Program Structure and Syllabus of M.Tech Power Electronics & Electrical Drives

Electrical & Electronics Engineering

R21 Regulations

ANURAG UNIVERSITY
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COURSE STRUCTURE AND SYLLABUS

M.TECH I YEAR I SEMESTER [6T + 1 P + 1S]

S.No	Course Code	Category	Course	Hours per week			Credits
				L	T	P	
1	A311001	PC-I	Machine Modeling and Analysis	3	0	0	3
2	A311002	PC-II	Modern Control Theory	3	0	0	3
3	A311003 A311004 A311005	PE-I	1. Special Machines 2. Energy Storage Systems 3. HVDC & FACTS	3	0	0	3
4	A311006 A311007 A311008	PE-II	1. Micro Grid Technologies 2. Reliability Engineering 3. Power Electronic Converters	3	0	0	3
5	A3100	Course Work	Research Methodology	2	0	0	2
6	A311009 A311010 A311011	PE-III	1. Programmable Logic Controllers and applications 2. Neural Networks and Fuzzy Logic 3. Electrical and Hybrid Vehicles	3	0	0	3
7	A311021	Laboratory-I	Machine Modeling and Analysis Lab	0	0	4	2
8	A3100		Seminar –I	0	0	4	2
TOTAL				**17**	**0**	**8**	**21**

M.TECH I YEAR II SEMESTER [6T + 1 P + 1 S]

S.No	Course Code	Category	Course	Hours per week			Credits
				L	T	P	
1	A312001	PC-III	Power Electronic Control of Drives	4	0	0	4
2	A312002	PC-IV	Advanced Power Electronic Devices and Converters	4	0	0	4
3	A312003 A312004 A312005	PE-IV	1. Electric Traction Systems 2. Power Quality Analysis and Mitigation Techniques 3. Smart Grid Technologies	3	0	0	3
4	A312006 A312007 A312008	PE-V	1. Dynamics of Electrical Machines 2. Switched Mode Power Supplies (SMPS) 3. Power Electronic Applications to Renewable Energy	3	0	0	3

5	A312009 A312010 A312011	OE	1. Introduction to AI and ML. 2. English for Professionals. 3. Technical and Business Communication Skills.	3	0	0	3
6	A312012	Audit Course I	English for Research Paper Writing	2	0	0	0
7	A312021	Laboratory-II	Electric Drives & Simulation Lab	0	0	4	2
8	A3100		Seminar –II	0	0	4	2
TOTAL				**19**	**0**	**8**	**21**

M.TECH II YEAR I SEMESTER [1 P]

S.No	Course Code	Category	Course	Hours per week			Credits
				L	T	P	
	A3100		Project Work Review-1	0	0	24	12
TOTAL				**0**	**0**	**24**	**12**

M.TECH II YEAR II SEMESTER [1 P]

S.No	Course Code	Category	Course	Hours per week			Credits
				L	T	P	
	A3100		Project Work Review-2	0	0	28	14
TOTAL				**0**	**0**	**28**	**14**

MACHINE MODELLING AND ANALYSIS

M. Tech I Year I Semester					Power Electronics & Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311001	PC-I	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of MMA are to:

- To comprehend the basic two-pole machine.
- To identify the methods and assumptions in modeling of machines.
- To write voltage and torque equations for different machines in various forms.
- To recognize the different frames for modeling of different AC machines.

Course Outcomes:

At the end of the MMA course, students will be able to:

- Write the voltage equation and torque equations for different machines like DC machine, induction motor and Synchronous machines.
- Model different machines using phase and Active transformations.
- Identify the different reference frames for modeling of machines.

Unit-I:

Basic Two-pole DC machine - primitive 2-axis machine – Voltage and Current relationship – Torque equation.

Unit-II:

Mathematical model of separately excited DC motor, DC Series motor, DC shunt motor DC Compound motor in state variable form. State Space model of DC Machine

Unit-III:

Clarkes's Transformation, Park's Transformation, Induction Motor model in various Reference Frames and Two-Axis model of 3-phase Motor.

Unit-IV:

State Space Model of 3-ph Induction Motor. State phase model of a 3ph Synchronous motor – Two axis representation of Syn. Motor. Voltage, current, and Torque Equations in state – space variable form.

Unit-V:

State Space Model of Permanent Magnet Synchronous Motor, State Space model of Brushless DC Motor Voltage, current, and Torque Equations in state – space variable form.

TEXT BOOKS:

1. Ashok Kumar Mukhopadhyay,MatrixAnalysisofelectricalMachinesNewageInternational(p)Ltd 2007.
2. R. Krishnan, Electric Motor Drives – Modeling, Analysis and Control Pearson Education.

REFERENCES BOOKS:

1. P.S. Bimbhra, Generalized Machine theory,Khanna Publishers, 2002
2. Paul C. Krause , Oleg Wasynezuk, Scott D. Sudhoff,Analysis of electric machinery and Drive systemsthirdedition, IEEEpress

MODERN CONTROL THEORY

M. Tech I Year I Semester					Power Electronics & Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
		L	T	P	C	CIE	SEE	Total
A311002	PC-II	3	0	0	3	40	60	100

Course Objectives:

Course Objectives of MCT are to:

- To explain the concepts of basic and modern control system for the real time analysis and design of control systems.
- To explain and apply concepts of state variables analysis.
- To study and analyze non linear systems.
- To analyze the concept of stability of nonlinear systems and categorization.
- To apply the comprehensive knowledge of optimal theory for Control Systems.

CourseOutcomes:

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

- Understand the concepts of state variable analysis
- Apply the knowledge of basic and modern control system for the real time analysis and design of control systems.
- Analyze the concept of stability of nonlinear systems and optimal control

UNIT–I:

Mathematical Preliminaries: Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non-uniqueness of state model – State diagrams for Continuous-Time State models.

UNIT-II:

State Variable Analysis: Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and its properties. General concept of controllability – General

concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability- Canonical forms of State model.

UNIT-III:

Non Linear Systems: Introduction – Non Linear Systems - Types of Non-Linearity – Saturation – Dead- Zone - Backlash – Jump Phenomenon etc.– Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of non-linear controlsystems.

UNIT-IV:

Stability Analysis: Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method - Generation of Lyapunov functions – Variable gradient method – Krasooviski'smethod.

State feedback controller design through Pole Assignment – State observers: Full order and Reduced order.

UNIT-V:

Optimal Control: Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.

TEXT BOOKS:

1. M. Gopal, Modern Control System Theory– New Age International-1984
2. Nagrath and Gopal,Control System Engineering - New Age International – FourthEdition

REFERENCES BOOKS:

1. Ogata. K, Modern Control Engineering– Prentice Hall -1997
2. A. NagoorKani, Advanced Control Theory RBA Publications,1999
3. Kirck ,Optimal control DoverPublications

SPECIAL MACHINES

M. Tech I Year I Semester					Power Electronics & Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311003	PE-I	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course objectives:

Course Objectives of SM are to:

- To understand the working and construction of special machines
- To know the use of special machines in different feed-back systems
- To understand the use of digital controllers for different machines

CourseOutcomes:

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

- To understand the operation of different special machines
- To select different special machines as part of control system components
- To use special machines as transducers for converting physical signals into electrical signals
- To design digital controllers for different machines

UNIT–I:

Stepper Motors: Introduction-synchronous inductor (or hybrid stepper motor), Hybrid stepping motor, construction, principles of operation, energization with two phase at a time- essential conditions for the satisfactory operation of a 2-phase hybrid step motor - very slow - speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors-an open-loop controller for a 2-phase stepping motor.

UNIT-II:

Variable Reluctance Stepping Motors: Variable reluctance (VR) Stepping motors, single-stack VR step motors, Multiple stack VR motors-Open-loop control of 3-phase VR step motor-closed-Loop control of step motor, discriminator (or rotor position sensor) translator, major loop-characteristics of step motor in open-loop drive – comparison between open-loop position control with step motor and a position control servo using a conventional (dc or ac) servo motor- Suitability and areas of application of stepping motors-5- phase hybrid stepping motor - single phase - stepping motor, the construction, operating principle torque developed in themotor.

Switched Reluctance Motor: Introduction – improvements in the design of conventional reluctance motors- Some distinctive differences between SR and conventional reluctance motors-principle of operation of SRM- Some design aspects of stator and rotor pole arcs, design of stator and rotor and pole arcs in SR motor-determination of L(θ)-θ profile - power converter for SR motor-A numerical example – Rotor sensing mechanism and logic control, drive and power circuits, position sensing of rotor with Hall problems-derivation of torque expression, general linear case.

UNIT–III:

Permanent Magnet Materials and PM DC Machines: Introduction, Hysteresis loops and recoil line-stator frames (pole and yoke - part) of conventional PM dc Motors, Equivalent circuit of PM Generator and Motor- Development of Electronically commutated dc motor from conventional dc motor.

Brushless DC Motor: Types of construction – principle of operation of BLDM-sensing and switching logic scheme, sensing logic controller, lockout pulses –drive and power circuits, Base drive circuits, power converter circuit-Theoretical analysis and performance prediction, modeling and magnet circuit d-q analysis of BLDM - transient analysis formulation in terms of flux linkages as state variables-Approximate solution for current and torque under steady state –Theory of BLDM as variable speed synchronous motor (assuming sinusoidal flux distribution)- Methods or reducing Torque Pulsations, 180 degrees pole arc and 120 degree current sheet.

UNIT-IV:

Linear Induction Motor: Development of a double sidedLIMfrom rotary type IM- A schematic of LIM drive for electric traction development of one sided LIM with back iron-field analysis of a DSLIM fundamental assumptions.

UNIT-V:

Permanent Magnet Axial Flux (PMAF) Machines: Construction, Armature windings – Toroidal Stator and Trapezoidal Stator Windings, Torque and EMF equations, Phasor diagram and output equation.

TEXT BOOKS/REFERENCE BOOKS:

1. K. Venkataratnam, Special electrical machines, - University press.
2. E. G. Janardanan, Special electrical machines, -PHI.
3. R. K. Rajput, “Electrical machines”-5thedition.
4. V. V. Athani, “Stepper motor: Fundamentals, Applications and Design”- New age International pub.

ENERGY STORAGE SYSTEMS

M. Tech I Year I Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311004	PE-I	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course objectives:

Course Objectives of ESS are to:

- To understand the different storage techniques
- To know the basic energy storage devices such as batteries, thermoelectric converters, fuel cells, super capacitors.
- To design energy storage for different applications.
- To analyze and design different fuel cells.

Course Outcomes:

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

- To understand different energy storage techniques
- To compare different battery technologies and its characters.
- To analyze and design modern day battery technologies.
- To analyze different fields of application of ESS.

Unit-I:

Introduction: Mechanical, electrical and chemical energy storage systems and its applications - Available and unavailable energy - Energy Analysis - Second law efficiency - Helmholtz & Gibb's function - Energy Analysis - Recent trends in Energy storagesystems.

Unit-II:

Classical & Modern Batteries: Basic Concepts - Battery performance - charging and discharging - storage density - energy density and safety issues - Lead Acid-Nickel-Cadmium - Zinc Manganese dioxide.
Zinc-Air - Nickel Hydride - Lithium Battery - State Of Charge - Technology Challenges.

Unit-III:

Super Capacitors & Fuel Cells: Super capacitors - types of electrodes and some electrolytes- Electrode materials – high surface area activated carbons- metal oxide- and conducting polymers- Electrolyte - aqueous or organic- disadvantages and advantages of super capacitors - Applications of Super capacitors.

Fuel cells - direct energy conversion - maximum intrinsic efficiency of an

electrochemical converter- physical interpretation - Carnot efficiency factor in electrochemical energy convertors - types of fuel cells - hydrogen oxygen cells - hydrogen air cell - alkaline fuel cell- and phosphoric fuel cell.

Unit-IV:

Mobile Applications and Micro-Power Sources: The diverse energy needs of mobile applications -Characteristics due to the miniaturized scale -Capacitative storage-electrochemical storage - Hydrocarbon storage- Pyro-electricity - Radioactive source - Recovering ambient energy.

Unit-V:

Energy Storage in Photovoltaic Systems:
Standalone photovoltaic systems - Grid connected systems- Energy Storage in PV systems using lead acid battery technology- Flywheels - Compressed Air Energy Storage - Thermal energy storage - capturing heat and cold to create energy on demand - Pumped Hydro power.

Text Books:

1. Yves Brunet, “Energy Storage", Wiley-ISTE, 1st Edition, 2010.
2. Robert A.Huggins, “Energy Storage”, Springer, 2nd Edition, 2015.

Reference Books:

1. Andrei G. Ter-Gazarian, "Energy storage systems for Power systems", 2nd edition, IET 2011.
2. R M. Dell, D.A.J. Rand, "Understanding Batteries" RSC Publications, 1st edition, 2012.

HVDC & FACTS

M. Tech I Year I Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311005	PE-I	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of HVDC & FACTS are to:

- To understand the control aspects of HVDC System
- To study HVDC Transmission system
- To know the importance of controllable parameters and types of FACTS controllers & their benefits
- To understand the fundamentals of FACTS Controllers.
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Course Outcomes:

At the end of this HVDC & FACTS course, students will be able to:

- Compare EHV AC and HVDC system and to describe various types of DC links
- Describe various methods for the control of HVDC systems and to perform power flow analysis in AC/DC systems
- Choose proper FACTS controller for the specific application based on system requirements
- Analyze the control circuits of Shunt Controllers, Series controllers &Combined controllers for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping

UNIT - I

HVDC transmission: HVDC Transmission system: Introduction, comparison of AC and DC systems, applications of DC transmission, types of DC links, Layout of HVDC Converter station and various equipments. HVDC Converters, analysis of bridge converters with and without overlap, inverter operation, equivalent circuit representation of rectifier and inverter configurations

UNIT -II

Control of HVDC system: Principles of control, desired features of control, converter control characteristics, power reversal, Ignition angle control, current and extinction angle control. Harmonics- introduction, generation, ac filters and dc filters.
Introduction to multiterminal DC systems and applications, comparison of series and parallel MTDC systems,
Voltage Source Converter based HVDC systems

UNIT - III

Facts concepts: Reactive power control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, brief description of FACTS controllers.

UNIT - IV

Static shunt and series compensators: Shunt compensation - objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators - SVC, STATCOM, SVC and STATCOM comparison. Series compensation - objectives of series compensation, thyristor switched series capacitors (TCSC), static series synchronous compensator (SSSC), power angle characteristics, and basic operating control schemes.

UNIT - V

Combined compensators: Unified power flow controller (UPFC) - Introduction, operating principle, independent real and reactive power flow controller and control structure. Interline power flow controller (IPFC), Introduction to Active power filtering, Concepts relating to Reactive power compensation and harmonic current compensation using Active power filters.

TEXT BOOKS:

1. Hingorani,L.Gyugyi, 'Concepts and Technology of Flexible AC Transmission System', IEEE Press New York, 2000 ISBN –0780334588.
2. Padiyar, K.R., 'HVDC transmission systems', Wiley Eastern Ltd.,2010.

REFERENCES BOOKS:

1. Song, Y.H. and Allan T. Johns, 'Flexible AC Transmission Systems (FACTS)', Institution of Electrical Engineers Press, London,1999.
2. Mohan Mathur R. and Rajiv K.Varma ,'Thyristor- based FACTS controllers forElectricalTransmission systems', IEEE press, Wiley Inter science,2002.
3. PadiyarK.R., 'FACTS controllers for Transmission and Distribution systems' New Age International Publishers, 1st Edition,2007.
4. Enrique Acha, Claudio R.Fuerte-Esqivel, Hugo Ambriz-Perez, Cesar Angeles-Camacho 'FACTS – Modeling and simulation in Power Networks' John Wiley &Sons,2002.
5. Jos Arrillaga, 'High voltage Direct Current Transmission' IET Power and Energy Series29

MICROGRID TECHNOLOGIES

M. Tech I Year I Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311006	PE-II	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of MT are to:

- Understand the integration of renewable sources
- Design modern control technologies for micro-grids in Islanded and grid connected operation.

Course Outcomes:

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

- Understanding of the micro-grid types and configurations
- Applications of power electronics in Micro-grid and acquire the knowledge of multi function grid connected converters
- Analyze the various types of control in micro - grid in islanded and grid connected operation
- Design an optimized Micro-grid considering the role of power market

UNIT – I:

Introduction: Micro-grid Configurations – CERTS Micro-grid Test Bed – DC Micro-grid- HFAC Micro-grid – LFAC Micro-grid – Hybrid DC- and AC- Coupled Micro-grid
Power Electronics in Micro-grid: Grid Connected Mode – Islanded mode – Battery Charging mode – design of power converters– Brick Busses Software Frame work- Multi Function grid connected inverters

UNIT- II:

Control in Micro-grid: Impact of load characteristics– Local control – Centralized Control- Decentralized Control- islandedoperation–PQControl- Droopcontrolmethods–Frequency/VoltageControl–Inverter Output Impedance

UNIT- III:

Micro-grid Energy Management Systems: Load Sharing and Power Management Strategy - Stand-alone – Grid connected – energy storage - Voltage Control and Active Power Management
Power Quality Enhancement: Compensators and controllers for power quality issues – Power Quality Improvement technologies– Impact of DG integration on Power Quality.

UNIT- IV:

Optimization in Micro-grid: Stochastic Optimization for Operating Cost- Unit Commitment- Congestion Management- Role of Micro-grid in Power Market

UNIT-V:

Protection in Micro-grid: Device Discrimination-Islanding detection, Effect on Feeder Reclosure, Protection for an Islanded Micro-grid having IIDG Units- Adaptive relaying scheme

TEXT BOOKS:

1. Suleiman M,Sharkh, Mohammad A.Abu-Sara Georgios I. Orfanoudakis, Babar Hussain, "Power Electronic Converters for Micro grid", Wiley-IEEE Press, 2014
2. A.Mahmoud, A.L- Sunni and Faud, M, "Control and Optimization of Distributed Generation Systems" ISBN: 978331916910, Springer Publishers, 2015.

REFERENCE BOOKS:

1. Nikos Hatziargyiou, "Microgrids: Architectures and Control" ISBN: 978-1-118-72068- 4,Wiley-IEEE Press, December 2013.
2. S.Chowhury, S.P.Chowdury and Peter Crossley, "Microgrids and Active Distribution Networks" ISBN978-1-84919-014-5, IET renewable Energy series, 2011.
3. Ritwi K Majumder, "Microgrid: Stability Analysis and Control" VDM Publishing 2010
4. Shin'yaObara, "Optimum Design of Renewable Energy Systems: Microgrid and Nature Grid Methods", AEEGT Book Series, 2014.

RELIABILITY ENGINEERING

M. Tech I Year I Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311007	PE-II	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of RE are to:

- To comprehend the basics of probability distributions & reliability models.
- To model systems with series-parallel block diagrams and state-space diagrams and to understand time dependent and limiting state probabilities using Markov models.
- To understand multi-mode failures of electrical & electronic circuits and their effect on reliability & availability.
- To understand reliability & availability models for generation, transmission and distribution systems and evaluate critical indices.

Course Outcomes:

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

- Able to relate the probability concepts and distributions in reliability engineering studies
- Able to draw reliability logic diagram and state-space diagram of engineering systems to evaluate reliability and availability
- Able to apply multi-mode failures in electrical and electronic circuits
- Able to evaluate various reliability indices related to generation, transmission and distribution systems

Unit-I

Discrete & Continuous random variables – Binomial, Exponential &Waybill distributions – Causes of failure – Failure rate & Failure density – Bath tub curve – Reliability & MTTF – Maintainability & Availability – MTBF & MTTR - Reliability block diagram – Series & Parallel systems – Conditional probability - Minimal Cut-set & Tie-set methods

Unit-II

Continuous Markov models – State space diagram - Reliability models of single unit, two unit & standby systems – Reliability & Availability models with repair – Frequency of failures – State transition matrix and estimation of MTTF

Unit-III

Multi-mode failures - Short circuit & open circuit failures - Resistors& capacitors in series & parallel - Diodes& MOSFETs in series & parallel - Quad system - Reliability Prediction - MIL standards - Parts count technique - Parts stress technique - Reliability, Availability and MTTF evaluation of Power electronic circuits & Drive systems

Unit-IV

Outage definitions – Markov model of Generating plant with identical and non-identical units – Capacity outage probability table – Cumulative frequency – LOLE & LOEE – Composite Generation & Transmission systems - Radial configuration

Unit-V

Customer oriented, load oriented & energy oriented indices of distribution system – Application to radial systems – Effects of lateral distributer protection, disconnects, protection failures & transferring loads – Parallel & Mesh networks – Dual transformer feeder – Approximate Network reduction methods

Text Books:

1. Charles E. Ebeling, 'An Introduction to Reliability and Maintainability Engineering', McGraw Hill International Edition, 1997
2. L. Umanand, 'Power Electronics: Essentials & Applications', Wiley, 2009
3. Roy Billinton, R.N. Allan, 'Reliability Evaluation of Power Systems', Springer, 1st Edition, Plenum Press, New York , 1996

Reference Books:

1. Roy Billinton, R.N. Allan, 'Reliability Evaluation of Engineering Systems', Springer International Edition, Plenum Press, New York, 1992
2. E. Balaguruswamy, 'Reliability Engineering', Tata McGraw Hill Education Pvt. Ltd., 2012

POWER ELECTRONIC CONVERTERS

M. Tech I Year I Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311008	PE-II	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of PEC are to:

- To understand the principle of operation of modern power semiconductor devices.
- To comprehend the concepts of different power converters and their applications
- To analyze and design switched mode regulators for various industrial applications.

Course Outcomes:

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

- Choose appropriate device for a particular converter topology.
- Use power electronic simulation packages for analyzing and designing power converters.

UNIT-I:

AC VOLTAGE CONTROLLERS

Single phase AC voltage controllers with Resistive, Resistive, inductive and Resistive-inductive-induced e.m.f. loads – ac voltage controllers with PWM Control – Effects of source and load inductances - Synchronous tap changers.

Three phase AC voltage controllers – Analysis of controllers with star and delta Connected Resistive, Resistive-inductive loads – Effects of source and load Inductances – Applications & Problems.

UNIT-II:

CYCLO-CONVERTERS

Singlephasetosinglephasecyclo-converters– analysisofmidpointandbridgeConfigurations–Three phase to three phase cyclo-converters –analysis of Midpoint and bridge configurations – Limitations – Advantages – Applications & Problems –Matrix Converter.

UNIT-III:

SINGLE PHASE & THREE PHASE CONVERTERS

Single phase converters – Half controlled and Fully controlled converters –

Evaluation of input power factor and harmonic factor – continuous and Discontinuous load current – single phase dual converters power factor Improvements Techniques– Extinction angle control – symmetrical angle control,PWM–single phase sinusoidal PWM – single phase series converters – overlap analysis – Applications &Problems.

Three phase converters – Half controlled and fully controlled converters – Evaluation of input power factor and harmonic factor – continuous and Discontinuous load current – three phase dual converters power factor Improvements Techniques– three phase PWM - twelve pulse converters – Applications- Problems – Design of converters.

UNIT-IV:

D.C. TO D.C. CONVERTERS

Analysis of step-down and step-up dc to dc converters with Resistive and Resistive-inductive loads – Switched mode regulators–Analysis of Buck Regulators-Boost regulators–buck and boost regulators Cuk regulators – Condition for continuous inductor current and capacitor voltage – comparison of regulators –Multi output boost converters – advantages – Applications –Problems.

UNIT-V:

PULSE WIDTH MODULATED INVERTERS

Principle of operation – performance parameters – single phase bridge inverter-evaluation of output voltage and current with resistive, inductive and Capacitive loads– Voltage control of single phase inverters – single PWM – Multiple PWM – sinusoidal PWM – modified PWM – phase displacement Control – Advanced modulation techniques for improved performance – Trapezoidal, staircase, stepped, harmonic injection and delta modulation – Advantages – Applications & Problems.

THREE-PHASEINVERTERS

Analysisof180degreeconductionforoutputvoltageandcurrentwithresistive, inductive loads – analysis of 120 degree Conduction – voltage control of three phase inverters – sinusoidal PWM – Third Harmonic PWM – 60 degree PWM – space vector modulation – Comparison of PWM techniques – harmonic reductions – Problems.

TEXT BOOKS:

1. Mohammed H. Rashid “Power Electronics” Pearson Education Third Edition – First Indian reprint2004.
2. Ned Mohan, Tore M. Undeland and William P. Robbins, “Power Electronics” - John Wiley & Sons – SecondEdition.

REFERENCES BOOKS:

1. Milliman Shepherd and Lizang – “Power converters circuits” – Chapter 14 (Matrix converter) PP-415-444,
2. M.H.Rashid - Power electronics hand book

3. Marian P. Kaźmierkowski, Ramu Krishnan, FredeBlabjerg Edition:" Controlinpowerelectronics" illustrated Published by Academic Press, 2002.
4. NPTEL online course, Power Electronics, by Prof. B. G. Fernandez,https://www.youtube.com/playlist?list=PLA07ACBDE053A8229.

RESEARCH METHODOLOGY

M. Tech I Year I Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
	CC	L	T	P	C	CIE	SEE	Total
		2	0	0	2	40	60	100

Course Objectives:

Course Objectives of RM are to:

- Understand the research problem.
- know the process of literature survey, plagiarism check and ethical means of doing research.
- get the knowledge about technical report writing.
- impart awareness about the intellectual property rights.
- know about licensing and transfer of technology.

Course Outcomes:

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

- formulate the research problem.
- analyze research related information by following research ethics.
- convert a technical paper into a research proposal by incorporating new ideas or concepts.
- apply intellectual property rights.
- get licensing and transfer technology for innovative ideas.

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.

Text Books:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

Reference Books:

1. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
2. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd, 2007
3. Mayall , “Industrial Design”, McGraw Hill, 1992
4. Niebel , “Product Design”, McGraw Hill, 1974
5. Asimov, “Introduction to Design”, Prentice Hall, 1962
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016

PROGRAMMABLE LOGIC CONTROLLERS AND APPLICATIONS

M. Tech I Year I Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311009	PE-III	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of PLCA are to:

- To understand the generic architecture and constituent components of a Programmable Logic Controller.
- To develop a software program using modern engineering tools and technique for PLC.
- To apply knowledge gained about PLCs to identify few real life industrial applications

Course Outcomes:

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

- Develop and explain the working of PLC with the help of a blockdiagram
- Execute, debug and test the programs developed for digital and analogoperations.
- Reproduce block diagram representation on industrial applications usingPLC.

Unit-I:

PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

Unit-II:

PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation.Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction, and flow chart for spray process system.

Unit-III:

PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

Unit-IV:

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

Unit-V:

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

TEXT BOOKS / REFERENCE BOOKS:

1. Programmable Logic Controllers – Principle and Applications by John W Webb and Ronald A Reiss Fifth edition,PHI
2. Programmable Logic Controllers – Programming Method and Applications by JR Hackworthand F.D Hackworth – Jr- Pearson, 2004.

Neural Networks and Fuzzy Logic

M. Tech I Year I Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311010	PE-III	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of NNFL are to:

- To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and GeneticAlgorithms.
- To observe the concepts of feed forward neural networks and about feedback neuralnetworks.
- Topracticetheconceptoffuzzinessinvolvedinvarioussystemsandcomprehensivek nowledgeof fuzzy logic control and to design the fuzzycontrol
- To analyze genetic algorithm, genetic operations and geneticmutations.

Course Outcomes:

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

- Understand feed forward neural networks, feedback neural networks and learning techniques.
- Analyze fuzziness involved in various systems and fuzzy settheory.
- Develop fuzzy logic control for applications in electricalengineering
- Develop genetic algorithm for applications in electricalengineering.

UNIT – I:

Artificial Neural Networks: Introduction-Models of Neural Network - Architectures – Knowledge representation – Artificial Intelligence and Neural networks – Learning process – Error correction learning– Hebbian learning – Competitive learning – Boltzman learning – Supervised learning – Unsupervised learning – Reinforcement learning - learning tasks.

UNIT- II:

ANN Paradigms : Multi – layer perceptron using Back propagation Algorithm-Self – organizing Map – Radial Basis Function Network – Functional link, network – Hopfield Network.

UNIT – III:

Fuzzy Logic: Introduction – Fuzzy versus crisp – Fuzzy sets - Membership function – Basic Fuzzy set operations – Properties of Fuzzy sets – Fuzzy Cartesian Product – Operations on Fuzzy relations – Fuzzy logic – Fuzzy Quantifiers - Fuzzy Inference - Fuzzy Rule based system - Defuzzification methods.

UNIT – IV:

Genetic Algorithms: Introduction-Encoding – Fitness Function-Reproduction operators - Genetic Modeling – Genetic operators - Crossover - Single–site crossover – Two-point crossover – Multi point crossover-Uniform crossover – Matrix crossover - Crossover Rate - Inversion & Deletion – Mutation operator –Mutation – Mutation Rate-Bit-wise operators - Generational cycle-convergence of Genetic Algorithm.

UNIT–V:

Applications of AI Techniques: Load forecasting – Load flow studies – Economic load dispatch – Load frequency control – Single area system and two area system – Small Signal Stability (Dynamic stability) Reactive power control – speed control of DC and AC Motors.

TEXT BOOK:

1. S. Rajasekaran and G. A. V. Pai, “Neural Networks, Fuzzy Logic & Genetic Algorithms”- PHI, New Delhi,2003.

REFERENCESBOOKS:

1 P. D. Wasserman, Van Nostrand Reinhold, “Neural Computing Theory & Practice” - New York, 1989.
2 Bart Kosko,”Neural Network & Fuzzy System” Prentice Hall, 1992.
3 G. J. Klirand T. A. Folger, “Fuzzy sets, Uncertainty and Information”- PHI,Pvt.Ltd, 1994.
4 D. E. Goldberg,” Genetic Algorithms”- Addison Wesley1999.

ELECTRICAL & HYBRID VEHICLES

M. Tech I Year I Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311011	PE-III	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of EHV are to:

- To study the concepts and drive train configurations of electric drive vehicles
- To provide different electric propulsion systems and energy storage devices
- To explain the technology, design methodologies and control strategy of hybrid electric vehicles
- To emphasize battery charger topologies for plug in hybrid electric vehicles

Course Outcomes:

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

- Understand the concepts and drive train configurations of electric drive vehicles Interpret different electric propulsion systems and energy storagedevices
- Appreciate the technology, design methodologies and control strategy of hybrid electric vehicles
- Realize battery charger topologies for plug in hybrid electricvehicles

UNIT - I

Introduction to Electric Vehicles: Sustainable Transportation - EV System - EV Advantages - Vehicle Mechanics - Performance of EVs - Electric Vehicle drive train - EV Transmission Configurations and components-Tractive Effort in Normal Driving - Energy Consumption - EV Market - Types of Electric Vehicle in Use Today - Electric Vehicles for the Future.

UNIT - II

Electric Vehicle Modeling - Consideration of Rolling Resistance - Transmission Efficiency - Consideration of Vehicle Mass - Tractive Effort - Modeling Vehicle Acceleration - Modeling Electric Vehicle Range - Aerodynamic Considerations - Ideal Gearbox Steady State Model - EV Motor Sizing - General Issues in Design.

UNIT - III

Introduction to electric vehicle batteries - electric vehicle battery efficiency - electric vehicle battery capacity - electric vehicle battery charging - electric vehicle battery fast charging - electric vehicle battery discharging - electric vehicle battery performance – testing.

UNIT - IV

Hybrid Electric Vehicles - HEV Fundamentals -Architectures of HEVs- Interdisciplinary Nature of HEVs - State of the Art of HEVs - Advantages and Disadvantages - Challenges and Key Technology of HEVs - Concept of Hybridization of the Automobile-Plug-in Hybrid Electric Vehicles **-** Design and Control Principles of Plug-In Hybrid Electric Vehicles - Fuel Cell Hybrid Electric Drive Train Design - HEV Applications for Military Vehicles.

UNIT - V

Advanced topics - Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles - The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks – Sizing Ultra capacitors for Hybrid Electric Vehicles.

TEXT BOOKS:

1 Eshani, Mehrdad, YiminGao, Sebastien E. Gay, and Ali Emadi. "Modern electric, hybrid electric and fuel cell vehicles." Fundamentals, Theory, and Design. Boca Raton, FL: CRC (2005).
2 Larminie, James, and John Lowry. Electric vehicle technology explained. John Wiley & Sons, 2012.
3 Dhameja, Sandeep. Electric vehicle battery systems. Elsevier, 2001.
4 Chris, Mi, M. AbulMasrur, and David WenzhongGao. "Hybrid electric vehicles: principles and applications with practical perspectives." Masrur, David WenzhongGap (2011).
5 Husain, Iqbal. Electric and hybrid vehicles: design fundamentals. CRC press, 2021.

RESEARCH PAPERS:

1. Green II, Robert C., Lingfeng Wang, and MansoorAlam. "The impact of plug-in hybrid electric vehicles on distribution networks: A review and outlook." Renewable and sustainable energy reviews 15, no. 1 (2011): 544-553.
2. Douglas, H., and P. Pillay. "Sizing ultracapacitors for hybrid electric vehicles." In 31st Annual Conference of IEEE Industrial Electronics

Society, 2005. IECON 2005., pp. 6-pp. IEEE, 2005.

3. Yilmaz, Murat, and Philip T. Krein. "Review of battery charger topologies, charging power levels, and infrastructure for plug-in electric and hybrid vehicles." IEEE transactions on Power Electronics 28, no. 5 (2012): 2151-2169.

MACHINE MODELLING AND ANALYSIS LAB

M. Tech I Year I Semester					Power Electronics &ElectricDrives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A311021	LAB-I	L	T	P	C	CIE	SEE	Total
		0	0	4	2	50	50	100

Course Objectives:

Course Objectives of MMA LAB are to:

- Identify the methods and assumptions in modeling of machines.
- Recognize the different frames for modeling of AC machines.
- To write voltage and torque equations in state space form for different machines.

Course Outcomes:

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

- Develop the mathematical models of various machines like, induction motor and Synchronous machines, permanent magnet synchronous motor, brushless DC motor using modeling equations.
- Analyze the developed models in various reference frames.

Experiment 1

1. Develop a dynamic model of open loop controlled dc motor

Experiment2

2. Develop a dynamic model of closed loop controlled dc motor

Experiment3

3. Convert ABC voltages into stationary frame

Experiment4

4. Convert ABC voltages into synchronous frames

Experiment5

5. Convert ABC voltages into rotor reference frames

Experiment6

6. Develop dynamic model of 3-phase Induction motor and generator

Experiment7

7. Develop a mathematical model for V/f controlled 3-phase Induction motor

Experiment8

8. Develop a mathematical model for 3-phase Synchronous motor

Experiment9

9. Develop a mathematical model for 3-phase Permanent Magnet Synchronous motor

Experiment10

10. Develop a mathematical model for Brushless DC Motor

Experiment 11

11. Develop a dynamic model for closed loop control of Induction Motor

Experiment 12

12. Develop a dynamic model for closed loop control of Synchronous motor

Any 10 Experiments to be performed using a Simulation Software

POWER ELECTRONIC CONTROL OF DRIVES

M. Tech I Year II Semester					Power Electronics& Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312001	PC-III	L	T	P	C	CIE	SEE	Total
		4	0	0	4	40	60	100

Course Objectives:

Course Objectives of PECD are to:

- To understand the drive system and converter, chopper fed DC separately excited motor
- To understand principle operation of scalar control of ac motor and corresponding speed-torque- slip characteristics
- To comprehend 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 comprehend the brushless dc motor principle of operation.

Course Outcomes:

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

- Analyze drive characteristics and converter as well chopper fed dc drives
- 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 and variable reluctance motor can be developed

UNIT- I:

Introduction to drive systems: Basic power electronic drive system, components – Single Phase semi & full converter feed separately excited DC motor for continuous & discontinuous modesof operation.

DC Motor Speed Control: Three Phase full converter fed separately excited motor for one, two and four quadrant applications for speed control, closed loop operation; dc chopper controlled separately excited motor for one, two and four quadrant application for speed control of closed loop operation

UNIT- II:

Stator Side Control of Induction Drives: Scalar control – Voltage fed inverter

control – Open loop volts/Hz control – speed control slip regulation – speed control with torque and flux control – current controlled voltage fed inverter drive – current – fed inverter control – Independent current and frequency control – Speed and flux control in Current –Fed inverter drive – Volts/Hz control of Current –fed inverter drive.

UNIT–III:

Rotor Side Control of Induction Drives: Slip power recovery drives – Static Kramer Drive – Phasor diagram– Torque expression – speed control of Kramer Drive – Static Scherbius Drive – modes of operation.

Vector control of Induction Motor Drives: Principles of Vector control – Vector control methods – Direct methods of vector control – Indirect methods of vector control

UNIT – IV:

Vector Control of PMSM:

Model of PMSM, Vector control PMSM drive– Control strategies – Constant torque angle control – Unity power factor control – Constant mutual flux linkage control.

Controllers: Flux weakening operation – Maximum speed – Direct flux weakening algorithm – Constant Torque mode controller – Flux Weakening controller – indirect flux weakening – Maximum permissible torque.

UNIT – V:

Variable Reluctance Motor Drive: Variable Reluctance motor drive – Torque production in the variable reluctance motor Drive characteristics and control principles – Current control variable reluctance motor servo drive.

Brushless DC Motor Drives: Three phase full wave Brushless dc motor – Sinusoidal type of Brushless dc motor- current controlled Brushless dc motor Servo drive.

TEXT BOOKS/REFERENCES BOOKS:

1. G. K. Dubey, Fundamentals of Electrical Drives –– Narora publications –1995.
2. R. Krishnan, Electric Motor Drives Modeling, Analysis and control ––Pearson Publications – 1st edition –2002.
3. B K Bose,Modern Power Electronics and AC Drives– Pearson Publications 1st edition
4. MD Murthy and FG Turn Bull,Power Electronics and Control of AC Motors – Pergman Press 1stedition
5. BK Bose,Power Electronics and AC Drives –– Prentice Hall Eagle wood diffs New Jersey - 1st edition
6. M H Rashid Power Electronic circuits Deices and Applications –– PHI –1995

ADVANCED POWER ELECTRONIC DEVICES AND CONVERTERS

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312002	PC-IV	L	T	P	C	CIE	SEE	Total
		4	0	0	4	40	60	100

Course Objectives:

Course Objectives of APEDC are to:

- To understand the characteristics and principle of operation of modern power semi conductor devices.
- To analyze and design switched mode regulator for various industrial applications.
- To analyze different power converters and know their applications

Course Outcomes:

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

- To choose appropriate device for a particular converter topology.
- To analyze and design various power converters and controllers

UNIT-I:

Modern Power Semiconductor Devices: Modern power semiconductor devices – MOS turn Off Thyristor (MTO) – Emitter Turn off Thyristor (ETO) – Integrated Gate-Commutated thyristor (IGCTs) – MOS-controlled Thyristors (MCTs) – Insulated Gate Bipolar Transistor (IGBT) – MOSFET – comparison of their features.

UNIT-II:

D.C. to D.C. Converters: Analysis of step – down and step-up dc to dc converters with resistive and Resistive –inductive loads – Switched mode regulators – Analysis of Buck Regulators – Boost regulators-buck and boost regulators – Cuk regulators – Condition for Continuous inductor current and capacitor voltage – comparison of regulators – Multi-output boost converters – Advantages -Applications.

UNIT-III:

PWM Techniques: single PWM – Multiple PWM – sinusoidal PWM – modified PWM – phase displacement Control – Advanced modulation techniques for improved performance – Trapezoidal, staircase, stepped, harmonic injection and delta modulations – Advantage –application.

Third Harmonic PWM – 60 degree PWM – space vector modulation – Comparison of PWM techniques – harmonic reductions.

UNIT-IV:

Multilevel Inverters: Two level voltage source inverter - Multilevel concept – Classification of multilevel inverters – Diode clamped multilevel inverter – principle of operation – main features – improved diode Clamped inverter – principle of operation – Flying capacitors multilevel inverter – principle of operation – main features. Cascaded multilevel inverter – principle of operation – main features – Multilevel inverter applications – reactive power compensation – back to back intertie system – adjustable drives – Switching device currents – de link capacitor voltage balancing – features of Multilevel inverters – comparisons of multilevel converters.

UNIT-V:

Resonant Pulse Inverters: Resonant pulse inverters – series resonant inverters – series resonant inverters with unidirectional switches – series resonant inverters with bidirectional Switches – analysis of half bridge resonant inverter - evaluation of currents and Voltages of a simple resonant inverter – analysis of half bridge and full bridge resonant inverter with bidirectional switches – Frequency response of series resonant inverters – for series loaded inverter – for parallel loaded inverter –For series and parallel loaded inverters – parallel resonant inverters – Voltage control of resonant inverters.

Resonant converters: Resonant converters – Zero current switching resonant converters – L type ZCS resonant converter – M type ZCS resonant converter – zero voltage switching resonant converters – comparison between ZCS and ZVS resonant Converters – Two quadrant ZVS resonant converters – resonant de-link Inverters – evaluation of L and C for a zero current switching inverter.

TEXT BOOKS:

1. Mohammed H. Rashid,Power Electronics —– Pearson Education Third Edition – First Indian reprint2004.
2. Ned Mohan, Tore M. Undeland and William P. Robbins,Power Electronics —– John Wiley and Sons – SecondEdition.

REFERENCE BOOKS:

1. Daniel W. Hart, Power Electronics –McGraw HillPublications.
2. V. R. Moorthi, Power Electronics Devices, Circuits and Industrial applications, Oxford UniversityPress
3. Dr. P. S. Bimbhra, Power Electronics, KhannaPublishers.
4. Philip T. Krein, Elements of Power Electronics, Oxford UniversityPress.
5. M. S. JamilAsghar, Power Electronics, PHI PrivateLimited.
6. John G. Kassakian, Martin F. Schlect, George C. Verghese,Principles of Power Electronics, PearsonEducation.
7. Robert W. Erickson, Dragan and Maksimobic,Fundamentalsof Power Electronics, Springer.

ELECTRIC TRACTION SYSTEMS

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312003	PE-IV	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of ETS are to:

- To understand various systems of track electrification, power supply system and mechanics of electric train.
- To identify a suitable drive for electric traction.

Course Outcomes:

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

- Understand Traction systems and its mechanics
- Identify the power supply equipment for traction systems
- Analyze various types of motors used in traction and differentiate AC and DC traction drives

UNIT – I

Traction Systems : Electric drives - Advantages & disadvantages - System of track electrification - DC, 1- Phase low frequency, 3-Phase low frequency and composite systems, Problems of 1-phase traction system - Current unbalance, Voltage unbalance, Production of harmonics, Induction effects, Booster transformer - Rail connected booster transformer. Comparison between AC and DC systems.

UNIT – II

Traction mechanics: Types of services, Speed - time curves - Construction of quadrilateral and trapezoidal speed time curves, Average & schedule speeds. Tractive effort - Speed characteristic, Power of traction motor, specific energy consumption - Factors affecting specific energy consumption, Coefficient of adhesion, slip - Factors affecting slip, magnetically suspended trains.

UNIT – III

Power supply arrangements : High voltage supply, Constituents of supply system - Substations, Feeding post, Feeding & sectioning arrangements, Remote control center, Design considerations of substations, Over head equipment - principle of design of OHE, Polygonal OHE - Different types of constructions, Basic sag &tension calculations, Dropper design, Current collection gear forOHE.

UN IT – IV

Traction motors: Desirable characteristics of Traction Motors, D.C. series motors, A.C. series motors, 3-Phase induction motors, linear induction motors, PMSM
Types of braking in A.C. and D.C. drives, Conditions for regenerative braking, Stability of motors under regenerative braking.

UNIT – V

Semi conductor converter controlled drives: Advantages of A.C. Traction - Control of D.C. motors - single and two stage converters, Control of ac. motors - CSI fed squirrel cage induction motor, PWM VSI induction motor drive, Diesel electric traction —Alternator fed D.C. series motor, Alternator fed squirrel cage induction motor. Locomotive and axle codes.

TEXT BOOKS:

1. Partab.H - Modern Electric Traction, DhanpatRai& Sons –1998.
2. Dubey. G.K. - Fundamentals of Electrical Drives, Narosa Publishing House - 2001.
3. C. L. Wadhwa — Generation, Distribution and Utilization of Electrical Energy, New Age International -2006.
4. J.B. Gupta - Utilization of Electrical Power and Electric Traction, S. K. Kataria& Sons publications, 9th edition2004.

POWER QUALITY ANALYSIS & MITIGATION TECHNIQUES

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312004	PE-IV	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of PQAMT are to:

- To describe various power quality issues in power system
- To analyze the power quality issues using appropriate techniques
- To give an insight to various measurement techniques and conduct power quality analysis.
- To evaluate and implement various mitigation techniques for power quality improvement.

Course Outcomes:

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

- Simulate and Analyze voltage sag, swell and interruption and Describe methods to reduce sag and swell
- Analyze single and three phase loads for improving power factor, harmonics and unbalanced loads
- Design of filters and compensators for harmonic reduction, load balancing and power factor improvement
- Evaluate power quality at an Industry/Data centre/Hospital and Develop solution and design a component or a product applying all the relevant standards withrealistic constraints

UNIT–I:

INTRODUCTION TO POWER QUALITY: Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients - short duration variations such as interruption - long duration variation such as sustained interruption. Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations. Power Acceptability curves – Power Quality Standards, limits and regulations.

UNIT–II:

VOLTAGE SAGS AND SWELLS: Sources of sags and interruptions - Estimating Voltage Sag Performance -Fundamental Principles of Protection - Solutions at the End-User Level-Evaluating the Economics of Different Ride-Through Alternatives -Motor-Starting Sags - Utility System Fault-Clearing Issues, Sources of over voltages - Capacitor switching – Ferro resonance. Mitigation of voltage swells - surge arresters.

UNIT-III:

ANALYSIS OF SINGLE PHASE AND THREE PHASE LOADS: Power in single phase systems: Sinusoidal voltage, non-sinusoidal voltage – Power in three phase systems: Balanced & unbalanced loads – phasor analysis – three phase unbalanced and distorted source supplying nonlinear loads – concept of power factor under non-sinusoidal voltages and/or currents.

UNIT-IV:

CONVENTIONAL LOAD COMPENSATION TECHNIQUES & HARMONIC ANALYSIS: Analysis of unbalance – symmetrical components, instantaneous real and reactive powers - Principle of load compensation and voltage regulation – classical load balancing problem: open loop balancing closed loop balancing, current balancing. Principles for Controlling Harmonics - Harmonic analysis using mathematical tools – Computation of THD, TDD, DIN – Extraction of fundamental sequence component from measured samples.

UNIT-V:

FILTER DESIGN & POWER QUALITY MONITORING AND SURVEY:

Harmonic Reduction: Design of passive filter – performance evaluation and rating of filters - Instantaneous real and reactive power theory - shunt active filter - series active filter - reference current generations - Instantaneous symmetrical component theory - realization of DSTATCOM,UPQC energy.

Monitoring Considerations - Power Quality Measurement Equipment-Assessment of Power Quality Measurement Data-Application of Intelligent Systems-Power Quality Monitoring Standards.

TEXT BOOKS:

1. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, “Electrical Power System Quality”, Tata Mcgraw-hill, Newdelhi, 2012
2. Mohammad A.SMasoum, EwaldF.Fuchs, “Power Quality in Power Systems and Electrical Machines”, Academic Press, Elsevier, 2015.

REFERENCE BOOKS:

1. Ghosh and G. Ledwich, “Power Quality Enhancement Using Custom Power Devices”, Springer Verlag, 2012.
2. SurajitChattopadhyay, MadhuchhandaMitra, SamarjitSengupta,“Electric Power Quality”, Springer Publications, 2011
3. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, “Power Quality: Problems and Mitigation Techniques”, John Wiley & sons Ltd, 2015.

SMART GRID TECHNOLOGIES

M. Tech I Year II Semester					Power Electronics &ElectricDrives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312005	PE-IV	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of SMT are to:

- To understand various aspects of smart grid
- To study various smart transmission and distribution technologies
- To appreciate distribution generation and smart consumption
- To know the regulations and market models for smart grid

Course Outcomes:

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

- Understand technologies for smart grid
- Appreciate the smart transmission as well distribution systems
- Realize the distribution generation and smart consumption
- Know the regulations and market models for smart grid

UNIT - I:

Introduction to Smart Grids: Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligent grid initiative, national smart grid mission (NSGM) by Govt. of India

UNIT - II:

Smart Transmission Technologies: Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)

UNIT - III:

Smart Distribution Technologies: Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration

UNIT - IV:

Distributed Generation and Smart Consumption: Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings,

home energy management system (HEMS), Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Micro grid

UNIT - V:

Regulations and Market Models for Smart Grid: Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc
Cost benefit analysis of smart grid projects

TEXT BOOKS:

1. Clark W Gellings, “The Smart Grid, Enabling Energy Efficiency and Demand Side Response”- CRC Press,2009.
2. Jean Claude Sabonnadière, NouredineHadjsaïd, “Smart Grids”, Wiley-ISTE, IEEE Press, May 2012

REFERENCES BOOKS:

1. Janaka Ekanayake, KithsiriLiyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”- Wiley,2012.
2. James Momoh, “Smart Grid: Fundamentals of Design and Analysis” - Wiley, IEEE Press,2012.
3. India Smart Grid Knowledge Portal

DYNAMICS OF ELECTRICAL MACHINES

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312006	PE-V	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objective:

Course Objectives of DEM are to:

- deals with generalized modeling and analysis of different electrical machines used for industrial drive applications.

Course Outcomes:

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

- Understand electrical machines and itscharacteristics
- Analyze the behavior of electrical machines under steady state and transient state Model electrical machines under dynamicconditions

UNIT- I:

Basic Machine Theory: Electromechanical Analogy – Magnetic Saturation – Rotating field theory – Operation of Inductor motor – equivalent circuit – Steady state equations of DC machines – operations of synchronous motor – Power angle characteristics

UNIT- II:

Electro dynamical Equation & Their Solutions: Spring and Plunger system - Rotational motion – mutually coupled coils – Lagrange's equation – Application of Lagrange's equation solution of Electro dynamical equations.

UNIT- III:

Dynamics of DC Machines: Separately excited d. c. generations – stead state analysis – transient analysis – Separately excited d. c. motors – stead state analysis – transient analysis – interconnection of machines – Ward Leonard system of speed control.

UNIT- IV:

Induction Machine Dynamics: Induction machine dynamics during starting and braking – accelerating time – induction machine dynamic during normal operation – Equation for dynamical response of the induction motor.

UNIT- V:

Synchronous Machine Dynamics: Electromechanical equation – motor operation – generator operationsmall oscillations – general equations for small oscillations – representation of the oscillation equations in state variableform.

TEXT BOOKS/REFERENCE BOOKS:

1. Sen Gupta D.P. and J. W **"**Electrical Machine Dynamics "Macmillan Press Ltd1980.
2. Bimbhra P.S. "Generalized Theory of Electrical Machines "Khanna Publishers2002.

SWITCHED MODE POWER SUPPLIES (SMPS)

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312007	PE-V	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course objectives:

Course Objectives of SMPS are to:

- To understand various modes of operation of DC-DC Converter
- To analyze control aspects of converter
- To design various Switched Mode Power Supply component
- To get awareness on EMI, Protection of converter system

Course Outcomes:

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

- Analyze various modes of operation of DC-DC converter Design different controllers for converter
- Design various components of DC-DC converter
- Analyze dc-dc converter in view of EMI and thermal considerations

UNIT – I

Basic Converter Circuits: Buck Regulator, Buck- Boost Regulator, Boost Regulator, Cuk Converters and Resonant Converters. Choice of switching frequency.

UNIT – II

Isolated SMPS: Fly back Converter, Forward Converter, Half-Bridge and Full Bridge Converters, Push- Pull Converter and SMPS with multiple outputs. Choice of switching frequency.

UNIT – III

Control Aspects: PWM Controllers, Isolation in feedback loop, Power Supplies with multiple output. Stability analysis using Bode Diagrams.

UNIT – IV

Design Considerations: Selection of output filter capacitor, Selection of energy storage inductor, Design of High Frequency Inductor and High frequency Transformer, Selection of switches. Snubber circuit design, Design of driver circuits.

UNIT – V

Electro Magnetic Interference (EMI): EMI Filter Components, Conducted EMI suppression, Radiated EMI suppression, Measurement.
Protection: Over current protection, over voltage protection, Inrush current protection.
Thermal Model: Thermal Resistance, Cooling Considerations, Selection of Heat sinks, Simple Heat sink calculations.

TEXT BOOKS:

1 H.W.Whittington,B.W.Flynnand,D.E.MacPherson,SwitchedModePowerSupplies,DesignandConstruction,, Universities Press, 2009 Edition.
2 Mohan N. Undeland. T & Robbins W., Power Electronics Converters, Application and Design. John Wiley, 3rd edition,2002
3 Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters. , Wiley EasternLtd.,1992
4 Robert. W. Erickson, D. Maksimovic .Fundamentals of Power Electronics., Springer International Edition,2005 Course Material on Switched Mode Power Conversion, V.Ramanarayanan.

REFERENCE BOOKS:

1. KreinP.T .Elements of Power Electronics., Oxford UniversityPress
2. M. H. Rashid, Power Electronics. Prentice-Hall ofIndia

POWER ELECTRONIC APPLICATIONS TO RENEWABLE ENERGY

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	Category	Hours / Week			Credits	Marks		
A312008	PE-V	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of PEARE are to:

- To understand the various Non-Conventional sources of energy
- To explain the DC to DC converters for Solar PV source of energy
- To explain the inverters and its control techniques for a grid connected system
- To understand the characteristics of a solar PV and wind power sources
- To explain the types of distributed generators and batteries in DG and micro grid system

Course Outcomes:

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

- To acquire knowledge on Non-Conventional energy sources
- To analyze various technologies and for renewable energy systems
- To develop stand alone DG sets and micro grid systems from renewable energy sources

UNIT - I

Introduction to renewable sources: world energy scenario, Wind, solar, hydro, geothermal, availability and power extraction.
Introduction to solar energy: Photovoltaic effect, basics of power generation, P-V &I-V characteristics, effect of isolation, temperature, diurnal variation, shading, Modules, connections, ratings, Power extraction (MPP) tracking and MPPT schemes; standalone systems, grid interface, storage, AC-DC loads.

UNIT - II

DC-DC converters for solar PV: buck/boost/buck-boost /flyback /forward/cuk, bidirectional converters, Interleaved and multi-input converters.

UNIT - III

Grid connected Inverters: 1ph, 3ph inverters with & w/o transformer, Heric, H6, Multilevel Neutral point clamp, Modular multilevel, CSI; Control schemes: unipolar, bipolar, PLL and synchronization, power balancing / bypass, Parallel power processing; Grid connection issues: leakage current, Islanding, harmonics, active/reactive power feeding, unbalance.

UNIT - IV

Introduction to wind energy: P-V, I-V characteristic, wind power system: turbine-generator-inverter, mechanical control, ratings; Power extraction (MPP) and MPPT schemes. Generators for wind: DC generator with DC to AC converters; Induction generator with & w/o converter.

UNIT - V

Synchronous generator with back to back controlled/ uncontrolled converter; doubly fed induction generator with rotor side converter topologies; permanent magnet based generators. Battery: Types, charging discharging. Introduction to AC and DC microgrids.

TEXT BOOKS:

1. SudiptaChakraborty, Marcelo G. Simes, and William E. Kramer. Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration. Springer Science & Business, 2013.
2. Nicola Femia, Giovanni Petrone, Giovanni Spagnuolo, Massimo Vitelli, Power Electronics and control for maximum Energy Harvesting in Photovoltaic Systems, CRC Press, 2013. Chetan Singh Solanki, Solar Photovoltaics: fundamentals, Technologies and Applications, Prentice Hall of India, 2011.

REFERENCE BOOKS:

1. N. Mohan, T.M. Undeland&W. P. Robbins, Power Electronics: Converter, Applications & Design, John Wiley &Sons,1989
2. Muhammad H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education India,2004
3. E. Guba, P. Sanchis, A. Ursa, J. Lpez, and L. Marroyo, Ground currents in single-phase transformerless photovoltaic systems, Progress in Photovoltaics: Research and Applications, vol. 15, no. 7,2007.
4. Remus Teodorescu, Marco Liserre, Pedro Rodriguez, Grid Converters for Photovoltaic and Wind Power Systems, John Wiley and Sons, Ltd.,2011.
5. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, Wiley-IEEEPress,2011.

INTRODUCTION to AI & ML

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312009	OE	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objectives:

Course Objectives of AIML are to:

- To have an understanding of the basic issues of problem solving by using search policies.
- To have a basic understanding on topics of AI such as learning, agents and robotics, expert systems, and planning.
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To understand the latest trends in machine learning
- To design appropriate machine learning algorithms for problem solving.

Course Outcomes:

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

- Ability to apply basic AI search algorithms to solve problems.
- Formalize a given problem in the language/framework of different AI methods (e.g. as a logical theory, as a planning problem, etc)
- Differentiate between supervised, unsupervised, semi-supervised machine learning approaches
- Apply the back propagation algorithm and genetic algorithms to various problems
- Usage of Bayesian concepts to machine learning

UNIT–I:

Introduction to Artificial Intelligence: Introduction and Foundations of Artificial Intelligence, Brief History, Risks and Benefits, Intelligence Agents: Agents and Environments, Nature of Environments, Structure of Intelligence Agents.

Problem Solving by Search: Formalism of State Space, Search Algorithms, Uninformed Search Strategies, Informed (Heuristics) Search Strategies, Heuristics Functions. Local Search: Hill Climbing Adversarial Search: Two-Agent Games, MiniMax Search Algorithm.

UNIT-II:

Knowledge Representation: Knowledge-Based Agents, Propositional Logic: Syntax, Semantics, Inference and Proofs, Proof by Resolution, Model Checking, First-Order Logic:Syntax and semantics, Usage of First-Order Logic, Knowledge Engineering

process, Inferences: Propositional vs First-Order Inference, Backward Chaining and Forward Chaining.

UNIT-III:

Learning and Applications: Learning Forms: Introduction to Supervised Learning, and Unsupervised Learning, Reinforcement Learning: Passive and Active Learning, Generalization, Policy Search and its Applications, Introduction to Learning using ANN.,

UNIT IV:

Neural Networks and Genetic Algorithms :Neural Network Representation – Problems – Perceptions – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

UNIT V:

Bayesian and Computational Learning ;Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

TEXT BOOKS:

1. Stuart Russell Peter Norvig “Artificial Intelligence” A Modern Approach, ThirdEditionPearsonEducation.
2. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
3. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill

REFERENCE BOOKS:

1. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan-Kaufmann.
2. SarojKaushik, “Artificial Intelligence”, Cengage Learning India, 2011.
3. EthemAlpaydin, —Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
4. Stephen Marsland, —Machine learning: An Algorithmic Perspective, CRC Press, 2009.
5. http://www.cs.cmu.edu/~tom/mlbook.html
6. https://www.cin.ufpe.br/~tfl2/artificial-intelligence-modern-approach.9780131038059.25368.pdf

ENGLISH FOR PROFESSIONALS

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	Category	Hours / Week			Credits	Marks		
A312010	OE	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objective:

To prepare the students to use the language effectively in all professional pursuits

Course Outcomes:

At the end of this English for professionals course, students will be able to:

1. Analyze the language use in communicative process
2. Describe the process and product
3. Interpret the ideas in group activities
4. Apply different approaches to comprehend the written text
5. Write any technical and official correspondence within the framework

UNIT-I

Essentials of Communication:

Essentials of Grammar**-**Rudiments of Communications Skills(Listening, Speaking, Reading, and Writing)- Applied Grammar and Usage- Non-Verbal Communication

UNIT-II

Listening Skills:

Art of Listening- Developing Effective Listening Skills-Process of Listening, Intensive & Extensive Listening

Podcasts, Vodcasts(ICT enabled)-Five steps to Active Listening-Effective and Ineffective Listening Skills-Listening &Note-taking

UNIT-III

Speaking Skills:

Dynamics of Effective Speaking -Group Discussion-Simulated Presentations, Process & Product Descriptions- Proxemics, Paralinguistic Features

UNIT-IV

Reading Skills:

The Art of Effective Reading- Basic steps to Effective Reading-Extensive and Intensive Reading -Approaches to Efficient Reading-Reading Comprehension

UNIT-V

Writing Skills:

Art of Condensation-Descriptive Writing Techniques-Writing & Answering Memos, Circulars - Inter & Intra Official Communication -Writing Minutes of Meeting-Netiquette - E-mail & Blog Writing - Note-making

Textbook:

1. Kumar, Sanjay and Pushp Lata, *Communication Skills,* Second edition, Oxford University Press, 2015.

References Books:

1. Adair, John.The Effective Communicator. Jaico PublishingHouse.1995.
2. Adler, B.Ronald.Communicating at Work.(Seventh edition.) McGrawHill.2004.
3. Aruna, Koneru. Professional Communication.McGrawHill.2017.
4. Ibbotson,Mark.Cambridge English for Engineering Professionals. Cambridge University.2008.
5. Oxford English for Careers.Oxford University Press.

TECHNICAL AND BUSINESS COMMUNICATION SKILLS

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312011	OE	L	T	P	C	CIE	SEE	Total
		3	0	0	3	40	60	100

Course Objective:

To help the students to develop effective communication skills in all communicative contexts for professional advancement

Course Outcomes:

At the end of this Technical and Business Communication Skills course, students will be able to:

1. communicate technical and business correspondence
2. reflect on the themes discussed
3. recognize ethical implications of technical communication in professional contexts
4. identify the contemporary issues in engineering from environmental, societal, economic, and global perspectives
5. demonstrate ethical decisions in complex situations

UNIT-I

E-World & E-Communication:

E-language **-** E-governance **-** E-commerce/E-business **-** E-banking **-** E-waste

UNIT-II

Business Establishment & Infrastructure Development:

Power Supply **-** Industrial Park **-** Business Correspondence: Follow-up letters - Acceptance & Rejections **-** Persuasive letters **-** Resignation letters

UNIT-III

Technology and Society:

Robot Soldiers **-** For a Snapshot of a Web **-** Placing an order - Proposal Writing **-** Patents & Rights (National & International) **-** Intellectual Property - Nanotechnology

UNIT-IV

Ethics in Business Communication:

Ethical issues involved in Business Communication - Ethical dilemmas facing managers **-** Ethical Code & Communication - Standards in Daily Life - Total Quality Management - World University Ranking

UNIT-V

Management Information System:

Corporate Governance **-** Business Process Outsourcing **-** Project Management Communication **-**

Marketing Communication

Textbook:

1. Dhanavel, P. S. *English and Communication Skills for Students of Science and Engineering.* Orient Black Swan.2009.

References Books:

1. Anderson, V. Paul. *Technical Communication.* Cengage.2014.
2. Kalkar, Anjali. et.al. *Business Communication*. Orient Black Swan.2010.
3. Knisely, W. Charles. and Knisely,I.Karin. *Engineering Communication.* Cengage. 2015.
4. Kumar,Sanjay.andPushpLata.*LanguageandCommunicationskillsforEngineers.* Oxford University Press. 2018.
5. Raman, Meenakshi and Singh, Prakash. *Business Communication.* (Second Edition.). Oxford University Press.2012.

English for Research Paper Writing

M. Tech I Year II Semester		Power Electronics &Electric Drives						
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312012	AC-I	L	T	P	C	CIE	SEE	Total
		2	0	0	0	40	60	100

Course objectives

Course Objectives of ERPW are to:

- Understand that how to improve your writing skills and level of readability Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first- time submission

UNIT-I

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT-II

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT-III

Review of the Literature, Methods, Results, Discussion, Conclusions, the Final Check.

UNIT-IV

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT-V

Skills are needed when writing the Methods, skills needed when writing the Results; skills are needed when writing the Discussion, Skills are needed when writing the Conclusions.

UNIT-VI

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

TEXT BOOKS/ REFERENCE BOOKS:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge UniversityPress
3. Highman N (1998), Handbook of Writing for the MathematicalSciences,SIAM. Highman'sbook.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London,2011

ELECTRIC DRIVES & SIMULATION LAB

M. Tech I Year II Semester					Power Electronics &Electric Drives			
Code	**Category**	**Hours / Week**			**Credits**	**Marks**		
A312021	LAB-II	L	T	P	C	CIE	SEE	Total
		0	0	4	2	40	60	100

Course Objectives:

Course Objectives of EDS LAB are to:

- Show awareness of the impact of power electronic control circuits on utility supply
- To observe the difference of the conventional and power electronic control of drives.
- Have a better understanding of the close relationship between hardware and simulation models of actual systems.
- To familiarize the student with various power electronic converter topologies and their speed Control application (open loop and closed loop operation)

Course Outcomes:

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

- Conduct experiments on drives for different modes of operation using different converter topologies.
- Select the suitable controller for getting the desired speed performance of drive.
- Validate the results

Part - A

1. Speed Measurement and closed loop control using PMDC motor.
2. Thyristorised drive for PMDC Motor with speed measurement and closed Loop control.
3. IGBT used single 4 quadrant chopper drive for PMDC motor with speed measurement and closed loop control.
4. Thyristorised drive for 1Hp DC motor with closed loop control.
5. 3-Phase input, Thyristorised drive, 3 HP DC motor with closed loop
6. 3-Phase input IGBT, 4 quadrant chopper drive for DC motor with closed Loop control equipment.

7. Cyclo-converter based AC Induction motor control equipment.
8. Speed control of 3 phase wound rotor Induction motor.
9. Single-phase fully controlled converter with inductive load.
10. Single phase half wave controlled converter with inductive load.

Part - B

1. Simulation & analysis of Boost converters with RL load.
2. Simulation & analysis of Boost converters with RL load.
3. Simulation & analysis of Buck-Boost converters with RL load
4. Single-Phase Inverter using PWM Controller with RL Load.
5. Simulation & analysis of three phase PWM inverter fed Induction Motor.
6. Simulation & analysis of Multi Level inverter fed Induction Motor
7. Analysis of single Phase full Converter using R, L and E Loads
8. Analysis of three-phase full Converter using R, L and E Loads
9. Single and three-phase AC Voltage Controller with R, L Load
10. Simulation of three-phase Inverter fed Permanent Magnet synchronous Motor

NOTE: Any 8 Experiments from PartA and 7 Experiments from Part B have to be performed