Design of transformer, Capacitors for power electronic applications.

UNIT :II

Basic concepts of Switched Mode power converters, DC-DC converters Characteristics, constituent elements, operating principles.

UNIT : III

Steady state analysis, stress and sizing of elements, control methods, duty ratio, current programmed, frequency programmed and sliding mode control, Dynamic analysis and frequency domain models.

UNIT :IV

Classification of resonant converters, Basic resonant circuit concepts, Load resonant converters, Resonant switch converters, Zero voltage switching.

UNIT :V

Design of feedback compensators, unity power factor rectifiers, resistor emulation principle and applications to rectifiers.

Text Book:

1. Switched Mode Power Conversion, Course Notes, CCE, IISc, 2004.

2. Issa Batarseh, „Power Electronic Circuits", John Wiley, 2004.

3. Philip T Krein," Elements of Power Electronics „,Oxford Press,1997.

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Semester : 2nd M.Tech Branch : Power Electronics

Subject : Power Electronics Drives
Code : MT231

UNIT :I
Basic power electronic drive system, components, Different types of loads, shaft-load coupling systems, Stability of power electronic drive.

UNIT :II
Conventional methods of D.C. motor speed control, single phase and three phase converter fed D.C motor drive, Power factor improvement techniques, four quadrant operation.

UNIT :III
Chopper fed drives, input filter design, Step-up chopper for photovoltaic systems. Braking and speed reversal of DC motor drives using choppers, multiphase choppers.

UNIT :IV
Conventional methods of induction motor speed control, Solid state controllers for Stator voltage control, soft starting of induction motors, Rotor side speed control of wound rotor induction motors. Voltage source and Current source inverter fed induction motor drives.

UNIT :V
Speed control of synchronous motors, field oriented control, load commutated inverter drives, switched reluctance motors and permanent magnet motor drives.

Text Books:

1. P.C Sen, „Thyristor DC Drives‟, John wiely and sons, New York, 1981.
2. R.Krishnan, „Electric Motor Drives – Modeling, Analysis and Control‟, Prentice-Hall of India Pvt Ltd., New Delhi, 2003.
3. Bimal K.Bose, „Modern Power Electronics and AC Drives‟, Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.

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Semester :	2nd M.Tech. Course	Branch :	Power Electronics
Subject :	PWM converters & Application		
	Code : MT232		

UNIT :I

AC/DC and DC/AC power conversion, overview of applications of voltage source converters, pulse modulation techniques for bridge converters.

UNIT :II

Bus clamping PWM, space vector based PWM, advanced PWM techniques, practical devices in converter; calculation of switching and conduction losses.

UNIT :III

Compensation for dead time and DC voltage regulation; dynamic model of a PWM converter, multilevel converters; constant V/F induction motor drives.

UNIT :IV

Estimation of current ripple and torque ripple in inverter fed drives; line – side converters with power factor compensation.

UNIT :V

Active power filtering, reactive power compensation; harmonic current compensation.

Text Books:

1. Mohan, Undeland and Robbins,‟ Power Electronics; Converters, Applications and

Design‟,John Wiley and Sons,2nd edition , 1995.

2. Erickson R W,‟ Fundamentals of Power Electronics‟, Chapman and Hall, 2001.

3. Vithyathil J,‟Power Electronics: Principles and Applications „„, McGraw Hill, 1995

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Semester : 2nd M.Tech. Course   Branch : Power Electronics
Subject : Advance Digital Signal Processing

Code : MT233

UNIT - I
Review of signals and systems – Review of discrete-time Fourier transform (DTFT) – Discrete Fourier Transform – properties – inverse DFT – relationship between DFT and Z-transform – circular convolution – linear convolution using DFT – overlap add/save method – Fast Fourier Transform (FFT) - Decimation-in-time (DIT) & Decimation-in-Frequency (DIF) FFT algorithms.
UNIT - II
Implementation of discrete-time systems: Block diagram and signal flow graph representation of IIR and FIR filters, Realization of IIR filters Direct –I, Direct-II, Cascade, Parallel, Ladder and Transposed Realization), Realization of FIR filters (Direct, Cascade and linear phase FIR structure). Design of digital filter, specification of FIR filters, General consideration, design of FIR filters, Symmetric and antisymmetric FIR filter, Design of FIR filter using Windows, Frequency sampling method, Hilbert Transformers.
UNIT - III
Filter Design Techniques: Design of DTIIR filters. From continuous time filters, Introduction to analog filters for designing Digital filters (Butter worth and Chebyshev filters), filters design using Impulse invariant, Bilinear Z transform, Matched Z-Transform and Approximation of derivatives methods, frequency transformation, Frequency Transformations, Design of IIR Filters in frequency Domain, Difference between FIR and IIR filters.
UNIT - IV
Multirate digital signal processing – sampling rate conversion – decimation, interpolation – sampling
rate alternation or conversion – filter design and implementation for sampling rate alternation – direct form FIR digital filter structure, polyphase filter structure, time-varying digital filter structure – sampling rate conversion by an arbitrary factor, architecture of DSP processor - fixed point & floating point (block diagram approach) - applications of digital signal processors.
UNIT - V
Issues involved in DSP processor design, Architecture and applications of TMS 320 C6XX, Multiprocessing with DSP processors, Applications of DSP to speech & radar signal processing, Adaptive removal of ocular artifacts from human EEGs.

Text Books:
1. Advanced Digital Signal Processing, Proakis, McMillan
2. Ifeachor Emmanuel C. and Barrie W. Jervis, "Digital Signal Processing A Practical Approach" Pearson Education Ltd., Fifth Indian Reprint, 2005.
REFERENCE BOOKS:
1. Jhonson Jonny, "Digital Signal Processing", Tata Mc Graw Hill Publication.
2. Schafer R.W. and A.V. Oppeheim, "Digital Signal Processing", Prentice Hall of India, New Delhi, 1999

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Subject : Power Modules Laboratory
Code : MT234

List of Experiments:

1. Development of various configurations of power modules using SCRs, IGBTs, power transistors and power MOSFETs. Practical converter design considerations- Snubber design, gate and base drive circuits.

2. DC to DC converters of various configurations using SCRs, IGBTs, power transistors and power MOSFETs.

3. DC to AC converters of various configurations using SCRs, IGBTs, power transistors and power MOSFETs.

4. AC to AC converters of various configurations using SCRs, IGBTs, power transistors and power MOSFETs..

5. Practical implementation of control techniques for voltage control, speed control and harmonic minimization.

Subject : Power Electronics Drives Laboratory

Code : MT235

List of Experiments:

1. Micro controller based speed control of Converter/Chopper fed DC motor.

2. Micro controller based speed control of VSI fed three-phase induction motor.

3. Micro controller based speed control of Stepper motor.

4. DSP based speed control of BLDC motor.

5. DSP based speed control of SRM motor.

6. Self-control operation of Synchronous motors.

7. Condition monitoring of three-phase induction motor under fault conditions.

8. Re-programmable Logic Devices and Programming

(a) VHDL programming – Examples

(b) Verilog HDL programming – Examples

(c) Realization of control logic for electric motors using FPGA.

9. Simulation of Four quadrant operation of three-phase induction motor.

10. Simulation of Automatic Voltage Regulation of three-phase Synchronous Generator.

11. Design of switched mode power supplies

Scheme of Teaching & Examination
M.Tech in Power Electronics
III- Semester

Semester - 3							
Code	Subject	Periods per week			Scheme of marks		Total Credit
		L	T	P	ESE	IM	
MTP3XX	**Professional Elective - 2**	3	-	-	70	30	3
MTP3XmXm	**Professional Elective - 3 - Through MOOC**	3	-	-	70	30	3
MT332	Renewable Energy Sources Laboratory	-	-	2	30	20	2
MT333	Project Work Phase - I	-	-	-	140	60	10
	Total	6		2	310	140	18

L – Lecture, T – Tutorial, ESE – End Semester Examination,

P – Practical, IM – Internal Marks (Include Class Test & Teacher's Assessments)

DEPARTMENT OF ELECTRICAL ENGINEERING & ELECTRONICS ENGINEERING
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<table>
<tr><th colspan="8">Semester - 4</th></tr>
<tr><th rowspan="2">Code</th><th rowspan="2">Subject</th><th colspan="3">Periods per week</th><th colspan="2">Scheme of marks</th><th rowspan="2">Total Credit</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>ESE</th><th>IM</th></tr>
<tr><td>MT440</td><td>Project Work Phase - II + Seminar</td><td>-</td><td>-</td><td>-</td><td>315</td><td>135</td><td>16</td></tr>
<tr><td colspan="3">Total</td><td>-</td><td>-</td><td>-</td><td>315 | 135</td><td>16</td></tr>
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Semester : 2nd and 3rd M.Tech. Course Branch : Power Electronics
Subject : **PROFESSIONAL ELECTIVE-I & II**

Code : MTP3XX

Code	PROFESSIONAL ELECTIVE-I
MTP301	Advance Control Theory
MTP302	Power Systems Operation And Control
MTP303	Energy Auditing, Conservation & Management
MTP304	Advanced Power System Protection
MTP305	Transient Over Voltages In Power Systems
MTP306	Artificial Neural Networks
MTP307	Optimization Techniques
MTP308	HVDC Transmission
MTP309	Computer Aided Design Of Power Electronic Circuits
MTP2310	Power System Planning and Reliability
MTP311	Static VAR Control & Harmonic Filtering
MTP312	Flexible AC Transmission Systems
MTP313	Digital Controllers in Power Electronics Applications
MTP314	Power Quality
MTP315	Programmable Logic Controllers And Their Applications
MTP316	Fuzzy Systems
MTP317	Digital Simulation of Power Electronic Systems
MTP318	Electrical Energy Conservation and Management
MTP319	Renewable Energy Sources
MTP320	Machine Modelling And Analysis

Semester :	M.Tech. Course	Branch :	Power Electronics
Subject :	Advance Control Theory	Total Theory Periods :	40
	Code :	MTP301	

UNIT – I
Introduction-Concept of State-State equation for Dynamic Systems-Time invariance and linearity-Non uniqueness of state model-State Diagrams-Physical System and State Assignment.

UNIT – II
Existence and uniqueness of solutions to Continuous-time state equations-Solution of Nonlinear and Linear Time Varying State equations-Evaluation of matrix exponential System modes, Role of Eigen values and Eigenvectors.

UNIT – III
Controllability and Observability- Stabilizability and Detectability-Test for Continuous time Systems- Time varying and Time invariant case-Output Controllability-Reducibility-System Realizations.

UNIT – IV
Introduction-Equilibrium Points-Stability in the sense of Lyapunov-BIBO Stability-Stability of LTI Systems-Equilibrium Stability of Nonlinear Continuous Time Autonomous Systems-The Direct Method of Lyapunov and the Linear Continuous-Time Autonomous Systems-Finding Lyapunov Functions for Nonlinear Continuous Time Autonomous Systems-Krasovskii and Variable-Gradiant Method.

UNIT – V
Introduction-Controllable and Observable Companion Forms-SISO and MIMO Systems- The Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.

TEXT BOOKS:
1. M. Gopal, “Modern Control System Theory”, New Age International, 2005.
2. K. Ogatta, “Modern Control Engineering”, PHI, 2002.
REFERENCE BOOKS:
1. John S. Bay, “Fundamentals of Linear State Space Systems”, McGraw-Hill, 1999.
2. D. Roy Choudhury, “Modern Control Systems”, New Age International, 2005.
3. John J. D‟Azzo, C. H. Houpis and S. N. Sheldon, “Linear Control System Analysis and Design with MATLAB”, Taylor Francis, 2003.
4. Z. Bubnicki, ”Modern Control Theory”, Springer, 2005.

Semester :	M.Tech. Course	Branch :	Power Electronics
Subject :	Power Systems Operation And Control	Total Theory Periods :	40
		Code :	MTP302

Unit-I

Optimal Generation Scheduling: Power flow scheduling using economic load dispatch, power flow scheduling using Lagrange multiplier method, penalty factor, scheduling with network losses, hydrothermal coordination with and without losses, cascaded and pump storage plant scheduling, unit commitment, unit commitment solution methods, introduction to optimal power flow solution using Newton Raphson method.

Unit-II

Automatic Generation Control: Types of alternator exciters, automatic voltage regulators for generator excitation control, static and dynamic performance of AVR loop, automatic load frequency control, primary automatic load frequency control loop, secondary automatic load frequency control loop, extension of automatic load frequency control loop to multi area systems, tie line power flow model.

Unit-III

Power System Security: Security analysis, security assessment, contingency analysis, algorithm to determine system security following contingency analysis procedure, security assessment using ac power flow model, security analysis using concept of performance index.

Unit-IV

State Estimation and load forecasting: Methods of state estimation – least square and weighted least square estimation, bad data detection and suppression of bad data, load forecasting, load forecasting techniques – methods of extrapolation and correlation, estimation of average and trend terms of deterministic part of load – limitation of the method, prediction of deterministic load, generalized load modeling, estimation of periodic components, estimation of stochastic part of load – time series approach.

Books:

1. Power System Analysis, Operation and Control, Abhijit Chakrabarti and Sunita Halder PHI.

2. Power Generation Operation and Control, Allen J. Wood, Bruce F. Woolenburg

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MATS SCHOOL OF ENGG & IT
MATS UNIVERSITY, GULLU, ARANG, C.G.

Semester :	M.Tech. Course	Branch	:	Power Electronics
Subject :	Energy Auditing, Conservation & Management	Total Theory Periods :		40
	Code :	MTP303		

Unit-I

Introduction: Energy Scenario – global, sub continental and Indian, Energy economy relation, Future energy demand and supply scenario, Integrated energy planning with particular reference to Industrial Sector in India, Captive power units and others –demand v/s supply.

Unit-II

Types of Energy: Physical Aspects of Energy: Classification of energy – Hydel, Thermal, Nuclear, Wind, & from Waste Products. Efficiency and effectiveness of energy utilization in Industry. Energy and energy analysis. Renewable and nonrenewable energy, Conventional and unconventional energy. **Demand Side Management:** Energy Demand Management: Energy utilization, Instrumentation and data analysis, financial aspects of energy management, Energy management as a separate function and its place in plant management hierarchy. Energy Planning, Energy Staffing, Energy Organization, Energy requirement. Energy Costing, Energy Budgeting, Energy Monitoring, Energy Consciousness, Energy Conversions, Energy Efficient Equipment, Energy Management Professionals, Environment Pollution due to Energy Use, Components of Pollution, Harmful Effects of Pollution, Measures taken to combat Pollution.

Unit-III

Energy Audit and Energy Saving: Energy Audit and analysis, Energy load measurements, System evaluation and simulation, Energy saving techniques and guidelines: Administrative control, Proper Measurement and monitoring system, Process control, proper planning & scheduling, Increasing capacity utilization, Improving equipment control, waste heat recovery, Change of energy source. Upgradation of Technology. Change of product specifications, Use of High efficiency equipment, Design modification for better efficiency, Improved periodic maintenance;

Unit-IV

Energy Control Centers: Remote Telemetry; Remote Terminal Units; IEC TC 57 (870-5-1) Protocol Standard; Data Acquisition Procedure; Data Handling and Organization; Real Time Database; Alarm and Events; Disturbance Processing; Fault Locating Technology; Real Time Display; MIMIC Boards; Supervisory Remote Control; Load Dispatch Control Centers; Distribution Control Centers; Time Keeping Systems;

Unit-V Integration of Distributed and Renewable Energy Systems to Power Grids: DC-to-AC Converters; AC-to-AC Converters; DC-to-DC Converters; Plug-In Hybrid Electric Vehicles; Energy Storage Technologies; Microgrids; **Legal Provisions:** The Prevention and Control of Pollution Act, 1974, The Energy Conservation Act, 2001, The Environmental Protection Act, 1986. The Electricity Act, 2003. National Electricity Policy. Rural Electrification.

Reference Books:

1. Paul W., O'callaghan; "*Energy Management*", McGraw Hill Book Company
2. Steve Doty, Wayne C. Turner; "*Energy Management Handbook*", Fairmont Press Inc., GA 30047

3. Barny L. Capehart, Wainey C. Turner, William J. Kennedy; "*Guide to Energy Management*", Fairmont Press Inc., GA 30047
4. Handbook of Energy Engineering, Albert Thumann & Paul Mehta, The Fairmont Press, INC.
5. NPC energy audit manual and reports
6. Cleaner Production – Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council

Semester :	M.Tech. Course	Branch	:	Power Electronics
Subject :	Advanced Power System Protection	Total Theory Periods :		40
	Code :	MTP304		

Unit-I Introduction: Protective Relays; Basic requirements and type of protection, reviews of relay characteristics and operating equations, protective CTs, PTs, , phase and amplitude comparator, classification of Electromagnetic relays, Plug Setting Multiplier and Time Multiplier setting, Universal Torque Equation, Non Directional Relay, Directional relay, Distant relay, Differential relay.

Unit-II Protection of Alternators: Protection against Stator fault (Phase to Phase and Phase to Ground), Balanced earth fault protection, Stator inter turn protection, Unbalanced loading of Alternator, Prime Mover failure, Overvoltage protection, Overloading (or over current) Protection, Restricted Earth fault and standby earth fault protection, Rotor Fault Protection.

Protection of Transformer: Overcurrent and unrestricted Earth fault protection, Different CT connections, Balanced (Restricted) earth fault protection, Harmonic restraint, Frame leakage protection

Unit-III Bus bar, Feeder, Transmission line Protection:

Bus bar Protection: Circulating Current Protection, Frame Leakage Protection. Feeder protection: Time Graded protection, Differential Protection. Transmission Line Protection: Introduction to distance relay, Simple Impedance relay, Reactance relay, Mho relays, comparison of distance relay – Choice between Impedance, Reactance and Mho relay, High speed Impedance relay, setting of distance relays. Pilot Relaying Schemes: Wire Pilot Protection, Carrier Current Protection.

Unit-IV Static Relay

Introduction: Basic construction of static relays, advantages and disadvantages of Static Relay, different types of static relays (static overcurrent, static time overcurrent, static instantaneous overcurrent, directional static overcurrent, static differential and static distance relay) comparators and associated elements, system switching and transient effects.

Unit-V Protection of High Voltage Capacitor Bank: Including consideration of inrush current, over current and over voltage, and differential protection scheme.

Protection Of large Motors: Differential protection, Earth fault Protection, Thermal overload protection, Starting and Stalling currents and effect of negative Sequence current.

Digital Relay: Introduction, protection philosophy, basic hardware and protection schemes, protection algorithms, microprocessor based digital relaying.

Text Books:

1. A. Chakrabarti,M.L. Soni, P. V. Gupta, U. S. Bhatnagar "A text book on Power System Engineering", Dhanpat Rai and Co.
2. Paithankar.Y.G and Bhide.S.R, "Fundamentals of Power System Protection", Prentice-Hall of India.
3. Badri Ram and Vishwakarma.D.N, "Power System Protection and Switchgear", Tata McGraw- Hill Publishing Company, 2002.
4. Arun K. Phadke, James. S. Thorp, "Computer relaying for Power system", John Wiley and sons,

New York, 1998.

Reference:

1. Power System Protection, PM Anderson, IEEE Press Book
2. Protective Relays Application and Guide, GEC Measurements
3. Jones D., " Analysis and protection of electrical power systems", Pitman Publishing, 1971

Semester :	M.Tech. Course	Branch	:	Power Electronics
Subject :	Transient Over Voltages In Power Systems	Total Theory Periods :		40
	Code :	MTP305		

Unit-I
Introduction and survey: Review of various types of power system transients – effect of transients on power systems –relevance of the study and computation of power system transients.

Unit-II
Lighting surges: Electrification of thunderclouds – lightning current surges – lightning current parameters and their values – stroke to tower and midspan – induced lightning surges.

Unit-III
Switching surges: Closing and reclosing of lines – load rejection – fault initiation – fault clearing – short line faults – Ferro – resonance – isolator switching surges – temporary over voltages – surge on an integrated system – switching – harmonics.

Unit-IV
Computation of transient in conversion equipment: Travelling wave method – Beweley's Lattice diagram – analysis in time and frequency domain – eigen value approach – Z-transform – EMTP software.

Unit-V
Insulation coordination: Over voltage protective devices – shielding wires, rods gaps and surge diverters, principles of insulation co ordination-recent advancements in insulation co ordination – design of EHV system.

References:

1. Allan Greenwood, Electrical transients in Power Systems, Wiley Interscience, New York, 1971.
2. Klaus Ragaller, Surges in High Voltage Networks, Plenum Press, New York, 1980.
3. Diesendrof W., Over Voltages On High Voltage Systems, Renselaer Bookstore, Troy New York, 1971.
4. Peterson H.A., transients in power systems, Dover Publications, New York, 1963.

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MATS UNIVERSITY, GULLU, ARANG, C.G.

Semester :	M.Tech. Course Artificial	Branch	: Power Electronics
Subject :	Neural Networks	Code :	MTP306

UNIT-I
Pattern classification –Learning and generalisation-structure of neural networks – ADA line and Mada line-perceptrons.

UNIT-II
Linear separability – Back propagation – XOR function-Back propagation algorithm-Hopfied and Hamming networks- Kohensen‟s network-Boltzmenn machine-in and out star network –Art 1 and Art 2 nets.

UNIT-III
Neuro adaptive control applications-ART architecture – Comparison layer – Recognition layer – ART classification process – ART implementation – Examples.

UNIT-IV
Character recognition networks, Neural network control application, connectionist expert systems for medical diagnosis Self organizing maps.

UNIT-V
Applications of neural algorithms and systems -Character recognition networks, Neural network control application, connectionist expert systems for medical diagnosis.

Text Books:
1. Neural Netwroks, Fuzy logic , Gnenetic algorithms: synthesis and applications by Rajasekharan and Rai- PHI Publication.
2. Introduction to Artificial Neural Systems- Jacek M.Zurada, Jaico Publishing House, 1997.
REFERENCE BOOKS:
1. Neural Netwroks – James A Freeman and Davis Skapura, Pearson, 2002
2. Neural Netwroks – Simon Hykins, Pearson Education.
3. Neural Engineering by C. Eliasmith and CH. Anderson, PHI

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MATS UNIVERSITY, GULLU, ARANG, C.G.

Semester : M.Tech. Course Branch : Power Electronics
Subject : Optimization Techniques
Code : MTP307

UNIT - I

Linear programming –formulation-Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems.

UNIT - II

Unconstrained one dimensional optimization techniques -Necessary and sufficient conditions – nrestricted search methods-Fibonacci and golden section method-Quadratic Interpolation methods, cubic interpolation and direct root methods.

UNIT - III

Unconstrained n dimensional optimization techniques – direct search methods –Random search – pattern search and Rosen brooch‟s hill claiming method- Descent methods-Steepest descent, conjugate gradient, quasi -Newton method.

UNIT - IV

Constrained optimization Techniques- Necessary and sufficient conditions –Equality and inequality constraints-Kuhn-Tucker conditions-Gradient projection method-cutting plane method- penalty function method.

UNIT - V

Dynamic programming- principle of optimality- recursive equation approach-application to shortest route, cargo-loading, allocation and production schedule problems.

TEXT BOOKS:

1. Rao,S.S.,‟Optimization :Theory and Application‟ Wiley Eastern Press, 1978.
2. Taha,H.A., Operations Research –An Introduction, Prentice Hall of India.
3. Fox, R.L.,‟Optimization methods for Engineering Design‟, Addition Welsey, 1971

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MATS SCHOOL OF ENGG & IT
MATS UNIVERSITY, GULLU, ARANG, C.G.

Semester : M.Tech. Course Branch : Power Electronics
Subject : HVDC Transmission
Code : MTP308

UNIT - I
HVDC Transmission : General consideration , Power Handling Capabilities of HVDC lines , Basic Conversion principles , static converter configuration.

UNIT - II
Static Power Converters: 3 pulse, 6 pulse & 12 pulse converters, converter station and terminal equipment communication process, Rectifier and inverter operation, equivalent circuit for converter- special futures of converter transformers.

UNIT - III
Harmonics in HVDC systems, harmonicas elimination, AC & DC filter, Control of HVDC converter and systems: constant current, constant extinction angle and constant ignition angle control. Individual phase control and equidistant firing angle control,DC power flow control.

UNIT - IV
Interaction between HVAC & DC systems –voltage interaction, harmonic instability problems and DC power modulation, Multi-terminal DC link and systems; series, parallel and series parallel systems, their operation and control.

UNIT - V
Transient over voltage in HVDC systems: Over voltages due to disturbance on DC side, over voltages due to DC and AC side line faults, Converter faults and protection in HVDC systems: Converter faults, over current protection- valve group and DC line protection. Over voltage protection of converters, surge arresters.

TEXT BOOKS:
1.E.W.Kimbark: Direct current Transmission, Wiely inter Science- New york.
2.J.Arillaga: H.V.D.C.Tranmission peter peregrilnus ltd., London UK 1983
3.K.R.Padiyar: High Voltage Direct current Transmission, Wiely Eastern Ltd
4.E.Uhlman: Power Transmission by Direct Current Springer Verlag, Berrlin

Semester :	M.Tech. Course	Branch :	Power Electronics
Subject :	Computer Aided Design Of Power Electronic Circuits	Code :	MTP309

UNIT - I INTRODUCTION

Importance of simulation – General purpose circuit analysis – Methods of analysis of power electronic systems – Review of power electronic devices and circuits.

UNIT - II

ADVANCED TECHNIQUES IN SIMULATION

Analysis of power electronic systems in a sequential manner – coupled and decoupled systems – Various algorithms for computing steady state solution in power electronic systems – Future trends in computer simulation.

UNIT - III

MODELING OF POWER ELCTRONIC DEVICES

Introduction – AC sweep and DC sweep analysis – Transients and the time domain analysis – Fourier series and harmonic components – BJT, FET, MOSFET and its model- Amplifiers and Oscillator – Non-linear devices.

UNIT - IV

SIMULATION OF CIRCUITS

Introduction – Schematic capture and libraries – Time domain analysis – System level integration and analysis – Monte Carlo analysis – Sensitivity/stress analysis – Fourier analysis.

UNIT - V

CASE STUDIES

Simulation of Converters, Choppers, Inverters, AC voltage controllers, and Cyclo-converters feeding R, R-L, and R-L-E loads – computation of performance parameters: harmonics, power factor, angle of overlap.

Text Books:

1. Rashid, M., Simulation of Power Electronic Circuits using pSPICE, PHI, 2006.
2. Rajagopalan, V. “Computer Aided Analysis of Power Electronic systems”-Marcell – Dekker Inc., 1987.
3. John Keown “Microsim, Pspice and circuit analysis”-Prentice Hall Inc., 1998

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Semester :	M.Tech. Course	Branch	: Power Electronics
Subject :	Power System Planning and Reliability		
		Code :	MTP310

Unit-I
Load Forecasting: Load Forecasting Categories-Long term, Medium term, short term, very short term Applications of Load Forecasting, Factors Affecting Load Patterns Medium and long term load forecasting methods- end use models, econometric models, statistical model based learning. Short Term Load Forecasting (STLF): Applications of Load Forecasting, methods- similar day approach, regression methods, time series, ANN, Expert systems, Fuzzy logic based method, support vector machines ANN architecture for STLF, Seasonal ANN, Adaptive Weight, Multiple-Day Forecast, STLF Using MATLAB'S ANN Toolbox, Training and Test Data, Stopping Criteria for Training Process, sensitivity analysis

Unit-II
Power System Reliability: Basic Notions of Power System Reliability- sub systems, reliability indices, outage classification, value of reliability tools, Concepts and methodologies, power system structure, Reliability based planning in power systems, Effect of failures on power system, Planning criteria, Risk analysis in power system planning, multi-state systems.

Unit-III
Basic Tools and Techniques- random processes methods & Markov models, Computation of power system reliability measures by using Markov reward models, Evaluation of reliability indices, Universal Generating Function (UGF) Method, Monte Carlo simulation.

Unit-IV
Reliability of Generation Systems- capacity outage calculations, reliability indices using the loss of load probability method, unit commitment and operating constraints, optimal reserve management, single and multi-stage expansion.

Unit-V
Reliability Assessment for Elements of Transmission and Transformation Systems- reliability indices of substations based on the overload capability of the transformers, evaluation and analysis of substation configurations, Reliability analysis of protection systems for high voltage transmission lines,.

References:
1. Markey operations in electric power systems Forecasting, Scheduling, and Risk Management, Shahidehpour M,Yamin H, Li z, John Wlley & sons
2. Reliability evaluation of power systems, Billinton R, Allan R (1996) Plenum Press New York
Computational Methods in Power system Reliability, D. Elmakias, Springer-Verlag

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MATS SCHOOL OF ENGG & IT
MATS UNIVERSITY, GULLU, ARANG, C.G.

Semester : M.Tech. Course Branch : Power Electronics
Subject : Static Var Control & Harmonic Filtering
Code : MTP311

UNIT I

Fundamentals of Load Compensation, Steady-State Reactive Power Control in Electric Transmission Systems , Reactive Power Compensation and Dynamic Performance of Transmission Systems . Power Qulity Issues . Sags, Swells, Unbalance, Flicker , Distortion , Current Harmonics.

UNIT II

Static Reactive Power Compensators and their control. Shunt Compensators, SVCs of Thyristor Switched and Thyristor Controlled types and their control, STATCOMs and their control, Series Compensators of Thyristor Switched and Controlled Type and their Control, SSSC and its Control, Sub-Synchronous Resonance and damping,

UNIT III

Converters for Static Compensation . Single Phase and Three Phase Converters and Standard Modulation Strategies (Programmed Harmonic Elimination and SPWM) . GTO Inverters . Multi-Pulse Converters and Interface Magnetics . Multi-Level Inverters of Diode Clamped Type and Flying Capacitor Type and suitable modulation strategies (includes SVM) . Multi-level inverters of Cascade Type and their modulation . Current Control of Inverters.

UNIT IV

Passive Harmonic Filtering . Single Phase Shunt Current Injection Type Filter and its Control, Three Phase Three-wire Shunt Active Filtering and their control using p-q theory and d-q modelling . Three-phase four-wire shunt active filters . Hybrid Filtering using Shunt Active Filters . Series Active Filtering in Harmonic Cancellation Mode . Series Active Filtering in Harmonic Isolation Mode.

UNIT V

Sources of Harmonics in Distribution Systems and Its Effects . Use of STATCOMs and SSSCs for Transient and Dynamic Stability Improvement in Power Systems Dynamic Voltage Restorer and its control . Power Quality Conditioner

Text Books:

1. T.J.E Miller : Reactive Power Control in Electric Systems, John Wiley & Sons
2. N.G. Hingorani & L. Gyugyi :Understanding FACTS: Concepts and Technology of Flexible AC Transmission, Systems. IEEE Press, 2000.

REFERENCE BOOKS:

1. Ned Mohan et.al :Power Electronics. John Wiley and Sons

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Semester :	M.Tech. Course	Branch	: Power Electronics
Subject :	Flexible AC Transmission Systems		

Code : MTP312

UNIT I
Fundamentals of ac power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.

UNIT II
Principles of shunt compensation – Variable Impedance type & switching converter type- Static Synchronous Compensator (STATCOM) configuration, characteristics and control.

UNIT III
Principles of static series compensation using GCSC, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC).

UNIT IV
Principles of operation-Steady state model and characteristics of a static voltage regulators and phase shifters- power circuit configurations.

UNIT V
UPFC -Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters.

Text Books:

1. Song, Y.H. and Allan T. John, Flexible ac transmission systems (FACTS)‟, Institution of Electrical Engineers Press, London, 1999.
2. Hingorani ,L.Gyugyi, „ Concepts and Technology of flexible ac transmission system‟, IEEE Press New York, 2000 ISBN –078033 4588.
3. IEE Tutorials on „Flexible ac transmission systems‟, published in Power Engineering Journal, IEE Press, 1995.
4. K.R.Padiyar, „FACTS controllers for transmission and Distribution systems‟ New Age international Publishers 1st edition -2007

Semester : M.Tech. Course Branch : Power Electronics
Subject : Digital Controllers in Power Electronics Applications
Code : MTP313

UNIT I
Introduction to the C2xx DSP core and code generation, The components of the C2xx DSP core, Mapping external devices to the C2xx core , peripherals and Peripheral Interface ,System configuration registers , Memory , Types of Physical Memory , memory Addressing Modes , Assembly Programming using C2xx DSP, Instruction Set, Software Tools.

UNIT II
Pin Multiplexing (MUX) and General Purpose I/O Overview, Multiplexing and General Purpose I/O Control Registers .Introduction to Interrupts, Interrupt Hierarchy , Interrupt Control Registers , Initializing and Servicing Interrupts in Software .

UNIT III
ADC Overview , Operation of the ADC in the DSP , Overview of the Event manager (EV) , Event Manager Interrupts , General Purpose (GP) Timers , Compare Units, Capture Units And Quadrature Enclosed Pulse (QEP) Circuitry , General Event Manager Information.

UNIT IV
Introduction to Field Programmable Gate Arrays – CPLD Vs FPGA – Types of FPGA , Xilinx XC3000 series , Configurable logic Blocks (CLB), Input/Output Block (IOB) – Programmable Interconnect Point (PIP) – Xilinx 4000 series – HDL programming –overview of Spartan 3E and Virtex II pro FPGA boards- case study.

UNIT V
Controlled Rectifier , Switched Mode Power Converters , PWM Inverters , DC motor control, Induction Motor Control.

TEXT BOOKS:

1. Hamid.A.Toliyat And Steven G.Campbell " DSP Based Electro Mechanical Motion Control " CRC Press New York , 2004.
2. XC 3000 Series Datasheets (Version 3.1). Xilinx,Inc.,USA, 1998.
3. XC 4000 Series Datasheets (Version 1.6). Xilinx,Inc.,USA, 1999.
4. Wayne Wolf," FPGA Based System Design ", Prentice Hall, 2004

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Semester : M.Tech. Course Branch : Power Electronics
Subject : Power Quality
Code : MTP314

Unit-I
Electric power quality phenomena: - Impacts of power quality problems on end users, Power quality standards, power quality monitoring.
Power quality disturbances:- transients, short duration voltage variations ,long duration voltage variations, voltage imbalance, wave-form distortions, voltage fluctuations, power frequency variations, power acceptability curves.

Unit-II
Power quality problems: poor load power factor, loads containing harmonics, notching in load voltage, dc offset in loads, unbalanced loads, disturbances in supply voltage.

Unit-III
Transients: Origin and classification- capacitor switching transient-lighting-load switching-impact on users-protectionmitigation.

Unit-IV
Harmonics: harmonic distortion standards, power system quantities under non sinusoidal conditions-harmonic indices-source of harmonics-system response characteristics-effects of harmonic distortion on power system apparatus –principles for controlling harmonics, reducing harmonic currents in loads, filtering, modifying the system frequency response- Devices for controlling harmonic distortion, inline reactors or chokes, zigzag transformers, passive filters, active filters.

Unit-V
Power quality conditioners: Shunt and series compensators, Dstatcom-dynamic voltage restorer, unified power quality conditioners.

Book

1. Ghosh Arindam and Ledwich Gerard, 'Power quality enhancement using custom power devices' Springer.
2. Arrillaga J., Watson N. R. and Chen S., 'Power System Quality Assessment' Wiley.
3. Caramia P, Carpinelli G and Verde P, 'Power quality indices in liberalized markets' – Wiley
4. Angelo Baggini 'Handbook of Power Quality' – Wiley.

Semester :	M.Tech. Course	Branch	: Power Electronics
Subject :	Programmable Logic Controllers And Their Applications		
	Code :	MTP315	

UNIT I – CLASSICAL CONTROLLER DESIGN
Introduction of controller design – Proportional (P)-Integral (I)-Derivative (D)-PI-PD - PID controllers-Characteristics-Design of controller- Tuning- Ziegler-Nichol's method, Cohen coon method and damped oscillation method

UNIT II – SLIDING MODE CONTROL & VARIABLE STRUCTURE CONTROLLER
Dynamics in the sliding mode – linear system, non-linear system, chattering phenomenon – sliding mode control design – reachability condition, robustness properties –application Sliding surfaces-Continuous approximations of Switching control laws- Modeling / Performance trade-Variable structure controller-Adaptive variable structure controller bang-bang control theory-trajectory planning-Case Studies

UNIT III – CURRENT CONTROLLER DESIGN
Hysteresis current control (HCC) – Design of HCC with PWM schemes-Case Studies Predictive current controller (PCC) –Model predictive control (MPC)-PWM predictive control (PPC)

UNIT IV – H-INFINITY CONTROL & ROBUST CONTROL THEORY
Introduction of H-infinity methods in control theory-Elements of robust control theory – Design objectives – Shaping the loop gain –Signal spaces – Computation of H∞ norm- All pass systems--Linear-quadratic-Gaussian control (LQG)- -Case Studies Robust control theory- Robust controller design- Robust decision methods- Analytic tools for robust decision making-Case Studies

UNIT V – CONTROLLER DESIGN
Controller synthesis and tuning, Linear Matrix inequalities, LMI solvers, control system analysis and design with LMIs using MATLAB/Simulink Uncertain system analysis -Statistical and worst-case analysis of stability and performance Analysis
Survey and review of different controllers used in power system and power electronics practices

REFERENCES

1. Jean Pierre Barbot., "*Sliding Mode Control in Engineering*" Marcel Bekker, 2002.
2. Green M. and Limebeer /D.J.N., "*Linear Robust Control*", Englewood cliffs, NJ: Prentice Hall, 1995.
3. P.C.Chandrasekharan., "*Robust Control of Linear Dynamical Systems*", AcademicPress Limited, San Diego.1996.
4. Zinober, Alan S.I., ed. *"Variable Structure and Lyapunov Control"* , London: Springer-Verlag. doi:10.1007/BFb0033675. ISBN 978-3-540-19869-7, 1994.
5. Bryson, A.E and Ho, Y., "*Applied Optimal Control: Optimization, Estimation and Control* (Revised Printing)", John Wiley and Sons, New York, 1975.
6. SomanathMajhi., *"Advanced Control Theory A relay Feedback Approach",* Cengage Learning, 2009.
7. www.Mathworks,com/Matlab-2012b,2013a/Simulnik.

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Semester : M.Tech. Course Branch : Power Electronics
Subject : Fuzzy Systems
Code : MTP316

UNIT I
Different faces of imprecision – inexactness, Ambiguity, Undecidability, Fuzziness and certainty, Probability and fuzzy logic, Intelligent systems.

UNIT II
Fuzzy sets and crisp sets - Intersections of Fuzzy sets, Union of Fuzzy sets, the complement of Fuzzy sets.

UNIT III
Fuzzy reasoning - Linguistic variables, Fuzzy propositions, Fuzzy compositional rules of inference- Methods of decompositions, Defuzzification.

UNIT IV
Methodology of fuzzy design - Direct & Indirect methods with single and multiple experts, Adaptive fuzzy control, Rule base design using dynamic response.

UNIT V
Fuzzy logic applications to engineering, Fuzzy decision making, Neuro-Fuzzy systems, Fuzzy Genetic Algorithms.

TEXT BOOKS:
1. Zimmermann, H.J., „Fuzzy set theory and its applications‟, Allied publishers limited, Madras,1966
2. Klir, G.J., and Folge., T., „Fuzzy sets, uncertainty and information‟, PHI, New Delhi,1991.
3. EarlCox,,‟The Fuzzy Systems Handbook‟, AP professional Cambridge, MA 02139, 1994.

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Semester :	M.Tech. Course	Branch	: Power Electronics
Subject :	Digital Simulation of Power Electronic Systems		
	Code :	MTP317	

UNIT I
Review of numerical methods. Application of numerical methods to solve transients in D.C.Switched R, L, R-L, R-C and R-L-C circuits. Extension to AC circuits.

UNIT II
Modeling of diode in simulation. Diode with R, R-L, R-C and R-L-C load with ac supply.
Modelling of SCR, TRIAC, IGBT and Power Transistors in simulation. Application of numerical methods to R, L, C circuits with power electronic switches. Simulation of gate/base drive circuits, simulation of snubber circuits.

UNIT III
State space modeling and simulation of linear systems. Introduction to electrical machine modeling: induction, DC, and synchronous machines, simulation of basic electric drives, stability aspects.

UNIT IV
Simulation of single phase and three phase uncontrolled and controlled (SCR) rectifiers, converters with self commutated devices- simulation of power factor correction schemes, Simulation of converter fed dc motor drives ,Simulation of thyristor choppers with voltage, current and load commutation schemes, Simulation of chopper fed dc motor.

UNIT V
Simulation of single and three phase inverters with thyristors and self-commutated devices, Space vector representation, pulse-width modulation methods for voltage control, waveform control. Simulation of inverter fed induction motor drives.

TEXT BOOKS:
1. Simulink Reference Manua , Math works, USA.
2. Robert Ericson, „Fundamentals of Power Electronics‟, Chapman & Hall, 1997.
3. Issa Batarseh, „Power Electronic Circuits‟, John Wiley, 2004Simulink Reference Manual, Math works, USA

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Semester :	M.Tech. Course	Branch	: Power Electronics
Subject :	Electrical Energy Conservation and Management		
		Code :	MTP318

UNIT I
Electrical Energy and safety audit-Overview of Electricity Act – Energy conservation act - Electrical energy audit – tools for electrical energy audit - billing elements - tariff system, energy and demand charge, electrical demand and load factor improvement, power factor correction, power demand control, demand shifting – Electrical Safety Auditing.

UNIT II
Electric motors-Motors efficiency, idle running - motor selection – factors affecting motor performance, efficiency at low load – high efficiency motors - reduce speed/variable drives, load reduction - high-starting torque, rewound motors, motor generator sets, energy efficiency in transformers - Case studies.

UNIT III
Electrical energy conservation in driven equipments-Input electrical energy requirements in pumps – fans and compressors – load factor estimation in the equipments – different types of VFD, energy conservation potential – electrical energy conservation in refrigeration and A/C system, operation and maintenance practices for electrical energy conservation case studies.

UNIT IV
Electrical Energy conservation in industrial lighting-Choice of lighting - energy saving – control of lighting - lighting standards – light meter audit - methods to reduce costs – summary of different lighting technologies – Case Studies.

UNIT V
Energy efficiency and demand management-Basic concepts – Co-generation – importance of demand side management – virtues of DSM –efficiency gains - estimation of energy efficiency potential, cost effectiveness, payback period, barriers for energy efficiency and DSM – Case Studies.

References:
1. Openshaw Taylor E., "Utilisation of Electric Energy", Orient Longman Ltd, 2003
2. Donald R. Wulfingoff, "Energy Efficiency Manual", Energy Institute Press, 1999.
3. Tripathy S.C., "Electrical Energy Utilization and Conservation", TMH, 1991

Semester : M.Tech. Course Branch : Power Electronics
Subject : Renewable Energy Sources
Code : MTP319

UNIT I

Basic characteristics of sunlight – solar energy resource – photovoltaic cell-characteristics – equivalent circuit – photo voltaic for battery charging.

UNIT II

Wind source – wind statistics - energy in the wind – aerodynamics - rotor types – forces developed by blades – aerodynamic models – braking systems – tower - control and monitoring system – power performance.

UNIT III

Wind driven induction generators-power circle diagram-steady state performance –modeling integration issues –impact on central generation- transmission and distribution systems – wind farm electrical design.

UNIT IV

Wind-diesel systems-fuel savings-permanent magnet alternators – modeling – steady state equivalent circuit-self-excited induction generators – integrated wind-solar systems.

UNIT V

Micro-hydel electric systems – power potential – scheme layout – generation efficiency and turbine part flow-isolated and parallel operation of generators – geothermal-tidal and OTEC systems.

TEXT BOOKS:

1. John F.Walker & Jenkins. N , „Wind energy Technology „ , John Wiley and sons, chichester , U.K,1997.
2. Van Overstraeton and Mertens R.P., „Physics, Technology and use of Photovoltaics", Adam Hilger, Bristol,1996.
3. Freries LL , „ Wind Energy Conversion Systems", Prentice Hall, U.K., 1990

DEPARTMENT OF ELECTRICAL ENGINEERING & ELECTRONICS ENGINEERING
MATS SCHOOL OF ENGG & IT
MATS UNIVERSITY, GULLU, ARANG, C.G.

Semester :	M.Tech. Course	Branch	: Power Electronics
Subject :	Machine Modeling And Analysis		
		Code :	MTP320

Unit-I

Principles of Electromagnetic Energy Conversion, General expression of stored magnetic energy, co-energy and force/torque, example using single and doubly excited system.

Unit-II

Basic Concepts of Rotating Machines-Calculation of air gap mmf and per phase machine inductance using physical machine data; Voltage and torque equation of dc machine.

Unit-III

Three phase symmetrical induction machine and salient pole synchronous machines in phase variable form; Application of reference frame theory to three phase symmetrical induction and synchronous machines, dynamic direct and quadrature axis model in arbitrarily rotating reference frames

Unit-IV

Determination of Synchronous Machine Dynamic Equivalent Circuit Parameters, Analysis and dynamic modeling of two phase asymmetrical induction machine and single phase induction machine.

Unit-V

Special Machines - Permanent magnet synchronous machine: Surface permanent magnet (square and sinusoidal back emf type) and interior permanent magnet machines. Construction and operating principle, dynamic modeling and self-controlled operation; Analysis of Switch Reluctance Motors.

TEXT BOOKS

1. Charles Kingsley,Jr., A.E. Fitzgerald, Stephen D.Umans, „Electric Machinery‟, Tata Mcgraw Hill,6ht Edition, 2003.
2. R. Krishnan, „Electric Motor & Drives: Modeling, Analysis and Control‟, Prentice Hall of India, 2001.
3. Miller, T.J.E,. „Brushless permanent magnet and reluctance motor drives‟, Clarendon Press, Oxford, 1989